Grant Agreement No.: 101080718
Call: HORIZON-HLTH-2022-STAYHLTH-01-two-stage
Topic: HORIZON-HLTH-2022-STAYHLTH-01-05-two-stage
Type of action: HORIZON-RIA

BIO-STREAMS

D6.1 Bio-Streams Strategy for Behavioural Change

Revision: v. 2.0

Work package	WP6
Task	T6.1
Due date	30/04/2025
Submission date	30/04/2025
Deliverable lead	Harokopio University of Athens (HUA)
Version	2.0
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Abstract	The deliverable “Bio-Streams Strategy for Behavioural Change” summarises the Bio-Streams living lab methodology for the design and deployment of pilot intervention studies aiming at the prevention/management of childhood overweight/obesity in clinical and educational settings across Europe. The findings included in the present deliverable provide an overview and critical appraisal of the feedback obtained through co-creation activities from all relevant stakeholders, including children, parents, teachers and experts from clinical and educational settings, regarding the design and implementation of

	the pilot studies. The outcomes of this co-creation process will be further utilised in the context of T6.3 and T6.4 of the Bio-Streams project to: a) align actual stakeholder requirements with research objectives, b) form the final pilot study protocols to facilitate an optimal pilot deployment and real-world applicability across Europe, and c) ensure that the pilot studies produce relevant evidence for decision-making in clinical practice and public health.
Keywords	Childhood, Adolescence, Overweight, Obesity, Living Lab Methodology, Co-Creation, Delphi Studies, Workshops, Clinical Setting, Educational Setting

Document Revision History

Version	Date	Description of change	List of contributor(s)
V0.0	05/02/2025	Formulation of table of contents	HUA
V0.1	10/02/2025	Refinement of table of contents	HUA
V1.0	08/04/2025	Input from all partners	HUA, SIA, NKUA, DCHE, BLOCKS, KI, NUCLIO, VHIR, CHUL, ESHA, WLC, UKEMED, UKCM, PENTELI, EON, UM
V1.1	09/04/2025	Refinement and minor amendments	HUA
V1.2	23/04/2025	Amendments and comments from internal reviewers	Internal reviewers
V1.3	25/04/2025	Revisions from all partners	HUA, SIA, NKUA, DCHE, BLOCKS, KI, NUCLIO, VHIR, CHUL, ESHA, WLC, UKEMED, UKCM, PENTELI, EON, UM
V2.0	28/04/2025	Final refinement	HUA

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Executive Summary

The present document summarises the methodology and findings of the co-creation activities conducted within Task 6.1 “Bio-Streams Strategy for Behavioural Change in Children in Clinical and Educational Contexts” of the BIO-STREAMS project. It provides an overview of the living lab methodology and a critical appraisal of the feedback obtained from all relevant stakeholders for the design and deployment of the project’s pilot intervention studies aiming at the prevention/management of childhood overweight/obesity in clinical and educational settings across Europe. The document starts with a preamble that includes a brief description of the objectives and the content of the deliverable. Then, the main part of the deliverable is divided into four sections. Section 1 provides and overview of the methodology and findings of a series of Delphi studies, designed to collect feedback from professionals with clinical, research and educational background on the optimal approaches for the screening and assessment of childhood overweight/obesity, and the requirements for a successful implementation of anti-obesity interventions in clinical and educational settings. Section 2 provides an overview of the methodology and findings of a series of co-creation workshops among children of different cultural backgrounds and age groups, designed to obtain insights into their perspectives, preferences and needs in relation to the adoption of a healthy lifestyle and to actively involve them as co-creators in the process of developing the project’s clinical and school pilot interventions. Section 3 provides an overview of the methodology and findings of a series of co-creation workshops targeting representatives of other important stakeholder groups (parents, school leaders, non-formal health education providers and healthcare professionals), designed to further support the design and refinement of the pilot studies. Section 4 provides a critical appraisal of the findings of all co-creation activities and describes how they will be utilised to refine the BIO-STREAMS pilot study protocols, to ensure that the interventions are aligned with stakeholders’ needs and preferences, are optimally deployed across European clinical and educational settings, and produce relevant evidence for decision-making on individual level, as well as for clinical practice and health policy-making. The document ends with a general conclusion section, summarising the deliverable’s content.

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Abbreviations

OV/OB = overweight and obesity

MUO = metabolically unhealthy obesity

QoL = quality of life

MASLD = metabolic dysfunction–associated steatotic liver disease

BMI = body mass index

PREAMBLE

People-centredness has been identified as a core parameter for improving health outcomes. Major health organisations and bodies, such as the World Health Organisation (WHO) and the National Academy of Medicine (former Institute of Medicine US), have proposed people-centred models of care as a means for strengthening health systems and outcomes [1,2]. Among the characteristics that such a system should incorporate to ensure people-centredness – or tailoring – is the fostering of "responsiveness and participation" (WHO) [1], meaning that care should be coordinated around people's needs, and be delivered with respect and compassion. Tailoring interventions is emphasised in official guidelines by health and research associations regarding the management of chronic non-communicable diseases, including childhood obesity. The latest clinical practice guidelines edited by the American Academy of Pediatrics (2023) state that for the management of obesity in children and adolescents, they and their families are viewed as core partners in decision making at all levels of care [3].

The BIO-STREAMS project aims to pilot test two interventions for the prevention and management of overweight/obesity (OV/OB) in children and adolescents, to be conducted in school and clinical settings, respectively. The intervention protocols have been developed based on scientific evidence, as far as the components to be delivered and the parameters to be assessed are concerned. In order to optimise tailoring and support a people-centred approach, the protocols incorporate elements of the "living-lab methodology", namely practices that allow cooperation with relevant stakeholders and feedback from real-life settings. To this direction, two distinct methodologies have been applied aiming to target different protocol components and engage different key stakeholders in paediatric obesity prevention and management. One methodology is the Delphi technique [4] and the other is the co-creation workshops [5].

The Delphi technique was applied to refine the findings derived from the systematic reviews of obesity prevention and intervention aspects (described in D2.1) that would be the evidence-based material for the development of the intervention protocols. With the aim to harmonise the research findings with the every-day practice in real-life settings, the Delphi technique was chosen as the most appropriate in this regard [4]. Experts from a range of areas, covering screening, assessment, prevention and treatment of childhood OV/OB, in clinical or school settings, were recruited to share their expertise and contribute to reaching consensus about relevant aspects of the BIO-STREAMS intervention protocols. The co-creation workshops were chosen as a means to improve tailoring of the interventions through gaining better understanding of the values, the views, and the expectations of the direct beneficiaries, with the ultimate aim to improve engagement and sustainability of the intervention [5]. Thus, a series of in-person workshops were delivered in both clinical and school settings with children meeting the characteristics of the target population of the BIO-STREAMS interventions. Additional workshops were conducted among other important stakeholders (parents, health professionals and school representatives) to further support the co-creation of the project's pilot studies.

The current deliverable describes the aim, the methodology, and the results of this living-lab methodology, and discusses implications of the findings within the BIO-STREAMS project.

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1. SECTION 1 DELPHI STUDIES

1.1 Background/aim

Childhood overweight/obesity (OV/OB) remains one of the most significant global public health challenges of the 21st century and is associated with the development of comorbidities, such as diabetes, hypertension, lipid abnormalities and liver dysfunction (metabolically unhealthy obesity, MUO), as well as with increased risk of living with obesity and comorbidities in later life [1,2]. The BIO-STREAMS vision is to foster behavioural changes towards a healthier diet, increased physical activity, reduced sedentary time and overall better lifestyle patterns which will be maintained throughout childhood into adulthood.

Current literature highlights the importance and value of direct engagement and collaboration of people who are affected by an issue being studied for the purpose of action or change. The engagement of communities and integration of their perspectives in a research study design contributes to the co-creation of knowledge and to the production of data that are more adequate and relevant for them [3]. One of the core elements of the BIO-STREAMS project is the development and implementation of successful intervention protocols for the prevention and management of childhood OV/OB, in school and clinical settings, respectively. In order to co-construct intervention protocols, BIO-STREAMS applied the Living Lab methodology, which is a design and research methodology for developing and testing approaches to co-creation with project participants, in order to ensure applicability in real world conditions.

The Delphi approach is a widely used methodology in research which uses a series of sequential questionnaires or “rounds” and seeks to gain consensus of opinion of a group of participants with expertise on a specific topic of interest. This approach has been regarded as an appropriate methodology to build understanding in areas where there is lack of agreement, incomplete knowledge, uncertainty or lack of evidence [4-6]. The structured process of developing consensus among group members using the Delphi methodology has gained acceptance in diverse fields of health sciences and was thus deemed as an appropriate co-creation approach to inform the development of the clinical and school pilot intervention study protocols of the BIO-STREAMS project. Based on the Delphi approach, consensus among professionals with clinical, research and educational background was sought on the requirements for a successful implementation of interventions in clinical and educational settings, to ensure that the interventions produce relevant evidence for decision-making in clinical practice and public health.

The specific objectives were to elicit consensus on:

- The importance and feasibility of predictors and indicators for the assessment of childhood OV/OB and MUO in clinical settings
- The importance and feasibility of predictors and indicators for the screening of childhood OV/OB and MUO in school/community settings
- The characteristics and outcomes of lifestyle interventions for the management of childhood OV/OB and MUO in clinical settings
- The characteristics and outcomes of lifestyle interventions for the screening of childhood OV/OB and MUO in school/community settings

1.2 Methodology

The protocol of the Delphi studies was approved by the Bioethics Committee of Harokopio University of Athens (approval code: Γ-5493/14-12-2023; approval date: 14 January 2024).

1.2.1 Round 1

Round 1 involved the preparation and development of the statements, which derived from the results of T2.1 “Basic Obesity Research Analysis; Current Evidence & Knowledge Gaps” and

T2.2 “Obesity Intervention Implementation Landscape Analysis; Best Practices, Facilitators & Barriers”. T2.1 and T2.2 aimed to provide an overview of risk factors for the development and strategies for the prevention and management of childhood OV/OB and MUO. The outcomes of T2.1 and T2.2 have been reported in D2.1 “Knowledge on Underage Overweight & Obesity”. Based on a vigorous methodology, a thorough review of the scientific literature was performed to produce outcomes relative to the use of prognostic markers (ranging from genetic predispositions and medical variables to lifestyle behaviours and environmental exposures) as well as to identify successful community interventions for the prevention/management of obesity, with a view to showcasing potential areas of action at primary and secondary prevention levels. The reviewed research areas were as follows:

- Risk factors related to the external exposome (physical activity, physical inactivity, dietary patterns, meal patterns, food groups, nutrients, perinatal exposures, sleep) and the development of childhood OV/OB
- Risk factors related to the general external exposome (social and built environment) and the development of childhood OV/OB
- Risk factors related to the internal exposome (genetics, epigenetics, metabolomics) and the development of childhood OV/OB
- The childhood obesity intervention implementation landscape:
    - Community-based interventions (with emphasis on school-based interventions)
    - Digital interventions (delivered through technological utilities, e.g., mobile apps and web-based platforms)
- The available clinical practice guidelines for childhood obesity, focusing on recommended measures of adiposity, assessment domains (e.g., medical history, physical examination and laboratory tests) and lifestyle recommendations for the prevention and management of childhood OV/OB through lifestyle modifications

The findings of the aforementioned literature reviews provided an evidence-based overview of basic childhood obesity research and intervention implementation science, and served as the theoretical background to support and inform the development of the clinical and school pilot intervention protocols within the BIO-STREAMS project. In order to ensure that co-creation fully aligned with BIO-STREAMS overall aims and objectives, and that results would provide meaningful feedback towards the design of the clinical and school intervention protocols, the outcomes of T2.1 and T2.2 were thoroughly reviewed and were organised into three thematic groups: (1) predictors and indicators for the screening/assessment of OV/OB and MUO; (2) intervention characteristics for the assessment and lifestyle management of OV/OB and MUO in clinical settings and (3) intervention characteristics for the screening and lifestyle intervention for the prevention of OV/OB and MUO in school/community settings. Therefore, the following Delphi questionnaires were formulated in Google Forms:

1.2.1.1. **Delphi Study 1:** Consensus of experts on predictors and indicators for the assessment of childhood OV/OB and MUO

This section was further split into two subsections to seek consensus for predictors and indicators for the assessment of childhood OV/OB and MUO in clinical and school settings:

Delphi Study 1a: Consensus of experts on predictors and indicators for the assessment of childhood OV/OB and MUO in clinical settings

The study aimed to create a consensus among participants on **the importance and feasibility of the assessment of predictors and indicators of childhood OV/OB and MUO in clinical settings**. Statements were organised into eight sections:

1. Importance of the assessment of predictors of childhood OV/OB
2. Feasibility of the assessment of predictors of childhood OV/OB
3. Importance of the assessment of predictors of childhood MUO

4. Feasibility of the assessment of predictors of childhood MUO
5. Importance of the assessment of indicators of childhood OV/OB
6. Feasibility of the assessment of indicators of childhood OV/OB
7. Importance of the assessment of indicators of childhood MUO
8. Feasibility of the assessment of indicators of childhood MUO

Delphi Study 1b: Consensus of experts on predictors and indicators for the screening of childhood OV/OB and MUO in school settings

The study aimed to create a consensus among participants on the **importance and feasibility of the assessment of predictors and indicators of childhood OV/OB and MUO in school settings**. Statements were organised into seven sections:

1. Importance of the assessment of predictors of childhood OV/OB
2. Feasibility of the assessment of predictors of childhood OV/OB
3. Importance and feasibility of the assessment of predictors of childhood MUO
4. Importance of the assessment of indicators of childhood OV/OB
5. Feasibility of the assessment of indicators of childhood OV/OB
6. Importance of the assessment of indicators of childhood MUO
7. Feasibility of the assessment of indicators of childhood MUO

1.2.1.2. **Delphi Study 2:** Consensus of experts on the assessment and lifestyle management of childhood OV/OB and MUO in clinical settings

The study aimed to create a consensus among participants on the **assessment and lifestyle management of childhood OV/OB and MUO in clinical settings**. Statements were organised into six sections:

2. Parameters for the assessment of childhood OV/OB
3. Parameters for the assessment of childhood MUO
4. Characteristics of lifestyle interventions for the management of childhood OV/OB
5. Characteristics of lifestyle interventions for the management of childhood MUO
6. Outcomes of lifestyle interventions for the management of childhood OV/OB
7. Outcomes of lifestyle interventions for the management of childhood MUO

1.2.1.3. **Delphi Study 3:** Consensus of experts on the screening and lifestyle intervention for the prevention of childhood OV/OB and MUO in school settings

The study aimed to create a consensus among participants on the **screening and lifestyle intervention for the prevention of childhood OV/OB and MUO in school settings**. Statements were organised into six sections:

1. Parameters for the screening of childhood OV/OB
2. Parameters for the screening of childhood MUO
3. Characteristics of lifestyle interventions for the prevention of childhood OV/OB
4. Characteristics of lifestyle interventions for the prevention of childhood MUO
5. Outcomes of lifestyle interventions for the prevention of childhood OV/OB
6. Outcomes of lifestyle interventions for the prevention of childhood MUO

1.2.2 Round 2

T6.1 partners, as well as EASO, were asked to identify and invite participants with extensive experience in childhood OV/OB and MUO from a clinical, research or school/community perspective. The identification of potential participants was based on the development of personas who would directly benefit from the development of the BIO-STREAMS project, as described in T2.3 (Use Cases Definition & User Requirements) and D2.2 (Requirements and

Use Cases). Briefly, T2.3 analysed and established user requirements and use cases through the creation of personas and identification of stakeholders relevant to addressing childhood OV/OB. Relevant stakeholders for this co-creation work included doctors, dietitians, health researchers, teachers, headmasters and policymakers. In particular, for each Delphi study, the following expertise was sought:

- Delphi Study 1a: doctor, dietitian, health researcher, policymaker
- Delphi Study 1b: doctor, dietitian, health researcher, policymaker
- Delphi Study 2: doctor, dietitian, health researcher, policymaker
- Delphi Study 3: doctor, dietitian, headmaster, teacher, health researcher, policymaker

An invitation letter was circulated to T6.1 partners' networks, as well as external organisations involved in research and raising awareness for the prevention and/or management of childhood OV/OB (the European Childhood Obesity Group), executive agencies (Joint Research Committee) and European professional bodies in Dietetics (the European Federation of the Associations of Dietitians). The invitation letter included information regarding the objectives of the study, the research topics and the procedure. The aim was to recruit at least 40 participants from all aforementioned professional backgrounds and from at least 10 European countries, so as to capture the diversity of views and variations in practice on a European level. It has been suggested that diverse panel of participants with expertise on a particular field leads to stronger findings, as it allows for a wider range of views and perspectives [5]. A sample of 10-15 participants with particular knowledge on a specific condition is considered adequate in health research [7]. An a priori criterion of two rounds of questionnaire distribution was used for these studies [5].

After the distribution of the invitation letter, people who expressed interest to participate received a Google Forms link with the relevant survey questionnaire, based on their expertise, and a two-week timeframe to complete. Participants were informed the survey would take approximately 30 minutes to complete. Reminder emails were sent two and three weeks after to ensure high participation and a time extension was provided upon request. Participants provided consent prior to the completion of the questionnaire. For each statement, five voting options were offered ("strongly disagree", "disagree", "indifferent", "agree", "strongly agree"; ranging from 1 "strongly disagree" to 5 "strongly agree") as well as an "I do not know" option. At the end of each section there was space for participants' additional comments and feedback.

1.2.3 Round 3

After completion of Round 2, results and individual feedback were collected and analysed. Since there are no universally accepted criteria on achieving consensus in Delphi studies [5], the consensus threshold for acceptance of an individual statement was based on previously published Delphi studies [8] and was set at 75% "agree" or "strongly agree". Variance in response [Interquartile Range (IQR)], which is an indicator for stability of response [5], has also been taken into consideration and it has been suggested that IQR≤1 would be a suitable consensus indicator for 5-unit scales [9]. When consensus was not achieved, statements were either rephrased, where possible, or removed. The following criteria applied, with a few exceptions after review from the research team.

Statements were rephrased when:

- There was <75% agreement and qualitative feedback with suggestions for improvement or indication of a lack of understanding of a statement.
- There was no agreement on feasibility of assessing/screening of a predictor or indicator but there was agreement on importance. In this case, statement(s) on feasibility of assessing/screening of a predictor or indicator was/were rephrased (Delphi Studies 1a and 1b).

In Delphi Studies 1a and 1b, statements regarding importance of assessing/screening of predictors and indicators could not be rephrased, as this would indicate deviation from the findings of Round 1 (systematic review of the literature). Therefore, in Round 3 these statements either remained the same or were removed.

Statements were removed when:

- There was <60% agreement and no qualitative feedback from participants.
- There was <60% agreement on importance of assessing/screening of a predictor or indicator. In this case, the statement on feasibility was also removed (Delphi Studies 1a and 1b).

Statements in which consensus was achieved in Round 2 and the rephrased ones, were recirculated to all participants who responded in Round 2 around 4-6 weeks later. Participants were again given a two-week timeframe to complete, with a possibility for time extension, upon request. Reminder emails were sent to reduce attrition and ensure as many participants as possible completed Round 3.

1.2.4 Data analysis

Basic demographic information was collected, including age (<30, 31-40, 41-50, 51-60, 61-70, >70 years old); sex (male, female, non-binary, prefer not to say); type of expertise (doctor, dietitian, health researcher, teacher, headmaster, policymaker); highest degree (bachelor, masters, doctorate); years of employment; and country.

At the end of each Round (2 and 3), results and qualitative feedback from free text were extracted in an Excel database. For each individual statement, the percentage (%) of participants “agreeing” or “strongly agreeing” was calculated. For other statistical parameters, such as median, mode and IQR, data were transformed into ordinal values (strongly disagree=1; disagree=2; indifferent=3; agree=4; strongly agree=5). Consensus was achieved at >75% of participants “agreeing” or “strongly agreeing” and IQR ≤1 for each statement in Round 2.

All statements presented in the results have >75% agreement. Seven of these statements had an agreement between 75-80%, but IQR between 1-1.5. The median and mode values for these statements were high (median value of 4 and mode value of 4 or 5 for all statements; Appendix 1.2) and, thus, it was decided to retain and include them in the results. Similarly, one statement had >80% agreement but IQR>1 (median value of 4 and mode value of 4 for all statements; Appendix 1.2) and was also retained and presented. HUA was responsible for data handling.

1.3 Results

One hundred sixty-two participants from 17 European countries were initially invited to complete one of the questionnaires in Round 2, of which 67 responded. Round 3 was completed by 57 participants from 16 European countries. Attrition was low between Round 2 and Round 3 (12-25%), indicating that the majority of participants who took part in Round 2 also contributed to Round 3 (Table 1.1).

Table 1.1 Participation rates in Rounds 2 and 3.

	Delphi 1a	Delphi 1b	Delphi 2	Delphi 3
Responded in R2 (n)	17	14	16	20
Responded in R3 (n, % of R2)	15 (88)	14 (100)	13 (81)	15 (75)

R2 = Round 2; R3 = Round 3; n = number

1.3.1 Delphi Study 1a

Table 1.2 presents the basic demographic characteristics of the Delphi participants (n=15). Most participants were female, doctors, with a doctorate degree and with over 10 years of employment in their field. In this study there was representation from 7 European countries.

Table 1.2 Demographic characteristics of the participants who completed Round 2 (n=15).

Demographic characteristics		**N**
Age	≤40	5
	41-50	5
	51-60	3
	>61	2
Sex	Male	6
	Female	9
Type of expertise	Doctor	9
	Dietitian	2
	Health researcher	4
Highest degree	Bachelor	1
	Master	2
	Doctorate	12
Years of employment	1-5	1
	6-10	3
	>10	11
Country	Bulgaria	1
	Denmark	1
	Finland	1
	Greece	7
	Slovenia	2
	Sweden	1
	United Kingdom	2

Round 2 consisted of 78 statements. After the end of Round 2, consensus was achieved in 53/78 statements (67.9%), while 25/78 (32.1%) had an agreement ≤75%. Round 3 consisted of 61 statements. After the end of Round 3, consensus was achieved in 50/61 statements (81.9%), whereas there was ≤75% agreement for the remaining 11. For 2/50 statements (4%) in which agreement was achieved in Round 3 (>75%), IQR was >1. In the following subsections, only statements in which consensus was reached in Round 3 are presented, whereas the remaining statements are included in Appendix 1.1.

Importance of the assessment of predictors of childhood OV/OB in clinical settings

Table 1.3 presents the agreed statements on the importance of assessing predictors of childhood OV/OB in clinical settings. With regards to the protective factors against childhood OV/OB risk, there was consensus on the statements about the role of physical activity (moderate-to-vigorous physical activity, substitution of sedentary time with physical activity of any intensity, participation in organised physical activity and active commuting to school), dietary practices (eating meals with family, increased adherence to a “healthy” dietary pattern), sleep (increased sleep duration and quality) and built environment characteristics (neighbourhood structure).

In relation to the detrimental factors for childhood OV/OB risk, there was consensus on the statements about the role of sedentary activities (total screen time and time spent in screens), dietary practices (eating while watching TV, increased adherence to an “unhealthy” dietary pattern, consumption of sugar-sweetened beverages and processed foods), perinatal factors

(maternal perinatal OV/OB status, maternal glucose abnormal metabolism and being born with increased weight/large for gestational age) and genetic factors (genetic variants) (Table 1.3).

Table 1.3 Statements on the importance of the assessment of predictors of childhood OV/OB in clinical settings (n=15).

Statement	% agreement	IQR
Physical activity and inactivity		
"Engagement in moderate-to-vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB."	93	1
"Substituting sedentary time with light/moderate/vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB."	100	1
"Participation in organised physical activity or sports (self-reported) is an important protective factor against childhood OV/OB."	87	1
"Active commuting to school (self-reported) is an important protective factor against childhood OV/OB."	93 ǂ	1
"Total screen time and time spent in specific screens (e.g. TV, DVD, video and computer) (self-reported) is an important detrimental risk factor for childhood OV/OB."	100	0
Diet		
"Eating meals with family (e.g. breakfast, dinner) is an important protective factor against childhood OV/OB."	87	0
"Eating while watching TV is an important detrimental factor for childhood OV/OB."	100	1
"Increased adherence to a "healthy" dietary pattern (characterised by increased consumption of vegetables, fruits, legumes, fish and wholemeal products) or to patterns like the Mediterranean or the DASH diet, is an important protective factor against childhood OV/OB."	100	1
"Increased adherence to an "unhealthy" dietary pattern (characterised by increased consumption of processed foods or energy-dense foods like takeaways, high fat and sugars intake), is an important detrimental factor for childhood OV/OB."	100	1
"Sugar-sweetened beverage consumption shows positive associations with adiposity measurements and should be regarded as a risk factor for childhood OV/OB."	100	1
"Processed food consumption seems to unfavourably impact children's weight status, but data are limited to a very small number of studies."	79 ǂ	1.25
Sleep		
"Increased sleep duration and quality may have a protective effect against childhood OV/OB, though findings are limited by the very small number of studies."	80	1
Perinatal factors		
"Maternal perinatal OV/OB status is an important detrimental factor for childhood OV/OB."	100	1
"Maternal glucose abnormal metabolism (including gestational diabetes mellitus) is an important detrimental factor for childhood OV/OB."	100	1
"Being born with increased weight/large for gestational age (indicating overnutrition during pregnancy) is an important detrimental factor for childhood OV/OB."	80	1
Other factors		

"Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children's weight status but findings are inconsistent, from small heterogeneous studies."	87	1
"Based on a small number of studies, some genetic variants (e.g. MMP3, LEP, LEPR and FTO) have been associated with increased adiposity in children and adolescents."	100 ǂǂ	1

ǂ n=14 ǂǂ n=13

Feasibility of the assessment of predictors of childhood OV/OB in clinical settings

Table 1.4 presents the agreed statements on the feasibility of assessing predictors of childhood OV/OB in clinical settings. Participants have agreed that it is feasible to assess lifestyle habits in clinical settings. In particular, there was consensus on the assessment of physical activity/inactivity through self-reported measurement; diet through the evaluation of dietary patterns, meal patterns and consumption of foods and food groups; sleep habits; perinatal factors through prenatal exposures; social and built environment characteristics.

Table 1.4 Statements on feasibility of the assessment of predictors of childhood OV/OB in clinical settings (n=15).

Statement	**% agreement**	**IQR**
It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Physical activity and inactivity		
"Self-reported physical (in)activity (e.g. participation in organised physical activity / sports, active commuting to school and screen time)."	87	1
Diet		
"Dietary habits in terms of meal patterns (e.g. consumption of breakfast, eating meals with family and eating while watching TV)."	100	1
"Dietary habits in terms of dietary patterns (e.g. adherence to "healthy", such as the Mediterranean diet, or "unhealthy", such as the energy dense pattern)."	100	1
"Dietary habits in terms of foods and food groups (e.g. sugar-sweetened beverages and processed foods)."	93	0
Sleep		
"Sleep habits (e.g. sleep duration and quality)."	100	0
Perinatal factors		
"Prenatal exposures (e.g. maternal prenatal body weight status and lifestyle habits)."	93	0
Other factors		
"Social environment characteristics (e.g. teacher influence and parental practices)."	87	1
"Built environment characteristics (e.g. availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density)."	93	1

Importance of the assessment of predictors of childhood MUO in clinical settings

One statement was included in relation to the importance of the assessment of genetic variants in the risk of childhood MUO (specifically insulin resistance) in clinical settings: "Some genetic variants have been associated with insulin resistance (e.g. TCF7L2, CDKAL1, IGF2BP2,

HHFX and HNF1A) based on a small number of studies. The statement had low agreement in Round 2 (55%) and was removed from Round 3.

Feasibility of the assessment of predictors of childhood MUO in clinical settings

One statement was included in relation to the feasibility of assessing genetic variants for insulin resistance in children with OV/OB in clinical settings: "It is feasible to evaluate genetic variants associated with insulin resistance (e.g. TCF7L2, CDKAL1, IGF2BP2, HHFX and HNF1A) when assessing childhood MUO in clinical settings." The statement had a low agreement score (37%), and, in combination with low agreement on the importance of assessing genetic variants for insulin resistance in MUO (see section above), the statement was removed from Round 3.

Importance of the assessment of indicators of childhood OV/OB in clinical settings

Table 1.5 presents the agreed statements on the importance of assessing indicators of childhood OV/OB in clinical settings. Body mass index (BMI), BMI-z score, waist circumference and waist-to-height ratio were all considered important indicators of childhood OV/OB.

Table 1.5 Statements on the importance of the assessment of indicators of childhood OV/OB in clinical settings (n=15).

Statement	% agreement	IQR
Body mass index is an important indicator of childhood OV/OB.	87	1
For the diagnosis of childhood OV, body mass index z-score equal to or more than 1 and less than 2 standard deviations above the median of the World Health Organisation growth reference for children and adolescents is an important indicator.	93	1
For the diagnosis of childhood OB, body mass index z-score equal to or more than 2 standard deviations above the median of the World Health Organisation growth reference for children and adolescents is an important indicator.	93	1
It is important to measure waist circumference for the assessment of childhood OV/OB.	79 ǂ	1.25
Waist-to-height ratio ≥0.5 is an important indicator of childhood OV/OB.	86 ǂ	1

ǂ n=14

Feasibility of the assessment of indicators of childhood OV/OB in clinical settings

Table 1.6 presents the agreed statements on the feasibility of assessing indicators of childhood OV/OB in clinical settings. Participants agreed that all important indicators (i.e. BMI, BMI z-score, waist circumference and waist-to-height ratio) are also feasible to assess in clinical settings.

Table 1.6 Statements on the feasibility of the assessment of indicators of childhood OV/OB in clinical settings (n=15).

Statement	% agreement	IQR
It is feasible to evaluate the following indicators when assessing childhood OV/OB in clinical settings:		
Body mass index.	100	1
Body mass index z-score.	93	1
Waist circumference.	93	1
Waist-to-height ratio.	93	1

Importance of the assessment of indicators of childhood MUO in clinical settings

Table 1.7 includes the agreed statements on the importance of assessing indicators of childhood MUO in clinical settings. Consensus was reached for the importance of evaluating

metabolic abnormalities such as hypertension, dyslipidaemia, impaired glucose/diabetes, hyperinsulinaemia, high blood liver enzymes, metabolic dysfunction-associated steatotic liver disease, obstructive sleep apnoea, polycystic ovary syndrome and the presence of metabolic syndrome.

Table 1.7 Statements on the importance of the assessment of indicators of childhood MUO in clinical settings (n=15).

Statement	% agreement	IQR
The following parameters are important indicators of childhood MUO:		
High blood pressure / hypertension.	100	1
Abnormal blood lipids (i.e. high total cholesterol, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol and high triglycerides) / dyslipidaemia.	100	1
Impaired fasting glucose / impaired glucose tolerance / diabetes mellitus.	100	1
Hyperinsulinaemia.	93	1
High blood liver enzymes.	100 ǂ	0
Metabolic dysfunction-associated steatotic liver disease.	100 ǂ	1
Obstructive sleep apnoea.	92 ǂ	1
Polycystic ovary syndrome.	92 ǂ	1
Metabolic syndrome is an important indicator of childhood MUO and its presence should be evaluated on top of the assessment of its individual components.	92 ǂ	1

ǂ n=13

Feasibility of the assessment of indicators of childhood MUO in clinical settings

Table 1.8 presents the agreed statements on the feasibility of assessing indicators of childhood MUO in clinical settings. For the evaluation of metabolic abnormalities that were considered important, participants agreed it was feasible to assess blood pressure, blood lipids, blood glucose and insulin indices, blood liver enzymes, menstrual irregularities and the presence of metabolic syndrome in clinical settings.

Table 1.8 Statements on the feasibility of the assessment of indicators of childhood MUO in clinical settings (n=15).

Statement	% agreement	IQR
It is feasible to evaluate the following indicators when assessing childhood MUO in clinical settings:		
Blood pressure.	100	1
Blood lipids (i.e. total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and triglycerides).	100	1
Blood glucose metabolism indices [e.g. fasting plasma glucose, 2-h plasma glucose after 75-g oral glucose tolerance test, or glycosylated haemoglobin].	100	1
Blood insulin.	87	1
Blood liver enzymes.	100 ǂ	1
Menstrual irregularities and evidence of hyperandrogenism (clinical or biochemical) for the diagnosis of polycystic ovary syndrome.	86 ǂ	1
Presence of the metabolic syndrome.	87	1

ǂ n=14

Lack of consensus

Statements in which consensus was not reached are presented in detail in Appendix 1.1. Briefly, agreement was low particularly in statements where there was lack of association, lack of evidence, or inconclusive findings on the role of predictors in childhood OV/OB and MUO risk. Such predictors included light/moderate physical activity, macronutrients, micronutrients, maternal postnatal exposures and internal exposome. Also, several predictors and indicators of childhood OV/OB, such as internal exposome, skinfold thickness, body composition parameters, as well as MUO (liver steatosis and obstructive sleep apnoea) were deemed less feasible to assess in clinical settings.

1.3.2 Delphi Study 1b

Table 1.9 presents the basic demographic characteristics of the Delphi participants (n=14). Most participants were female, health researchers, with a doctorate degree and with over 10 years of employment in their field. In this study there was representation from 10 European countries.

Table 1.9 Demographic characteristics of the participants who completed Round 2 (n=14).

Demographic characteristics		N
Age	≤40	8
	41-50	3
	51-60	2
	>61	1
Sex	Male	2
	Female	12
Type of expertise	Doctor	4
	Dietitian	1
	Health researcher	8
	Policymaker	1
Highest degree	Master	2
	Doctorate	12
Years of employment	1-5	3
	6-10	4
	>10	7
Country	Belgium	1
	Bulgaria	1
	Greece	4
	Republic of Ireland	1
	Italy	1
	Portugal	2
	Slovenia	1
	Spain	1
	Sweden	1
	United Kingdom	1

Round 2 consisted of 60 statements. After the end of Round 2, consensus was achieved in 32/60 statements (53.3%), while 28/60 (46.7%) had an agreement ≤75%. Round 3 consisted of 50 statements. After the end of Round 3, consensus was achieved in 35/50 statements (70%), whereas there was ≤75% agreement for the remaining 15. For 2/35 statements (6%) in which agreement was achieved in Round 3 (>75%), IQR was >1. In the following subsections, only statements in which consensus was reached in Round 3 are presented, whereas the remaining statements are included in Appendix 1.1.

Importance of the assessment of predictors of childhood OV/OB in school settings

Table 1.10 presents the agreed statements on the importance of assessing predictors of childhood OV/OB in school settings. With regards to the protective factors against childhood OV/OB risk, there was consensus among participants on the statements about the role of physical activity (moderate-to-vigorous physical activity, substitution of sedentary time with physical activity of any intensity and participation in organised physical activity), dietary practices (increased adherence to a "healthy" dietary pattern), sleep (increased sleep duration and quality) and built environment characteristics (neighbourhood structure).

In relation to the detrimental factors for childhood OV/OB risk, there was consensus on the statements about the role of sedentary activities (total screen time and time spent in screens), dietary practices (eating while watching TV, increased adherence to an "unhealthy" dietary pattern, consumption of sugar-sweetened beverages and processed foods) and perinatal factors (maternal perinatal OV/OB status, maternal glucose abnormal metabolism and being born with increased weight/large for gestational age). There was also agreement on the lack of evidence of the role of micronutrients in childhood OV/OB risk (Table 1.10).

Table 1.10 Statements on the importance of the assessment of predictors of childhood OV/OB in school settings (n=14).

Statement	% agreement	IQR
Physical activity and inactivity		
"Engagement in moderate-to-vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB."	100	1
"Substituting sedentary time with light/moderate/vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB."	93	1
"Participation in organised physical activity or sports (self-reported) is an important protective factor against childhood OV/OB."	86	0
"Total screen time and time spent in specific screens (e.g. TV, DVD, video and computer) (self-reported) is an important detrimental risk factor for childhood OV/OB."	100	1
Diet		
"Eating while watching TV is an important detrimental factor for childhood OV/OB."	79	1.25
"Increased adherence to a "healthy" dietary pattern (characterised by increased consumption of vegetables, fruits, legumes, fish and wholemeal products) or to patterns like the Mediterranean or the DASH diet, is an important protective factor against childhood OV/OB."	100	1
"Increased adherence to an "unhealthy" dietary pattern (characterised by increased consumption of processed foods or energy-dense foods like takeaways, high fat and sugars intake), is an important detrimental factor for childhood OV/OB."	100	1
"Sugar-sweetened beverage consumption shows positive associations with adiposity measurements and should be regarded as a risk factor for childhood OV/OB."	100	0.25
"Processed food consumption seems to unfavourably impact children's weight status, but data are limited to a very small number of studies."	85 ǂ	0
"There is a lack of studies exploring the role of micronutrients intake as risk factor for childhood OV/OB."	91 ǂǂ	0
Sleep		

"Increased sleep duration and quality may have a protective effect against childhood OV/OB, though findings are limited by the very small number of studies."	93	1
Perinatal factors		
"Maternal perinatal OV/OB status is an important detrimental factor for childhood OV/OB."	93	1
"Maternal glucose abnormal metabolism (including gestational diabetes mellitus) is an important detrimental factor for childhood OV/OB."	93	1
"Being born with increased weight/large for gestational age (indicating overnutrition during pregnancy) is an important detrimental factor for childhood OV/OB."	77	1
Other factors		
"Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children's weight status but findings are inconsistent, from small heterogeneous studies."	86 ǂ	0.5

ǂ n=13 ǂǂ n=11

Feasibility of the assessment of predictors of childhood OV/OB in school settings

Table 1.11 presents the agreed statements on the feasibility of assessing predictors of childhood OV/OB in school settings. Participants have agreed that it is feasible to assess lifestyle habits in school settings. In particular, there was consensus on the assessment of physical activity / inactivity through self-reported measurement; diet through the evaluation of dietary patterns, meal patterns and consumption of foods and food groups; sleep habits; and built environment characteristics.

Table 1.11 Statements on feasibility of the assessment of predictors of childhood OV/OB in school settings (n=14).

Statement	**% agreement**	**IQR**
It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Physical activity and inactivity		
"Self-reported physical (in)activity (e.g. participation in organised physical activity / sports, active commuting to school and screen time)."	93	1
Diet		
"Dietary habits in terms of meal patterns (e.g. consumption of breakfast, eating meals with family and eating while watching TV)."	93	1
"Dietary habits in terms of dietary patterns (e.g. adherence to "healthy", such as the Mediterranean diet, or "unhealthy", such as the energy dense pattern)."	86	1.25
"Dietary habits in terms of foods and food groups (e.g. sugar-sweetened beverages and processed foods)."	93	1
Sleep		
"Sleep habits (e.g. sleep duration and quality)."	93	0
Other factors		
"Built environment characteristics (e.g. availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density)."	93	1

Importance and feasibility of the assessment of predictors of childhood MUO in school settings

Table 1.12 includes the agreed statement that children at high risk or with a diagnosis of OV/OB in school settings should be referred to a clinical setting for a comprehensive assessment of predictors of MUO.

Table 1.12 Statement on the importance and feasibility of the assessment of predictors of childhood MUO in school settings (n=14).

Statement	% agreement	IQR
Children at high risk or with a diagnosis of OV/OB in school settings should be referred to a clinical setting (e.g. hospital) for a comprehensive assessment of predictors of MUO.	93	1

Importance of the assessment of indicators of childhood OV/OB in school settings

Table 1.13 includes the agreed statements on the importance of assessing indicators of childhood OV/OB in school settings. BMI, BMI-z score, waist circumference, waist-to-height ratio and body composition (i.e. fat mass, fat-free mass) were all considered important indicators of childhood OV/OB.

Table 1.13 Statements on the importance of the assessment of indicators of childhood OV/OB in school settings (n=14).

Statement	% agreement	IQR
The following parameters are important indicators of childhood OV/OB:		
Body mass index.	86	1
Body mass index z-score.	93	1
Waist circumference.	86	1
Waist-to-height ratio ≥0.5.	93	1
Body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	86	1

Feasibility of the assessment of indicators of childhood OV/OB in school settings

Table 1.14 includes the agreed statements on the feasibility of assessing indicators of childhood OV/OB in school settings. All the important indicators except for body composition (i.e. fat mass, fat-free mass) were all considered feasible for screening of childhood OV/OB in school settings.

Table 1.14 Statements on the feasibility of the assessment of indicators of childhood OV/OB in school settings (n=14).

Statement	% agreement	IQR
It is feasible to evaluate the following indicators when screening for childhood OV/OB in school settings:		
Body mass index.	100	1
Body mass index z-score.	100	1
Waist circumference.	93	1
Waist-to-height ratio.	93	1

Importance of the assessment of indicators of childhood MUO in school settings

Table 1.15 includes the agreed statements on the importance of assessing indicators of childhood MUO in school settings. Consensus was reached for the importance of evaluating metabolic abnormalities such as hypertension, dyslipidaemia, impaired glucose/diabetes and high blood liver enzymes.

Table 1.15 Statements on the importance of the assessment of indicators of childhood MUO in school settings (n=13)

Statement	% agreement	IQR
The following parameters are important indicators of childhood MUO:		
High blood pressure / hypertension.	100	1
Abnormal blood lipids (i.e. high total cholesterol, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol and high triglycerides) / dyslipidaemia.	85	1
High blood glucose.	85	1
High blood liver enzymes.	83 ǂ	0

ǂ n=12

Feasibility of the assessment of indicators of childhood MUO in school settings

In Round 2, consensus was not reached in any of the statements in relation to the feasibility of assessing the aforementioned important indicators of childhood MUO in school settings. All statements were removed and replaced by the statement "It is not feasible to evaluate blood pressure, blood lipids, blood glucose or blood liver enzymes in school settings" in Round 3. However, in Round 3, consensus was not reached for that statement either (Appendix 1.1).

Lack of consensus

Statements in which consensus was not reached are presented in detail in Appendix 1.1. Briefly, agreement was low particularly in statements where there was lack of association, lack of evidence, or inconclusive findings on the role of predictors in childhood OV/OB and MUO risk. Such predictors included light/moderate physical activity, macronutrients, micronutrients, different food groups, maternal perinatal exposures, social and environment characteristics and internal exposome. Regarding lifestyle habits, there was also no agreement on the protective role of active commuting to school, daily consumption of breakfast and eating meals with family against OV/OB. Also, several predictors and indicators of childhood OV/OB, such as internal exposome, perinatal factors, skinfold thickness, body composition parameters were deemed as not feasible to be assessed in school settings. Regarding MUO indicators, although there was no agreement on the feasibility of their assessment in school settings, rephrasing of the statements into a single statement "It is not feasible to evaluate blood pressure, blood lipids, blood glucose or blood liver enzymes in school settings" did not result in agreement.

1.3.3 Delphi Study 2

Table 1.16 presents the basic demographic characteristics of the Delphi participants (n=13). Most participants were female, doctors, with a doctorate degree and with over 10 years of employment in their field. In this study there was representation from 5 European countries.

Table 1.16 Demographic characteristics of the participants who completed Round 2 (n=13).

Demographic characteristics		N
Age	≤40	5
	41-50	5
	51-60	2
	>60	1
Sex	Male	2
	Female	11
Type of expertise	Doctor	7
	Dietitian	3
	Health researcher	3
Highest degree	Bachelor	2

	Master Doctorate	5 6
Years of employment	1-5 6-10 >10	1 2 10
Country	Belgium Denmark Germany Greece Sweden	2 2 1 6 2

Round 2 consisted of 57 statements. After the end of Round 2, consensus was achieved in 47/57 statements (82.5%), while 10/57 (17.5%) had an agreement ≤75%. Round 3 consisted of 54 statements. After the end of Round 3, consensus was achieved in 48/54 statements (88.9%), whereas there was ≤75% agreement for the remaining 6. For 3/48 statements (6%) in which agreement was achieved in Round 3 (>75%), IQR was >1. In the following subsections, only statements in which consensus was reached in Round 3 are presented, whereas the remaining statements are included in Appendix 1.1.

Parameters for the assessment of childhood OV/OB in clinical settings

Table 1.17 presents the agreed statements on the parameters that should be assessed for childhood OV/OB in clinical settings. More specifically, consensus was reached for the statements related to the assessment of dietary habits (evaluation of nutrients intake, foods and food groups intake, meal patterns and adherence to dietary patterns); physical activity and inactivity, sleep habits, perinatal exposures, social environment characteristics, anthropometric and body composition parameters and parental characteristics (body weight and socioeconomic status) in clinical settings.

Table 1.17 Statements on the parameters for the assessment of childhood OV/OB in clinical settings (n=13).

Statement	**% agreement**	**IQR**
The assessment of childhood OV/OB in clinical settings should include the evaluation of:		
Dietary habits in terms of intake of nutrients (e.g. carbohydrates, lipids, proteins, dietary fibres, vitamins and minerals)	100	1
Dietary habits in terms of consumption of foods and food groups (e.g. fruits, vegetables and sugar-sweetened beverages).	100	0
Dietary habits in terms of adherence to dietary patterns (e.g. the Mediterranean diet and the Western-type diet)	77	1.5
Dietary habits in terms of meal patterns (e.g. meal frequency, meal context, meal setting and meal quality).	100	0.5
Physical activity (e.g. time spent in light/moderate/vigorous activities, participation in sports and active commuting).	100	0
Physical inactivity (e.g. total sedentary time and screen time – TV, computer, cell phone).	100	1
Sleep habits (e.g. daily sleep duration, sleep quality and presence of sleep disorders).	100	1
Prenatal exposures (e.g. maternal pre-pregnancy weight, maternal dietary habits during pregnancy and gestational diabetes)	92	0
Postnatal exposures (e.g. infant birth weight, breastfeeding, formula feeding and child weight gain during infancy)	92	0.5
Social environment characteristics (e.g. parental practices and peer support/pressure).	100	1

Anthropometric indices (e.g. body weight and waist circumference).	100	0.5
Body composition parameters (e.g. body fat and fat-free mass).	85	1
Parental body weight status (e.g. body mass index).	92	0.5
Parental/family socioeconomic status (e.g. educational level and income).	92	1

Parameters for the assessment of childhood MUO in clinical settings

There was consensus about the routine assessment of MUO for each case of childhood OV/OB in clinical settings (92%). Table 1.18 presents the agreed statements on the parameters that should be assessed for childhood MUO. More specifically, consensus was reached for the assessment of hypertension, dyslipidaemia, (pre)diabetes, insulin resistance and MASLD.

Table 1.18 Statements on parameters for the assessment of childhood MUO in clinical settings (n=13).

Statement	% agreement	IQR
The assessment of MUO should be routinely included in the assessment of each case of childhood OV/OB in clinical settings.	92	1
The assessment of childhood MUO in clinical settings should also include the evaluation of the presence of:		
Hypertension	100	1
Dyslipidaemia	100	1
(pre) Diabetes.	100	1
Insulin resistance (e.g. HOMA-IR)	83 ǂ	1
Metabolic dysfunction–associated steatotic liver disease (MASLD)	92 ǂ	1

ǂ n=12

Characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings

Table 1.19 presents the agreed statements on the characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings. Lifestyle interventions should be delivered by a multidisciplinary clinical team and involve parents/caregivers. Delivery of interventions could be done individually or through group sessions and incorporate health education, skill building, behaviour modification and counselling and last for at least 3 months. Lifestyle interventions should target multiple lifestyle habits such as a healthy diet, sufficient physical activity and sleep. Also, such interventions would profit from the use of digital tools, which should have engaging content, serious games to enhance motivation, a focus on meeting individual needs and preferences and the opportunity to share progress with health professionals and parents/caregivers.

Table 1.19 Statements on characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings (n=13).

Statement	% agreement	IQR
Lifestyle interventions for the management of childhood OV/OB in clinical settings:		
Should be delivered by a multidisciplinary team (e.g. paediatricians and/or paediatric health care providers with training in OV/OB, as well as other professionals with training in behaviour and lifestyle fields, such as dietitians, exercise specialists, psychologists and behavioural health practitioners).	100	0
Should follow a family-centred approach (i.e. the parent/caregiver or family is involved in the treatment).	100	0

Can be delivered through group sessions, individual sessions or a combination of both.	85	1
Should have a duration of at least 3 months.	100	1
Should incorporate health education and skill building.	100	0
Should incorporate behaviour modification and counselling.	100	0
Should be based on motivational interviewing (i.e. a patient-centred counselling style that identifies and reinforces patient's own motivation for change) to engage patients in treating OV/OB.	100	0
Should be multicomponent, i.e. target multiple lifestyle habits (e.g. diet, physical activity and sleep).	100	0
Should target a healthy diet (e.g. low consumption of energy-dense foods rich in sugars and fat, low consumption of sugar-sweetened beverages, daily consumption of fruits and vegetables).	92	0.5
Should target a physically active lifestyle (e.g. engagement in ≥60 minutes of moderate to vigorous physical activity per day and <1-2 hours of screen time per day).	92	1
Should target sufficient sleep (i.e., appropriate amount of sleep for age).	92	0.5
Would profit from the use of digital tools as a complementary feature (e.g. web-based platforms and smartphone applications).	77	1.5
In case digital tools are available for lifestyle management of childhood OV/OB in clinical settings, they should:		
Be available in multiple devices (e.g. smartphones, tablets and computers).	77	1.5
Have engaging content.	85	1
Use serious games to enhance motivation and engagement.	85	1
Have customizable features to meet individual needs and preferences.	85	1
Provide tailored feedback and recommendations based on user data.	85	1
Facilitate sharing patients' progress with healthcare professionals and parents/caregivers.	85	1

Characteristics of lifestyle interventions for the management of childhood MUO in clinical settings

In relation to the management of childhood MUO, one additional statement was agreed that lifestyle interventions in clinical settings should be more intense and prioritise comorbidities (Table 1.20).

Table 1.20 Statement on characteristics of lifestyle interventions for the management of childhood MUO in clinical settings (n=13).

Statement	% agreement	IQR
Lifestyle interventions for the management of childhood MUO in clinical settings should be more intense and prioritise the existing comorbidities.	83	1

Outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings

Table 1.21 presents the agreed statements on the outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings. Outcomes should include anthropometric and body composition parameters, lifestyle habits (diet, physical activity, sleep), food literacy, health-related Quality of Life (hr-QoL), as well as mental wellbeing and distress.

Table 1.21 Statements on outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings (n=13).

Statement	% agreement	IQR
Outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings should include:		
Anthropometric indices (e.g. body weight and waist circumference).	100	0
Body composition parameters (e.g. body fat and fat-free mass).	83	1
Lifestyle habits (e.g. diet, physical activity and sleep).	100	0
Food literacy (i.e. the knowledge, skills, and attitudes necessary to make informed decisions about food and its impact on health).	92	1
Health-related quality of life.	100	1
Mental wellbeing (emotional and psychological).	100	1
Mental distress (e.g. anxiety, depressive symptoms and self-perceived stigma).	92	1

Outcomes of lifestyle interventions for the management of childhood MUO in clinical settings

Additionally, on the presence of MUO, it was agreed that outcomes of lifestyle interventions should also include the evaluation of blood pressure and common metabolic biomarkers, such as glucose metabolism indices, lipidemic profile and liver enzymes (Table 1.22).

Table 1.22 Statements on outcomes of lifestyle interventions for the management of childhood MUO in clinical settings (n=13).

Statement	% agreement	IQR
Outcomes of lifestyle interventions for the management of childhood MUO in clinical settings should also include:		
Blood pressure	92	1
Common metabolic biomarkers (e.g. glucose metabolism indices, lipidemic profile and liver enzymes).	100	1

Lack of consensus

Statements in which consensus was not reached are presented in detail in Supplementary Material A. Briefly, agreement was low on the importance of assessment of the internal exposome for childhood OV/OB and of obstructive sleep apnoea and polycystic ovarian syndrome for childhood MUO in clinical settings. Participants did not agree with the statement that lifestyle interventions for the management of childhood MUO should have the same general characteristics as those for the management of OV/OB, but they agreed they should be more intense and prioritise comorbidities. Finally, agreement was not reached in including medical costs related to OV/OB as an outcome of lifestyle interventions in clinical settings.

1.3.4 Delphi study 3

Table 1.23 presents the basic demographic characteristics of the Delphi participants (n=15). Most participants were female, health researchers and with over 10 years of employment in their field. In this study there was representation from 8 European countries.

Table 1.23. Demographic characteristics of the participants who completed Round 2 (n=15).

Demographic characteristics		N
Age	≤40	4
	41-50	6
	51-60	2
	>61	3

Sex	Male	5
	Female	10
Type of expertise	Health researcher	8
	Teacher	3
	Headmaster	2
	Policymaker	2
Highest degree	Bachelor	1
	Master	8
	Doctorate	6
Years of employment	1-5	2
	6-10	2
	>10	11
Country	Greece	3
	Hungary	1
	Italy	2
	The Netherlands	2
	Portugal	2
	Sweden	3
	United Kingdom	2

Round 2 consisted of 45 statements. After the end of Round 2, consensus was achieved in 38/45 statements (84.4%), while 7/45 (15.6%) had an agreement ≤75%. Round 3 consisted of 42 statements. After the end of Round 3, consensus was achieved in 35/42 statements (83.3%), whereas there was ≤75% agreement for the remaining 7. For one statement (3%) in which agreement was achieved in Round 3 (>75%), IQR was >1. In the following subsections, only statements in which consensus was reached in Round 3 are presented, whereas the remaining statements are included in Appendix 1.1.

Parameters for the screening of childhood OV/OB in school settings

Table 1.24 presents the agreed statements on the parameters that should be assessed for the screening of childhood OV/OB in clinical settings. More specifically, consensus was reached for the statements related to the assessment of dietary habits (evaluation of foods and food groups intake and meal patterns); physical activity and inactivity, sleep habits, social and built environment characteristics, anthropometric indices and parental characteristics (socioeconomic status) in school settings.

Table 1.24 Statements on the parameters for the screening of childhood OV/OB in school settings (n=15).

Statement	**% agreement**	**IQR**
The screening of childhood OV/OB in school settings should include the evaluation of:		
Children's dietary habits in terms of consumption of foods and food groups (e.g., fruits, vegetables and sugar-sweetened beverages.	100	1
Children's dietary habits in terms of meal patterns (e.g. meal frequency, meal context, meal setting and meal quality).	100	1
Children's physical activity (e.g. time spent in light/moderate/vigorous activities, participation in sports and active commuting).	100	1
Children's physical inactivity (e.g. total sedentary time and screen time – TV, computer, cell phone).	93	1
Children's sleep habits (e.g. daily sleep duration, sleep quality and presence of sleep disorders).	100	1

Children's social environment characteristics (e.g. parental practices and peer support/pressure).	93	1
Children's built environment characteristics (e.g. street intersection density, presence of greenspace, neighbourhood safety, access to fresh food and proximity to fast food).	80	1
Children's anthropometric indices (e.g. body weight and waist circumference).	93	1
Parental/family socioeconomic status (e.g. educational level and income).	100	1

Parameters for the screening of childhood MUO in school settings

Two statements were included in relation to the evaluation of parameters for the screening of childhood MUO in school settings and consensus was not achieved in neither of them (Appendix 1.1). More specifically:

- The screening of childhood MUO in school settings should also include the evaluation of family history of non-communicable diseases (71% agreement).
- Parents/caregivers of children at high risk or with a diagnosis of OV/OB in school settings should be informed and encouraged to proceed to a clinical setting (e.g. hospital) for the child's comprehensive screening/assessment of MUO (73% agreement).

Characteristics of lifestyle interventions for the prevention of childhood OV/OB in school settings

Table 1.25 presents the agreed statements on the characteristics of lifestyle interventions for the management of childhood OV/OB in school settings. Lifestyle interventions should be delivered by a wide range of professionals (health researchers or educators) after appropriate training and involve parents/caregivers. Interventions should incorporate nutrition and physical activity education, practical and policy components, and have a duration of at least one school year. Also, such interventions would profit from the use of digital tools, which should be available in multiple devices; have engaging content and serious games to enhance motivation; focus on meeting individual needs and preferences; and the opportunity to share progress parents/caregivers in the context of a family-centred intervention approach. Participants have also agreed that the cultural characteristics and the family's socioeconomic status have an impact on the effectiveness of lifestyle interventions in school settings.

Table 1.25 Statements on the characteristics of lifestyle interventions for the prevention of childhood OV/OB in school settings (n=15).

Statement	**% agreement**	**IQR**
Lifestyle interventions for the prevention of childhood OV/OB in school settings:		
Can be delivered by a wide range of individuals (e.g. health researchers, classroom teachers and physical education teachers) after appropriate training.	93 ǂ	1
Should include teachers' training (train-the-trainer approach).	93	1
Should include the active participation/involvement of children's parents/caregivers.	93	1
Should have a duration of at least 1 school year.	93 ǂ	1
Should include a nutrition education component (based on dietary recommendations).	93	1
Should include a hands-on, experiential, practical nutrition component (e.g. nutrition games).	86 ǂ	1
Should include a nutrition policy component (e.g. limited availability of unhealthy snacks in school canteens).	93	0

Should include a physical activity education component (based on physical activity recommendations).	87	1
Should include a hands-on, experiential, practical physical activity component (e.g. participation in group sports).	87	1
Should include a physical activity policy component (e.g. universal access of students to a sports facility).	93 ǂ	1
Should utilise digital tools (e.g. web-based platforms and smartphone applications).	93 ǂ	1
Digital tools for the lifestyle prevention of childhood OV/OB in school settings should:		
Be available in multiple devices (e.g. smartphones, tablets and computers).	87	1
Be characterized by user-friendly interfaces and engaging content.	93	1
Have customizable features to meet individual needs and preferences.	93	1
Use gamification to enhance motivation and engagement.	93	1
Provide tailored feedback and recommendations based on user data.	93	1
Encourage collaboration between children and parents/caregivers in the context of a family-centric approach, targeting more inclusive interventions.	80	1
Cultural characteristics have an impact on the effectiveness of interventions in changing the lifestyle habits (dietary and physical activity) of children and adolescents in school settings.	86	1
Socioeconomic status has an impact on the effectiveness of interventions in changing the lifestyle habits (dietary and physical activity) of children and adolescents in school settings.	93	1

ǂ n=14

Characteristics of lifestyle interventions for the prevention of childhood MUO in school settings

In relation to the prevention of childhood MUO, one additional statement was agreed that lifestyle interventions in school settings should have the same general characteristics as those for the prevention of childhood OV/OB (Table 1.26).

Table 1.26 Statement on the characteristics of lifestyle interventions for the prevention of childhood MUO in school settings (n=15).

Statement	% agreement	IQR
Lifestyle interventions for the prevention of childhood MUO in school settings should have the same general characteristics as those for the prevention of childhood OV/OB.	100	1

Outcomes of lifestyle interventions for the prevention of childhood OV/OB in school settings

Table 1.27 presents the agreed statements on the outcomes of lifestyle interventions for the prevention of childhood OV/OB in school settings. Outcomes should include anthropometric and body composition parameters, lifestyle habits (diet, physical activity, sleep), food literacy, health-related Quality of Life and mental wellbeing.

Table 1.27 Statements on outcomes of lifestyle interventions for the prevention of childhood OV/OB in school settings (n=15).

Statement	% agreement	IQR

Outcomes of lifestyle interventions for the prevention of childhood OV/OB in school settings should include:		
Anthropometric indices (e.g. body weight and waist circumference).	79 ǂ	1.25
Body composition parameters (e.g. body fat and fat-free mass).	77 ǂǂ	1
Lifestyle habits (e.g. diet, physical activity and sleep).	100	1
Food literacy (i.e. the knowledge, skills, and attitudes necessary to make informed decisions about food and its impact on health).	93	0
Health-related quality of life.	100	1
Mental wellbeing (emotional and psychological).	100	1

ǂ n=14 ǂǂ n=13

Outcomes of lifestyle interventions for the prevention of childhood MUO in school settings

Two statements were included in relation to the evaluation of outcomes of lifestyle interventions for the prevention of childhood MUO in school settings and consensus was not achieved in either of them (Appendix 1.1). More specifically:

- Outcomes of lifestyle interventions for the prevention of childhood MUO in school settings should also include blood pressure (64% agreement).
- Outcomes of lifestyle interventions for the prevention of childhood MUO in school settings should also include common metabolic biomarkers (e.g. glucose metabolism indices, lipidemic profile and liver enzymes) (71% agreement).

Lack of consensus

Statements in which consensus was not reached are presented in detail in Supplementary Material A. Briefly, agreement was low particularly in statements about the importance of collecting information on perinatal risk factors for the screening of childhood OV/OB in school settings. Also, consensus was not achieved in relation to screening of MUO and outcomes of lifestyle interventions for the prevention of MUO in school settings.

1.4 Conclusions

The present study aimed to elicit consensus on feasible and evidence-based methods and characteristics of lifestyle interventions for the management of childhood OV/OB and MUO in clinical settings and the prevention of childhood OV/OB and MUO in school settings.

With regards to the clinical settings, lifestyle parameters that were important and feasible to assess for the management of childhood OV/OB included dietary habits (through assessment of dietary patterns, meal patterns and foods/food groups), physical activity and sedentary behaviours (self-reported instead of the use of objective measures) and sleep habits. Other characteristics that should be considered for evaluation for the management of OV/OB were perinatal factors, such as maternal pre-pregnancy body weight and lifestyle habits, infant birth weight, breastfeeding, formula feeding and child weight gain during infancy, as well as the social and built environment. In addition, in clinical settings MUO should be routinely included in the assessment of each case of OV/OB and evaluate presence of hypertension, dyslipidaemia, (pre)diabetes, insulin resistance and MASLD.

The design of lifestyle interventions for the management of childhood OV/OB in clinical settings should consider a family-centred approach and focus on engaging patients through health education, behaviour modification and motivational interviewing. Content of such interventions should target multiple lifestyle habits, i.e., healthy dietary habits, increased physical activity and sufficient sleep and would profit from the use of digital tools that offer engaging, personalised education content. Lifestyle interventions for the management of childhood MUO

in clinical settings should be more intense and prioritise potential comorbidities. Assessment of outcomes of lifestyle interventions in clinical settings would include anthropometric and body composition indices, food literacy, QoL, mental wellbeing, mental distress, blood pressure and metabolic biomarkers such as glucose metabolism indices, lipidemic profile and liver enzymes.

It is important to note some contradictions regarding importance and feasibility of assessing predictors and indicators of childhood OV/OB in clinical settings. Although it was deemed important to assess physical (in)activity, the use of objective measures such as accelerometry was considered not feasible in clinical settings, whereas there was agreement on the use of self-reported measures. Moreover, it was considered important but not feasible to assess each case of childhood OV/OB for MASLD and obstructive sleep apnoea in clinical settings. Future research could focus on addressing feasibility issues to improve services on the management of OV/OB and the assessment of MUO complications.

Taking into consideration the results of Delphi studies 1a and 2 regarding the feasibility of assessing predictors and indicators of childhood OV/OB in clinical settings, as well as the characteristics of successful interventions for the management of childhood OV/OB in clinical settings, Table 1.28 summarises the parameters that should be included in the clinical pilot intervention study protocol.

Table 1.28 Parameters to be included in a clinical intervention based on results of Delphi studies 1a and 2 (content and assessment of variables).

Targeting multiple lifestyle habits (healthy diet, physically active lifestyle, sufficient sleep)
Use of digital tools that offer a personalised approach
Assessment of dietary habits (dietary patterns, meal patterns and foods/food groups)
Assessment of physical activity / inactivity behaviours (self-reported)
Assessment of sleep habits
Assessment of perinatal factors (e.g. maternal pre-pregnancy body weight and lifestyle habits, infant birth weight, breastfeeding, formula feeding, child weight gain during infancy)
Assessment of social environment factors
Assessment of built environment factors
Assessment of anthropometric indices (BMI, BMI-z, WC, WtHR)
Assessment of food literacy
Assessment of QoL
Assessment of mental wellbeing and distress
Assessment of blood pressure
Assessment of metabolic biomarkers (glucose metabolism indices, lipidemic profile, liver enzymes)

Lifestyle parameters that were important and feasible to assess in school / community settings included dietary habits (through assessment of meal patterns and foods/food groups), physical activity and sedentary behaviours (self-reported instead of the use of objective measures) and sleep habits. Other characteristics that should be evaluated for the prevention of OV/OB included social environment (e.g. parental practices and peer support/pressure) and built environment (e.g. street intersection density, presence of greenspace, neighbourhood safety, access to fresh food and proximity to fast food). All the above constitute parameters that should be included in a lifestyle intervention protocol for the prevention of childhood OV/OB in school settings. On the other hand, although predictors of childhood OV/OB such as perinatal factors, and indicators of childhood OV/OB and MUO, such as body composition and metabolic markers, were deemed important for screening, they would not be feasible to assess in school settings.

The design of lifestyle interventions for the prevention of childhood OV/OB in school settings should also consider a family-centred approach and include nutrition and physical activity education, practical and policy components. Interventions would also profit from the use of digital tools that offer engaging, personalised education content. Outcomes of lifestyle interventions in school settings would include anthropometric indices, food literacy, QoL and mental wellbeing.

Contradictions regarding importance and feasibility of assessing predictors and indicators of childhood OV/OB in school settings have emerged. Although it was deemed important to assess physical (in)activity, the use of objective measures such as accelerometry was considered not feasible in school settings, whereas there was agreement on the use of self-reported measures. Moreover, it was considered important but not feasible to assess perinatal factors, body composition indices and MUO parameters in school settings, limiting their value within interventions. Regarding the latter, according to the findings, children at high risk or with a diagnosis of OV/OB in school settings should be referred to a clinical setting for a comprehensive assessment of predictors of MUO, highlighting the school environment as suitable for interventions targeting prevention, rather than management, of childhood OV/OB and MUO.

Taking into consideration the results of Delphi studies 1b and 3 regarding the feasibility of assessing predictors and indicators of childhood OV/OB in school settings, as well as the characteristics of successful interventions for the prevention of childhood OV/OB in school settings, Table 1.29 summarises the parameters that should be included in the school pilot intervention study protocol.

Table 1.29 Parameters to be included in a school intervention based on results of Delphi studies 1b and 3 (content and assessment of variables).

Inclusion of nutrition and physical activity education, practical and policy components
Use of digital tools that offer a personalised approach
Assessment of dietary habits (dietary patterns, meal patterns, foods/food groups)
Assessment of physical activity / inactivity behaviours (self-reported)
Assessment of sleep habits
Assessment of built environment factors
Assessment of anthropometric indices (BMI, BMI-z, WC, WtHR)
Assessment of food literacy
Assessment of QoL
Assessment of mental wellbeing

Across all studies, participants agreed on the importance and feasibility of evaluating key predictors and indicators of childhood OV/OB, including lifestyle factors (diet, physical activity, sleep), social and built environments, and anthropometric measures. The assessment of metabolic abnormalities was deemed crucial in clinical settings, whereas its feasibility in school settings remained uncertain. Additionally, consensus was reached on the characteristics and expected outcomes of lifestyle interventions, emphasising the need for multidisciplinary approaches, parental involvement, and the integration of digital tools. However, certain aspects, such as the role of the internal exposome and the feasibility of measuring biomarkers, including genetic and epigenetic, lacked agreement, highlighting areas for future research.

Findings of the aforementioned Delphi studies, combined with those of other co-creation activities, will be used to inform the project's clinical and school pilot intervention study protocols, as described in detail in Section 4 of Deliverable 6.1, in an effort to ensure an optimal deployment and real-world applicability across clinical and educational settings in Europe.

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2. SECTION 2 CO-CREATION WORKSHOPS WITH CHILDREN

2.1 Clinical setting

2.1.1 Background/aim

The broad aim of the public-patient involvement through co-creation workshops was to ensure the clinical pilot study is tailored to address the unique needs of children of different cultural background and ages.

Within the BIO-STREAMS project, a clinical pilot intervention study will be designed and conducted with the aim to develop and pilot-test a healthy lifestyle intervention incorporating digital tools for the prevention of OV/OB in 5-18-year-old children and adolescents in 6 European countries and 7 pilot sites, i.e. Slovenia (UKCM), Spain (VHIR), Greece (NKUA and PENTELI), Sweden (KI), Belgium (CHUL), and Bulgaria (BLOCKS). Although the design of the intervention will be based on an in-depth review of relevant scientific data, input from children themselves is also crucial. Thus, by conducting co-creation workshops in six different countries, we also ensured interventions are culturally appropriate, feasible, and sustainable.

Specific aims of the co-creation workshops with children were as follows:

1. To re-evaluate the Personas and refine user-requirements and stories.
2. To refine the digital interventions to ensure adherence and sustainability.
3. To refine the study to ensure minimal dropout and maximal output with minimal possible effort from the end-subjects.

2.1.2 Methodology

The co-creation workshops were conducted from November 2024 to March 2025 in 6 clinical pilot sites, i.e. Slovenia (UKCM), Greece (NKUA and PENTELI), Sweden (KI), Belgium (CHUL), and Bulgaria (BLOCKS). The protocol of the co-creation workshops, as described in detail below, was approved by ethical committees in Greece [NKUA; Scinetific Council of Athens Children's General Hosptial "Agia Sofia"; approval code: 23716-27/09/2024; approval date: 14 November 2024; PENTELI; Scientific Council of Children's Hospital PENTELI; approval code: 10916/19-9-2024; 19 September 2024], Slovenia [Committee of Republic of Slovenia for ethics in medicine, approval code: 0120-410/2024-2711-3; approval date: 16 October 2024], Belgium [University Hospital-Faculty Ethics Committee of Liège; approval code: 2024-584; approval date: 12 February 2025], Bulgaria [BLOCKS Rehabilitation Hospital Ethical Committee; approval code: BLOCKS-2024-002; approval date: 25 September 2024], and Sweden [Swedish Ethical Review Authority; approval code: 2024-05917-01; approval date: 13 November 2024].

Setting and participants

We aimed to include participants from four different age groups; (i) up to 8 years, (ii) 8-10 years, (iii) 10-14 years, (iv) 14-18 years) and 5 different countries to ensure effective engagement, collaboration, and diverse perspectives. In the workshops, each pilot site included children with normal weight as well as overweight, where BMI more than 1 SD above the median of the WHO growth reference for children was followed as a criterion for categorization. Individual workshops of 6-8 children were organized for each age group. Due to children's illness, recruitment issues or other factors, some workshops were conducted with less than 6 participants. In some workshops, especially the ones with youngest children (below 8 years), their parents were also present (whether or not parents should be present in the workshop was decided individually by the pilots). In Table 2.1, we present the sample of children that participated in the clinical workshops categorized into age group, cultural setting (site), and weight group (OV/OB or normal weight). At the bottom of the Table, we show that

in total, we recruited 113 children across all pilot sites, ages and weight groups. Within age groups, we recruited 44 children between 14 and 18 years of age, 27 between 10 and 14, 22 children aged between 8 and 10 and 20 youngest children aged 8 or less. Within weight groups, 51 children were categorised as with overweight or obesity and 38 as with normal weight, while for 24 participants weight category is unknown (NA). Additionally, we report 26 participants were recruited in Slovenian cultural setting (UKCM), 21 in Bulgarian (BLOCKS), 24 in Swedish (KI), 28 in Greek (NKUA and PENTELI), and 14 in Walloon (CHUL).

Table 2.1 Number of participants per age, site, and weight category.

	Site	N	N OV/OB	N NW
Age 14-18	UKCM	6	5	1
	BLOCKS	3	1	2
	KI	24	NA	NA
	NKUA	7	3	4
	CHUL	4	2	2
		Total 14-18:	Sum OV/OB:	Sum NW:
		44	11	9
Age 10-14	UKCM	8	7	1
	BLOCKS	6	2	4
	NKUA	1	1	0
	PENTELI	6	4	2
	CHUL	6	3	3
		Total 10-14:	Sum OV/OB:	Sum NW:
		27	17	10
Age 8-10	UKCM	6	5	1
	BLOCKS	6	3	3
	NKUA	1	0	1
	PENTELI	7	4	3
	CHUL	2	1	1
		Total 8-10:	Sum OV/OB:	Sum NW:
		22	13	9
Age <8	UKCM	6	4	2
	BLOCKS	6	2	4
	NKUA	6	4	2
	CHUL	2	0	2
		Total <8:	Sum OV/OB:	Sum NW:
		20	10	10
		Total:	**Total OV/OB:**	**Total NW:**
		113	**51**	**38**

Notes. N – number of participants, Total – sum of participants within category, OV/OB – children with overweight/obesity, NW – children with normal weight

Children were recruited by researchers that are involved in the BIO-STREAMS project and their teams. All children and their parents received and signed informed contents for children's participation in the workshops (Appendix 2.1). Participants did not receive any incentives for participation and were excluded from the workshops only in the case of refusal or inability of the child or its parent/legal guardian to give informed consent (e.g., in case of intellectual disability).

Workshop content and delivery

The BIO-STREAMS interactive workshops were designed to be practical, engaging, and collaborative. Workshops were carried out by at least two facilitators, where at least one facilitator took detailed notes of participants' answers and one interacted with them. In case of workshops with a smaller participant group (e.g. 2 participants), one facilitator was able to effectively lead the workshop. As previous related studies report the number of participants being up to 8 individuals per session to maintain a productive and inclusive environment, we followed this guideline for clinical workshops in all pilot sites [1]. Although the BIO-STREAMS intervention study will take place in 6 different countries, workshops were carried out in 5 different contexts, i.e. Slovenia, Greece, Sweden, Belgium and Bulgaria.

Co-creation workshops in all pilot sites followed the same procedures with slight deviations that were allowed to better fit the unique cultural context of the pilot sites. The wording of descriptions and the questions were allowed to deviate from site to site, adapting it to the respective pilot site language and culture. The wording and the level of description of materials also differed to some extent depending on the age group of the participants in the specific workshop. All deviations in the standard workshop procedure due to participant age are described below. All workshops were carried out in two parts (90 minutes each) to prevent participants' fatigue and maintain their engagement, in recognition that a longer workshop would likely be overwhelming for young children.

All workshops began with a short, child-friendly introduction to the BIO-STREAMS project and an explanation of the workshop aims. Then, as a first activity, the Child Persona developed in WP2 (a detailed description can be found in D2.2), was presented to children in form of a comic (Appendix 2.2) and evaluated through an open discussion using the following questions:

- Do you think this Persona represents people from your age group?
- Can you imagine a day in a life of this Persona?
- Is there something that you think should be modified? Do you have any ideas?
- What would this person do? What is her experience?

As the second activity, several open questions developed as part of WP2 activities were presented to the children with aim of additionally evaluating user requirements, also developed in WP2. We list the set of selected questions below:

<u>Questions for younger children (aged up to 10 years old):</u>

- What is healthy lifestyle to you?
- What healthy things do you do at home?
- Do you want or wish for anything regarding being healthy?
- What kind of activities do you find fun?
- What do you think makes these activities enjoyable for you?
- Can you tell me about a game or activity you enjoy on your phone, tablet, computer?

<u>Questions for older children (aged from 11 to 18 years old):</u>

- What is healthy lifestyle to you?
- How are healthy habits promoted at home?
- Can you think of any health goals you might want to set for yourself?
- What kind of activities do you find fun?
- What do you think makes these activities enjoyable for you?
- Can you tell me about a game or activity you enjoy on your devices (phone, tablet, computer)?

As the third activity, children were asked about the planned study design, to assess feasibility of the design from their perspective. First, we asked an opening question "Have you ever talked about nutritious food and physical activity in school? What do you already know?", followed by

a simple introduction of the study field (i.e., research in healthy lifestyle). Then, we asked the children the following question:

- Are there specific topics related to health that you are curious about?

With this question, we aimed to identify outcomes and research topics that interest children themselves. Older children (above 14 years old) were additionally asked two following questions:

- What do you think is important to know about healthy lifestyle?
- Through which channels/devices do you prefer to learn about healthy eating habits and physical activity?

After that, we presented an infographic of the BIO-STREAMS study procedure (see Appendix 2.3). Questions accompanying the infographic for all children were:

- What do you think about the number of activities you will have to participate in?
- How much time (per day/per week) would you be willing to devote to this study?

Additionally, we asked older children (above 14 years old) the following:

- What are potential barriers and facilitators of your adherence?
- Would you be willing to answer these questionnaires? How much time would you be willing to commit?

Lastly, each pilot site was shown questionnaires intended for use in the prospective study to validate the children's understanding and concurrence with the questionnaires. Prior to the workshops, questionnaires were selected by the clinical team based on their relevance to the primary and secondary outcomes of the study. Selection criteria included validated psychometric properties, age-appropriateness, brevity, and alignment with the intervention's theoretical framework. All questionnaires were presented to children in their native language, with professionally validated translations already available for most instruments. Where translations were not available (primarily for the SREBQ and PeRBA in three of the participating countries), forward and backward translation procedures were conducted following WHO guidelines. To minimise participant burden while maximising feedback, questionnaires were strategically distributed across pilot sites, ensuring that each site evaluated 3-4 instruments and that each instrument received feedback from at least two distinct cultural contexts. This distribution plan was developed to balance comprehensive evaluation of all instruments against the need to prevent fatigue and disengagement among young participants. The questionnaires assessed in the workshops are listed in table 2.2.

Table 2.2 Questionnaires presented in the workshops.

Questionnaire	Outcome	Number of items
Penn State Worry Questionnaire for Children (PSWQ-C)	Anxiety	14
Center for Epidemiological Studies Depression Scale for Children (CES-DC)	Depression	4
Weight Self-Stigma Questionnaire (WSSQ)	Self-perceived stigma	12
Self-regulation questionnaire (SRQ-E)	Self-regulation - exercise	12
Self-regulation of eating behaviour questionnaire (SREBQ)	Self-regulation - eating	5
Child Well-being Index (WHO-5)	Well-being	5
KIDSCREEN-10	Quality of life	10
Food and Nutrition Literacy (FNLIT)	Health/food literacy	15
User Experience Questionnaire Short Version (UEQ-S)	User experience	8

Unified Theory of Acceptance and Use of Technology Scale (UTAUT2)	Acceptance + Trust	12
System Usability Scale (SUS)	Usability	13
Perceived Research Burden Assessment (PeRBA)	Perceived burden	7

For each questionnaire, we asked the following questions:

Questions for Understandability of the questionnaire (U):

- U1 Is the wording of questions and response options clear?
- U2 Do you find it easy to complete?

Questions for Comfort with answering (C):

- C1 What are your immediate thoughts about this questionnaire?
- C2 Would you be comfortable with answering this questionnaire?

In the second part of the workshop, our aim was to present the technologies developed within BIO-STREAMS and receive feedback. We presented the BIO-STREAMS technologies that are aimed at children and their families: the ActiveHealth web-based app and the serious games. Piloting sites had the freedom to choose, given their specific context, whether they wanted to execute this workshop on a separate session from the first one or during the same workshop as part one. In case they choose the separate session, a brief introduction of the project was made again to refresh participants' memories.

First, we presented the children with some introductory questions. Younger children (below 10 years old) were asked:

- Do you play games on your phones or use apps?
- What do you like on the apps and games that you play?

Older children (11 years old and above) were asked:

- What do you like on the apps and games that you play?
- Imagine a 'healthy app'. What would you want this app to teach you or help you with?
- What kind of app features do you find most interesting or enjoyable?

Results on this section are reported in section 2.1.3.

Second, children were asked to use their phones (in case children did not have phones with them, the ActiveHealth app was shown on screen) and log into the app to test it. Subsequently, they were asked to respond to the UEQ-S (User Experience Questionnaire - Short Version) questionnaire [2,3], and some additional open questions, to rate the app (Appendix 2.4). Additionally, we asked children the following open questions, developed in WP2:

- What kind of features would you like to see in the app?
- What kind of progress tracking tools would you find helpful?
- What kind of personalized recommendations would be helpful for you in the app? (e.g. healthy recipes, recommended fruit intake, recommended sport activities)
- Are there specific aspects of nutrition or physical activity you would like guidance on?

Results of this section will be analyzed by technical partners of BIO-STREAMS consortium and reported elsewhere.

Third, children also explored the serious games either on their phones or via presentations on the screen. Later, they were presented with questions specifically tailored to the games and game developers' needs:

- Do you find this game engaging?
- How much time would you be willing to spend playing a game like this?
- What aspects of this game do you find most engaging?

- Does the game provide enough positive reinforcement to keep you motivated?
- Do you think that playing this game would support you in adopting healthier habits?
- What aspects of this game make you think it could help improve your dietary habits?

Results of this section will be analyzed by technical partners BIO-STREAMS consortium and reported elsewhere.

2.1.3 Results

In this chapter, we are reporting the results of clinical co-creation workshops with children. We provide results of qualitative analysis for each workshop section, i.e. Persona, User requirements, Study design, and Applications in general.

Data synthesis by age group

Children below 8 years

Persona feedback

Sligthly more children felt that the Persona did not represent people from their age group than those who felt it did. In general, children believed the girl representing the Persona: looked older than them; should play with her friends more; should play games on her phone; and that she should dress better. Children said they can imagine a day in life of this Persona; however, they mentioned that she should have more fun and play with friends and other sports, prepare food with her mom, laugh more, etc.

User requirements feedback

Children's responses to the question regarding what is a healthy lifestyle to them consistently highlighted three main themes: healthy eating, physical activity, and rest. The most frequently mentioned aspect was diet, with an emphasis on eating fruits, vegetables, and home-cooked meals, while avoiding junk food, sweets, and sugary drinks. Physical activity was also commonly mentioned, described as playing outside, running, and exercising to stay strong and avoid getting sick. Some children also identified sleep and hydration as important, linking them to feeling energetic and healthy.

Children's responses to what healthy things they do at home revealed several recurring themes. Healthy eating stood out as the most frequent, with children mentioning fruits, vegetables, soups, and home-cooked meals. Many also noted avoiding fast food and limiting sweets and chips, sometimes due to parental guidance. Physical activity and outdoor play were commonly mentioned as healthy habits, along with helping with cooking, which seemed to reinforce healthy food choices. Some children also highlighted personal hygiene practices like washing hands and brushing teeth, as well as sleep routines such as going to bed early.

Children's responses to the question whether they want or wish for anything regarding being healthy included a desire for improved physical performance and wish to be able to eat anything and remain healthy. Many children expressed wanting to be stronger, faster, or better at sports and physical activities like ballet, swimming, or karate. These wishes reflect an internal motivation to improve physical abilities and succeed in activities they value.

The children's responses regarding activities they find fun reveal a strong interest in both digital and physical activities. Playing video games, particularly on computers and phones, was frequently mentioned, alongside outdoor activities like riding bikes and jumping on trampolines. Physical activities such as gymnastics, swimming, and dancing also appeared often, though less so than gaming or outdoor play. Traditional forms of dance, ballet, and karate were mentioned by a few, indicating some interest in structured exercise.

Children's responses to the question about games or activities they enjoy on their devices highlight a strong interest in social and competitive gaming. Popular games like Roblox, Fortnite, and Brawl Stars were frequently mentioned, with the social aspect of playing with

friends and competing being the most fun part. Many also enjoy watching educational or funny videos on platforms like YouTube, while others prefer creative games like drawing or dressing up characters.

Study design feedback

The topics that children are curious about regarding health primarily focus on physical fitness, strength, and nutrition. Many expressed an interest in ways to become stronger, grow taller, and improve their performance in sports. There was also curiosity about understanding which foods are healthy and how to maintain energy and endurance for longer physical activity.

The majority of children would prefer to perform the saliva swabbing themselves, often with the help of a parent or under specific instructions. A few children explicitly stated that they would not be comfortable with either a nurse taking the swabs or doing it themselves. There were also a few children who seemed open to the idea of a nurse doing it but did not provide specific preferences.

The children generally found the number of activities to be manageable, with most expressing that it was not overwhelming. Some mentioned that they would be comfortable participating as long as the activities remain engaging or if they have support from a parent.

The children indicated varying amounts of time they would be willing to devote to the study. Some would commit around 15 minutes per day or 1 hour per week, while others mentioned more time, such as 1 hour per day or even 2 hours per day. However, several responses also suggested that the final decision would depend on parental approval or instructions.

Overall, young children showed positive attitude towards the design of clinical study. They and their parents did not seem to find the amount of activities and engagement into the study overwhelming. For saliva sampling, it would be good to consider giving participants freedom to decide who takes a sample of their saliva – their parents or a healthcare professionals. In general, no major adaptations of the clinical study design is needed from the aspect of youngest children.

Questionnaires

For the SRQ-E questionnaire (applied in Greek and Bulgarian context), children reported to have problems with understanding the response scale. For the KIDSCREEN-10 questionnaire (applied in Slovene and Bulgarian context), children understood the questions, yet again had problems understanding the response scale. PeRBA questionnaire (applied in Bulgarian context) was more difficult to understand for young children. In the Bulgarian context, children did not understand some questions (especially 3, 4, 6, and 7). For questionnaires CES-DC, SUS (ages 7-8; applied in Slovenian context), PSWQ-C, WHO-5, FNLIT, UTAUT2 (applied in the Greek context) no problems with understanding or discomfort while answering were reported.

It might prove useful to use graphical response scale for all questionnaires for age groups under 8 years old. It also might be necessary to consider adapting or removing the PeRBA questionnaire for the youngest children.

General attitude towards applications

Children in the workshops widely reported using phones, tablets, or computers to play games and use apps, mostly through their parents' phones or personal tablets. The types of games vary, but commonly include activities like dressing up characters, drawing, solving puzzles, and simulation games involving animals, cars, or role-play. While one child reported not using games, the vast majority do engage regularly with digital play, indicating that mobile apps are a familiar and accessible medium for this age group.

Children consistently highlighted that they enjoy apps and games that are interactive, customizable, and social. Games that offer variety, creativity, and storytelling—like *Roblox*, *Toca Boca*, and *Avatar World*—are especially appealing because they allow players to be

creative. Competitive games such as *Fortnite*, *FIFA*, and *Brawl Stars* are appreciated for their feature of competing with others.

Children, 8-10 years old

Persona feedback

Mostly, children agree that the Persona presented does represent people from their age group, some say she looks a bit older. Children say they can imagine a day in life of this Persona. In terms of what should be modified, children say she should spend more time with friends, receive help from others to get better, have a pet, have more friends, etc.

User requirements feedback

Children's responses about what is a healthy lifestyle to them emphasize the importance of regular exercise and eating nutritious foods, particularly fruits and vegetables. They associate health with being physically active, such as playing outside, running, dancing, or engaging in sports. Many also mention avoiding fast food and candy, suggesting that a healthy lifestyle involves eating foods that are good for you and maintaining balance in daily activities. Additionally, some children recognize the importance of limiting screen time and staying energized to enjoy their favorite activities.

Children's responses about healthy habits they adopt at home reflect a combination of family involvement in food preparation and active play. Many mentioned that they participate in cooking meals with their parents, focusing on healthier options such as fruit bowls, salads, and home-cooked meals rather than fast food. Physical activity was also emphasized, with activities like riding bikes, skiing, walking, and playing outside frequently mentioned. Several children mention limiting screen time.

Children's responses regarding their wishes for being healthy highlight a desire for improvement in physical fitness and better nutrition knowledge. Many expressed a wish to become stronger, fitter, or faster, particularly in sports like football, and to improve stamina. Several children mention wanting to eat healthier but also seek tasty options, including healthy snacks and recipes, such as sugar-free desserts. They also expressed a wish to better understand how to make healthy food choices and include more physical activity into daily life, including exercise suggestions and structured activities.

The activities children enjoy most are a mix of physical and digital activities. Many children mentioned playing sports, with favorites including football, judo, climbing, and handball, as well as more recreational activities like riding bikes, skiing, and trampoline jumping. They also enjoy social play, especially with friends or family. On the digital side, popular activities include watching YouTube and playing games on phones or computers such as Roblox. Some children expressed a fondness for creative play like making hand-made bracelets or role-play with toys.

Children find activities enjoyable primarily due to a mix of fun, social interaction, and learning. Many children highlighted the enjoyment of learning new skills or getting better at activities like sports or dancing. There was also a strong emphasis on the social aspect, as games and sports allow them to interact with friends, while others appreciate the personal satisfaction that comes with improving or learning.

Children enjoy a wide range of games and activities on their phones, tablets, and computers, often centered around competition and fun. Games like Fortnite, FIFA, and War and Order are popular because they offer a competitive element. Additionally, multiplayer games like Roblox and FIFA allow children to interact with friends. Some children also enjoy creative activities, such as using drawing apps to make pictures. Videos on YouTube and TikTok are a frequent source of entertainment, with many children watching content like cartoons, gaming videos, and other fun clips. Finally, some children enjoy sports-related games like UFC 5 or Super Mario.

Overall, we conclude that children between 8 and 10 years old already understand the meaning of healthy lifestyle and the strategies to retain it. Mostly, children mention healthy foods such

as fruits and vegetables, cooking with family and learning about healthy eating from parents. They enjoy activities that are fun and engaging, including sports and video and mobile games. Comparing to younger children, these children play and enjoy more complex games that give them the sense of competition, achievement, and interaction with peers.

Study design feedback

Children did not extensively respond to the question regaridng which topics they are curious about. Some were interested in improving their physical abilities, such as gaining strength or increasing stamina. A few were specifically curious about how certain foods might impact their performance, like running faster. However, many seemed less interested in health topics.

The children's responses to the idea of a nurse taking saliva samples varied. Some expressed a preference for doing it themselves, often with the assistance of a parent, as they felt more comfortable with this approach. A few were open to the nurse doing it, with no significant concerns.

The children generally felt that the number of activities planned in the clinical study was acceptable, provided they were engaging and not too demanding. Many emphasized that they would be comfortable as long as the activities were fun and not like extra homework. There were some concerns about the activities being too time-consuming or boring, with a few expressing that they wouldn’t want to do too much if it interfered with their free time or play.

The amount of time the children are willing to dedicate to the study varies. Some were open to spending 10-20 minutes per day, while others would prefer shorter time commitments, such as 5-10 minutes daily or an hour per week. A few indicated they could fit it in only on weekends, depending on homework or other activities. Most seemed willing to dedicate a relatively small amount of time daily, with flexibility in the total time spent per week.

Overall, children again did not find the number of activities planned within the study too overwhelming, however they expressed more concerns comparing to the youngest group. They are willing to spend somewhat less time daily per day for the study and they are stricter about the activities being boring or interferring with their free time and usual obligations.

Questionnaires

For the PeRBA questionnaire (applied in the Bulgarian context), children still had issues with understanding the reponse scale, however reported positive attitude otherwise. For FNLIT questionnaire (applied in Bulgarian, Greek, and Walloon context), children understood it well and showed a positive attitude. For WHO-5 questionnaire (applied in Bulgarian, Greek, and Slovenian context), children understood the questions and reported to be comfortable answering them. Again, minor problems with understanding the response scale emerged. For SUS (ages 9-11; applied in Slovenian context), children did not report any difficulties regarding understanding or discomfort while answering. For PSWQ-C and SRQ-E (ages 9-11; applied in Greek context), children did not report any difficulties regarding understanding or discomfort while answering. For UTAUT2 (applied in Greek and Walloon context) children did not report any difficulties regarding understanding or discomfort while answering, with the exception of one child that reported feeling as if the researchers apply this questionnaire with 'mean' intentions. For KIDSCREEN-10, WSSQ, UEQ-S (applied in Walloon context) children did not report any difficulties regarding understanding or discomfort while answering.

Similar to the youngest children, these children also reported difficulties with understanding the response scale. Changing the response scale to a graphical format should also be considered for this age group. Regarding the PeRBA questionnaire, less issues with understanding were reported compared to the youngest group.

General attitude towards applications

The responses clearly show that nearly all participating children actively use phones or tablets to play games and engage with apps. The most frequently mentioned platforms include

YouTube, TikTok, and popular games like Roblox, Minecraft, Among Us, and UFC 5. Children use these devices both for entertainment (e.g., watching videos, playing games) and creative activities (e.g., drawing apps, building houses in games). TikTok and YouTube appeared to be the dominant platforms for watching videos. Many children also have personal access to devices and mention the use of their parents' devices less frequently.

Children particularly enjoy platforms like YouTube and TikTok for their short, funny, and engaging videos. In games, features that allow playing with friends, competing, completing missions, or customizing characters and spaces are especially appealing. They also value the variety of options and the ability to express creativity through art or building activities.

Children, 10-14 years old

Persona feedback

Children mostly agreed that the Persona represents someone from their age group, however, they did not agree that many children their age are passionate about sports. They said that, for them, it is more relevant to spend time with friends, play games, and use their phones than participate in sports. They said they can imagine a life of this Persona and that not much should be changed, except for perhaps having more hobbies, interacting with friends more often.

User requirements feedback

A healthy lifestyle, as described by children, includes physical activity and healthy eating. Many children associated being healthy with exercise, such as being active outside, playing sports, and maintaining regular physical routines. They highlighted the importance of eating fruits and vegetables while also noting the need to avoid junk food or unhealthy foods in excess. There was a strong focus on balanced eating, with some children mentioning smaller, more frequent meals as beneficial. Adequate sleep was frequently mentioned, along with the importance of hydration, especially choosing water over sugary drinks. Other important aspects included hygiene, positive social interactions, and mental well-being.

Children often describe a variety of healthy habits practiced at home, which include both physical activity and mindful eating. A common theme is exercise, such as stretching in the morning, doing outdoor sports like walking the dog. In terms of food, children highlight eating fruits and vegetables regularly, avoiding unhealthy snacks and sugary drinks, and focusing on home-cooked meals. Many mention helping with cooking to ensure meals are healthier, like opting for grilled chicken over fried food. Some children also pay attention to meal timing, with a few setting time limits on eating and avoiding meals after certain time. Additionally, portion control and reducing fried food are part of their daily habits. These practices reflect a conscious effort to balance nutrition and activity for overall well-being.

Children expressed various wishes and goals related to improving their health. A consistent theme was the desire for more exercise, with some wanting to find ways to work out at home incorporate more activity into their routines. Many also wish to improve their skills in sports and to build stamina. Several children mentioned the difficulty of eating healthy at school and expressed a wish to eat more fruits and vegetables daily. Some children focused on avoiding sugary drinks and snacks, while others set more specific goals like losing weight or achieving better sports performance. A few children also expressed interest in learning how to cook healthy meals or finding ways to enjoy healthier treats, such as ice cream with real fruit.

Children reported a wide variety of activities they find enjoyable, with a strong emphasis on social interactions and physical activities. Many children enjoy sports such as volleyball, basketball, tennis, soccer, and swimming, with some mentioning team sports as particularly fun. Video games emerged as another favorite, especially those that allow them to play with friends online, including popular games like Fortnite and mobile games. Other activities include socializing with friends and family, going on bike rides, and engaging in creative hobbies like drawing, painting, and building LEGO sets. Many children also enjoy watching videos on platforms like YouTube and TikTok.

The activities children find enjoyable are largely driven by factors like fun and social connection. Many mentioned that they enjoy activities because they allow them to escape boredom or forget about problems, such as video games or biking. Socializing with friends or family was highlighted as an important part of the enjoyment, whether it's through team sports, video games, or social media. Additionally, children noted that positive emotions such as feeling better or having fun make activities enjoyable. Some also emphasized adrenaline and passion in competitive or physical activities like sports.

The activities children enjoy on their phones, tablets, and computers include watching videos on platforms like TikTok and YouTube, where children enjoy funny memes, influencer content, and mini-series. Many also engage in social media, using platforms like Instagram and Discord to connect with friends and follow role models. Playing video games is another favorite activity, with games like Minecraft, Fortnite, and Roblox being particularly popular. Children enjoy these games because they allow them to build, compete, and explore virtual worlds. The ability to customize and create in games like Sims and Minecraft is also highlighted as enjoyable.

Overall, older children between 10 and 14 years old demonstrated a higher variability of activities they enjoy to have fun and stay healthy. Comparing to the two smaller groups, their understanding of healthy lifestyle is more developed and more multifaceted. They report wider ranges of digital and sport activities they engage in and, as driving factors, they mentioned enjoyment, detachment, and relaxation.

Study design feedback

The children expressed curiosity about various health topics, including the importance of hydration, how to eat healthier snacks without getting bored, understanding food labels, and the connection between sleep and feeling tired despite getting enough rest. Some also showed interest in understanding specific health conditions like diabetes and diseases without cures, such as cancer. Others had neutral or no specific curiosity about health topics.

Regarding saliva swabbing, most of the children would prefer to take the swabs themselves, either with instructions or guidance from a parent, rather than having a nurse do it. Some mentioned that doing it themselves feels less awkward or more comfortable, while others were okay with either doing it themselves or having the nurse do it, depending on the situation.

Overall, the children seemed to be comfortable with the number of activities they will need to participate in during the clinical study, as long as they find the activities interesting and not too overwhelming. Many mentioned that if the activities are fun or useful, they would not mind doing more, while some expressed concerns about feeling like it might be too much if too many tasks are scheduled every day.

The children were generally willing to dedicate different amounts of time to the study, with most preferring shorter, more manageable time slots. Many are comfortable with 10-15 minutes per day (or 30 minutes a day) as long as the activities are not too time-consuming. Some were willing to dedicate up to 1 hour per week or a bit more, with a few willing to commit 2-3 hours per week depending on their schedule. A few would be okay with longer sessions, especially if they fit into their routine without interfering with other activities like sports.

Overall, children's responses have shown that by the time they reach 10 to 14 years of age, they develop more curiosity and questions regarding their health and body. Children did not report to have issues with saliva swabbing, however, they would prefer doing it themselves. Regarding the study activities, they would not mind devoting 15 to 30 minutes per day as long as the study activities and engagement does not interfere with their usual obligations.

Questionnaires

For SREBQ (applied in Bulgarian), adolescents understood the questionnaire. Again, they had issues with reponse scale. For UEQ-S (applied in Bulgarian and Walloon), adolescents understood it in Bulgarian, however in Walloon they had many issues with understanding the

questions. For UTAUT2 (applied in Bulgarian, Greek, and Wallon context) everything was clear, with exception of problems with understanding the response scale. For PeRBA and SUS (12-18, applied in Slovenian context), no problems were reported. For PSWQ-C and SRQ-E (applied in Greek context) no problems were reported with exception of item 9, where some children had difficulties with understanding it. For FNLIT (applied in Slovenian, Greek, and Walloon context), adolescents reported to be one of the most important questionnaires. They reported it to be understandable, with exception of items 14 and 15 in French. For KIDSCREEN-10 and WSSQ (applied in Walloon context), all items were reported to be clear.

Children generally experienced difficulties with understanding response scales across all questionnaires. This was particularly evident in the younger age groups, indicating a need for adaptation of these scales. Specific questionnaires requiring revision include:

- The French versions of the UEQ-S (User Experience Questionnaire Short Version) and FNLIT (Food and Nutrition Literacy) questionnaires, where participants reported difficulties comprehending the questions.
- The Greek version of the SRQ-E (Self-regulation questionnaire for exercise), specifically item 9, which needs rewording for better comprehension.
- The Greek version of the WHO-5 (Child Well-being Index), which requires review of wording to address the slight discomfort children reported when answering these questions.

General attitude towards applications

Across the responses, a clear set of themes emerged regarding what children and adolescents like in the apps and games they use. Entertainment, social interaction, creativity, and ease of use were consistently valued. Many enjoy apps like TikTok, YouTube, and Instagram for their short, humorous, or influencer video content, with some emphasizing that they prefer social networks over games. While interactive and competitive features were highly valued by participants, implementation of direct player-to-player interaction within the BIO-STREAMS platform is constrained by GDPR and privacy regulations concerning minors. This highlights the need to develop alternative engagement strategies that can simulate competitive and social elements without compromising data protection requirements.

From the responses, several key themes emerged regarding what children and adolescents want in a “healthy app.” Most commonly, they expressed interest in features that teach them about nutrition and physical activity in an engaging way. This includes tools like calorie and step counters, sleep and hydration trackers, and healthy recipe suggestions. Many participants wanted the app to offer daily challenges or reminders, such as to exercise, drink water, or choose healthy snacks. There was also strong interest in interactive features, such as the ability to take photos of meals for feedback, use diaries or logs to track daily activity, and even receive personalized advice based on age or lifestyle. Others suggested more social and creative elements, like quizzes, avatars, maps of local activity spots, or options to connect with friends for motivation.

The responses indicated that children and adolescents are most drawn to interactive and engaging app features that make the experience fun, social, and rewarding. A strong theme was the ability to connect and compete with friends, whether through shared challenges, social feeds, or multiplayer games. Many also enjoy customization features, such as creating avatars or decorating spaces, with being able to use colorful design and sound effects. Children also appreciated features that provide feedback and motivation, such as progress tracking, graphs, daily goals, and rewards for completing tasks.

Adolescents, aged 14-18

Persona feedback

Adolescents mostly agreed that the Persona represents their age group. However, some said, that their problems are more complex and various, e.g. they worry about studying, preparing

for university, etc. Other agreed that they also want to become healthier and participate in sports. They said they can imagine a life of this Persona.

User requirements feedback

The adolescents' responses highlighted key themes of physical activity, balanced nutrition, and sufficient sleep. Exercise was frequently mentioned as a core component of a healthy lifestyle, along with eating fruits, vegetables, and avoiding unhealthy foods like fast food and sugary snacks. Many responses emphasized the importance of balance, whether in diet or daily habits, and avoiding extremes. Mental health was also noted as essential, with several participants linking physical activity and good nutrition to improved mental wellbeing. Additionally, daily routines, such as drinking water, eating home-cooked meals, and managing screen time, were commonly mentioned as part of a healthy lifestyle.

Healthy habits at home are promoted primarily through home-cooked meals, encouraging physical activity, and establishing healthy routines. Many adolescents mentioned that their parents prepare nutritious meals, such as grilled chicken with vegetables, and emphasized the importance of eating fruits and vegetables. Parents also encourage drinking water instead of sugary sodas, eating breakfast, and avoiding late-night snacks. Additionally, there was a focus on reducing screen time and engaging in sports or physical activities. In some cases, parents model healthy habits by following the same diet plan and ensuring a balanced lifestyle at home. There are some mentions of family discussions around health and wellbeing.

The health goals expressed by adolescents mainly focus on improving physical fitness, eating healthier, and managing their lifestyle. Many mentioned goals related to exercise, such as building muscle and working out regularly (e.g., strength training, playing football, and stretching). Another common goal was to improve diet, with a focus on eating more fruits and vegetables and reducing fast food consumption. Hydration also stood out, with several participants setting goals to drink more water. Some goals reflected a desire to lose weight or improve body composition, such as reducing fat or gaining muscle. Additionally, adolescents expressed goals around mental health and balance, such as reducing screen time, improving, and sleep routines.

The activities that adolescents find fun cover a broad spectrum. Many participants enjoy spending time with friends, whether it's through hanging out, playing games online, or engaging in group activities like sports. Popular sports include swimming, running, volleyball, football, and basketball, with some also mentioning activities like dancing, skating, and going to the gym. In addition to physical activities, participants also enjoy creative and relaxing pursuits, such as playing musical instruments, cooking, and engaging in hobbies like learning languages or watching TV. Digital entertainment was also a common theme, with adolescents mentioning playing video games, watching videos on platforms like TikTok and Instagram, and using the internet for inspiration or to socialize. The enjoyment of these activities is mainly driven by social interaction, personal satisfaction, and physical or mental engagement. Many adolescents find activities enjoyable because they can connect with friends, whether through gaming, texting, or sports, and appreciate the sense of camaraderie and fun. Additionally, the chance to learn new skills or see personal growth, such as in dancing or sports, was highly valued. Physical activities were also seen as mood boosters and stress relievers.

Regarding digital activities, adolescents enjoy using social media platforms like Instagram and TikTok, where they watch and share videos or interact with friends. Gaming is another favorite activity, with games like Roblox, Among Us, and Fortnite being popular, often played with friends. Watching videos, particularly on YouTube, is also a common leisure activity.

Overall, a trend emerges for adolescents between ages 14 and 18 that they proactively set their own goals. Some adolescents had a clear picture of what they want to achieve regarding their own body and mental state. In their free time, they mostly prefer to spend time with friends or engage in sport activities. They engage in these activities because of pleasure and social interaction.

Study design feedback

The participants' responses highlighted a strong interest in physical and mental health. Sleep was also a key topic, with many curious about how it affects mood and energy, and how to improve sleep habits. Nutrition and physical health, particularly exercise, were frequently mentioned, with a focus on how food affects both physical and mental well-being, and the impact of processed foods. There was also interest in body monitoring and regular health check-ups. A few responses mention the importance of reliable health information and addressing specific health concerns like thyroid issues and skin care. Several responses highlighted the need for balance between exercise, nutrition, and mental well-being. Others mentioned the importance of understanding hydration, sleep, and the relationship between these habits in contributing to overall well-being. There was also recognition of the need for habits to become part of a routine and the long-term impact of making healthy choices.

Adolescents' preferred channels for learning about healthy eating habits and physical activity are various. Popular platforms include TikTok, Instagram, and YouTube, where many follow creators sharing quick tips, recipes, and advice on self-care. Some also rely on mobile apps, or health tracking devices like smartwatches or oxiometers, for real-time advice or data related to health. Others mentioned using traditional methods like consulting parents or trainers, though the internet remains a dominant source of information.

The majority of adolescents were comfortable with a nurse taking two swabs of their inner cheek to collect saliva. Many expressed no issue with the process, indicating they trust the nurse, and were comfortable either with the nurse performing the procedure or with doing it themselves, provided there is guidance or instruction from the nurse.

The responses indicated that the adolescents generally found the number of activities manageable, with many stating that they are comfortable with the study as long as the tasks are not overly time-consuming or complicated. While some participants expressed concerns about the potential workload, especially if the activities interfere with school or other commitments, most feel that the activities are acceptable if spaced out and easy to follow. The idea of having a reasonable duration for the study (e.g., six months) was also positively received, and a few mentioned that they would be open to participating in the activities if they are engaging and beneficial.

The responses reveal that adolescents are generally open to dedicating a modest amount of time to the study, with most preferring shorter daily or weekly time commitments. Many participants indicated that they would be comfortable with spending around 10–20 minutes per day, while a few mentioned being open to slightly longer durations if the activities are engaging and not boring. There was also mention of flexibility, with some adolescents willing to adjust the time they devote based on the nature of the tasks.

While half of the participant reported that they do not see any barriers to their participation in the study, some expressed issues related to time management, with some feeling that the study could become difficult to maintain if activities are too demanding or interfere with their existing schedules. Repetitiveness or boredom in the activities, especially if they feel like a chore, could also hinder adherence. Involvement of parents in certain activities or discussions might also be a barrier for some, particularly if sensitive topics are involved or if relationships with parents are strained. Additionally, certain technical aspects, like the need to log in repeatedly or uncomfortable procedures (e.g., DNA testing), were mentioned as potential obstacles. Facilitators of adherence include the simplicity of the activities and making them non-mandatory, such as providing recommendations rather than strict requirements. Ensuring the app is user-friendly, with fewer steps and clear notifications, would also facilitate participation. A flexible schedule, where activities can fit into the participants' day-to-day life without causing additional stress, would be an important factor in encouraging sustained engagement.

Participants generally expressed a willingness to answer the questionnaires, but most indicated that they would prefer to keep the time commitment manageable, typically between

10 to 20 minutes per session. Many emphasized that the questionnaires should be straightforward and not too lengthy, as longer durations could lead to frustration or boredom.

Overall, adolescents reported no issues regarding the saliva swabbing process, and no clear preference of who should collect the sample emerged. Adolescents expressed somewhat more concerns regarding the number of activities linked to the clinical study as the three younger groups. They said that such engagement in activities may be overwhelming, which depends on various factors, e.g. how engaging activities are, the length of the questionnaires, etc.

Questionnaires

For UEQ-S (applied in Bulgarian and Walloon context) and UTAUT2 (applied also in Greek) no problems were reported regarding the understanding and discomfort with answering. For PSWQ-C (applied in Bulgarian and Greek context), all items were clear to adolescents. However, everyone (in Bulgaria) agreed that parents should not have access to the responses, as mental health is a challenging topic for adolescents. From adults' side mental health issues in adolescents are often accepted with criticism. For CES-DC (applied in Bulgaria) opinions were similar than for PSWQ-C. For WSSQ (applied in Bulgaria) opinions are again similar than above. Some questions appeared sensitive. Participants agreed that psychological support should be available with administering this questionnaire, if needed. For SRQ-E, WHO-5 (applied in Greek context), and FNLIT (also applied in Walloon context) adolescents reported no issues regarding the understanding and discomfort with answering.

Overall, participants reported good understanding of the presented questionnaires and not much discomfort was shown. The exception was WSSQ questionnaire, about which participants in Bulgaria expressed major concerns in terms of its potential impact on participants' mental well-being. It should be considered that WSSQ is removed or adapted for use in the clinical study.

General attitude towards applications

Regarding preferred app features, many participants highlighted the enjoyment of connecting with friends through chatting, collaborating, or simply doing what their peers do online. Apps that allow interaction, sharing, and customization were also favored. Participants expressed appreciation for instant feedback and rewards, such as likes, views, or progress badges, which help maintain engagement. Ease of use and a clear, visually appealing interface were considered important for enhancing the experience. Some participants viewed these apps as a way to pass time while waiting.

From the responses about the "healthy app" participants would value to be able to track and receive instant feedback (measuring calories, steps, sleep, and even water intake). There was a clear interest in receiving guidance, especially simple and age-appropriate instructions for healthy eating, physical activity, and building meal plans. Participants expressed interest in features that address stress management, sleep issues, and emotional regulation, including breathing exercises and tips to stay calm before stressful events like exams. Several responses suggested that the app should offer encouragement or reminders to stay on track with health goals. Some emphasized the importance of learning through games, suggesting that integrating interactive or playful elements would make the app more engaging. Finally, customization and simplicity are considered essential.

The responses reveal a few key features that users find most appealing in apps. Personalization was mentioned, with many users expressing interest in features that allow them to set their own goals, receive tailored recommendations, or track personal data. The visual appeal of an app is also important, with preferences for colorful graphics or animations that make the app more engaging. Additionally, social interaction features, such as the ability to chat with others, share achievements, or engage in competitions, were highly valued. This includes likes, comments, and challenges that encourage connection and friendly competition.

Ease of use, particularly a good user interface and easy navigation, also plays a significant role in what makes an app enjoyable.

Total synopsis of findings and implications

The results showed some differences in preferences, attitudes, and needs of participants of different ages.

In Persona assessment, it has become evident that children aged 10 to 14 resonated the most with Persona, while others find her older (the younger groups) or younger (the older group) than themselves. In addition, older children said that the Persona should have more complexity and multifaceted problems to better represent their age group. From this, we can conclude that it would probably be beneficial to use differently aged Personas or other forms of representations of real people when communicating the topic of projects to children. It is important that the Persona resonates with individual children.

Regarding user requirements, collected from workshop participants via the questions previously developed in the project, we have acquired valuable insights regarding the depth of understanding and needs of children of different ages. While young children understood healthy lifestyle in terms of being active and eating fruit and vegetables, children above 10 years of age begin mentioning mental health and balance between various types of activities. Young children mostly rely and learn from their parents, while children above 10 or 14 years of age become more independent, less dependent on other figures in life (e.g. parents, teachers, coaches) and begin looking for knowledge on social media and so on. They are also much more proactive in setting their own goals regarding physical and mental health. Another factor that younger children and adolescents have in common is that they value having fun and enjoying the activities they engage in. A major factor for all is social interaction, retaining high engagement levels in activities, and being able to be physically active, which is enjoyable by itself. Technologies are undoubtedly an important aspect of young people's lives, where younger children use their parent's phones to play games, while older children already have their own devices and more various preferences towards digital activities. Main digital activities include playing games, interacting with peers on social media, and watching fun and engaging content for example on YouTube or TikTok.

Important feedback emerged when we asked children about our clinical study design. In general, children and adolescents showed a positive attitude towards the presented content. As they would prefer very different ways of saliva sampling, we sensed no major issue reported regarding the presented procedure. Participants also agreed with the number of activities they would have to engage in as participants of the study. However, older participants expressed more concerns as younger participants. In total, participants agreed to spend in average 10-20 minutes for the study per day, where numbers were in average lower for older children. Regarding the self-report questionnaires presented to participants, they mostly expressed no concerns with some exceptions regarding the response scale in general and WHO-5, WSSQ, UEQ-S, SRQ-E, and FNLIT questionnaires needing some adaptations in certain languages.

Features that children reported to enjoy in apps and games also differ among ages. While younger children frequently mention games of various types and their wish to have fun and stay engaged, older children specifically mentioned features for health tracking, progress tracking, receiving recommendations and tips for recipes. All children stressed that the ability to connect with peers on social media and mobile games is crucial.

2.1.4 Conclusions

With the aim of receiving feedback on various components relevant for the BIO-STREAMS project, we conducted co-creation activities with children aged 5 to 18 years. Children were recruited in a clinical setting, some of them fitting into category of having a diagnosis of OV/OB and some fitting into category of normal weight. Children provided their thoughts and opinions

on 1) the Child Persona developed in WP2 (T2,3), 2) questions developed in WP2 (T2.3), addressing healthy lifestyle and attitude towards using technologies in daily lives, 3) study design, including their attitude towards saliva sampling, amount of activities planned in the study, and feedback on the self-report questionnaires aimed to be administered for psychological data collection, and 4) general opinion about apps and video games that will help us develop digital interventions tailored to children's needs.

Through these co-creation activities, we gained a meaningful insight into the values, the needs, and the preferences of children of different ages. Based on the results of the clinical workshops it is evident that children are mindful of healthy food and physical activity from a young age, where parents play an important role of introducing healthy lifestyle to them. At later age, children become very curious about various health topics with eagerness to learn more and become better in terms of physical health, strength, and mental health as well. We see great potential in supporting children in adhering to the principles of a healthy lifestyle through digital interventions/tools, as their appetite to learn and their affinity towards technology are vast. As regards the clinical study design, children's and adolescents' attitude towards the presented content was positive with very minor implications for study content adaptations.

2.2 School setting

2.2.1 Background/aim

The school environment has been long recognised as a unique setting for delivering healthy lifestyle interventions to prevent childhood overweight/obesity (OV/OB). Schools facilitate wide access to the general childhood population as they encompass the majority of children within a geographical area, and provide a great range of tools that could facilitate the necessary healthy lifestyle modifications, such as nutritional and physical education, supportive diet- and exercise-related facilities, peer interaction and a communication link with the family [4,5]. Within the BIO-STREAMS project, a school pilot intervention study will be designed and conducted with the aim to develop and pilot-test a school-based, family-centric healthy lifestyle intervention incorporating digital tools for the prevention of OV/OB in 9-14-year-old children and adolescents in 5 European countries, i.e. Greece, Slovenia, Portugal, the Netherlands, and Denmark. Although the design of the intervention will be based on an in-depth review of relevant scientific data, input from children themselves is also crucial. In this context, a series of school co-creation workshops was designed and conducted as part of the living lab methodology of the BIO-STREAMS project, with a goal to gain insights into the perspectives, preferences, motives, burdens and needs of schoolchildren in relation to the adoption of a healthy lifestyle, to actively involve students as co-creators in the process of developing the project's school pilot intervention, to re-evaluate the Personas and user-requirements extracted from WP2 (T2.3) of the project, and to inform the design of the digital tools under development within WP5 of the project. Using this co-creation approach, the BIO-STREAMS project will ensure the design of a more targeted intervention, ultimately leading to a higher probability of successful implementation in real-world educational settings across Europe.

2.2.2 Methodology

The co-creation workshops were conducted in September and October 2024 in the 5 school pilot sites, i.e. Greece, Slovenia, Portugal, the Netherlands, and Denmark.

The protocol of the school co-creation workshops, as described in detail below, was approved by ethical committees in Greece (Bioethics Committee of Harokopio University of Athens; approval code: Γ-2281/11.07.2024; approval date: 25 September 2024), Slovenia [Research Ethics Committee of the Faculty of Arts (KERFF), University of Maribor; approval code: 038-17-183/2024/9/FF/UM; approval date: 5 August 2024], and the Netherlands [Ethics Committee of Stichting International Parents Alliance (the external ethics board for the European School

Heads Association); approval code: BIOSTREAMS COCREA; approval date: 4 September 2024]. Approval was not needed in Portugal, since the co-creation workshops were organised as a one-off educational initiative (short-term, non-invasive pedagogical intervention) which was integrated into the planned "Healthy Eating Week", and in Denmark, as the revelant body (National Ethical Committee) only requires ethical approval for research studies.

Setting and participants

The target population was schoolchildren aged 9-14 years and was split into two age subgroups, i.e. 9-11 years (primary education) and 12-14 years (secondary education), to ensure an equal distribution between younger and older children. Eligible subjects were recruited from schools by directly contacting headmasters. Schools were chosen based on existing contact due to previous collaboration with the project's school pilot sites. Upon recruitment, headmasters were presented with detailed information on the scope and the methodology of the co-creation workshops and information letters were distributed to students (Appendix 2.5), parents/guardians (Appendix 2.6) and teachers (Appendix 2.7) to provide them with an overview of the co-creation workshop process and the BIO-STREAMS project's privacy policy, and explore their interest in participating. Schoolchildren did not receive any incentives for participation, other than the opportunity for self-reflection and involvement in an open discussion with researchers on the co-development of the project's school pilot intervention. A signed written consent (Appendix 2.8) was obtained by children and their parent or legal guardian as a prerequisite for students' participation in the co-creation workshops. Children were excluded from the workshops only in the case of refusal or inability of the child or its parent/legal guardian to give informed consent (e.g. in case of intellectual disability).

Each school pilot site conducted 2 workshops, 1 among children aged 9-11 years and 1 among children aged 12-14 years, targeting a minimum of 10 participants in each workshop, and therefore a minimum of 20 participants per pilot site. In total, 181 participants were recruited. The distribution of participants per age group and pilot site is presented in Table 2.3.

Table 2.3 Participant distribution per age group and pilot site.

Country (partner)	Schools n*	9-11-year-olds n	12-14-year-olds n	Total n
Greece (HUA)	2	18	23	41
Slovenia (UM)	1	9	14	23
Portugal (NUCLIO)	1	24	28	52
Netherlands (ESHA)	2	12	12	24
Denmark (DCHE)	1	20	21	41
Total n	**7**	**83**	**98**	**181**

* One school was recruited in countries in which primary education involves students aged up to 14 years, while two schools were recruited in countries in which primary education involves students aged 9-11 years and secondary education involves students aged 12-14 years.

Workshop content and delivery

The co-creation workshops took place in schools within school hours. Each workshop was conducted in 1 school class and lasted for approximately 1-2 school hours (60 minutes on average). In the context of the workshops, participants were asked to reflect on and produce answers to a list of 15 questions developed within WP2 (T2.3) of the BIO-STREAMS project. The development of the questions has been described in detail in D2.2. In brief, a 3-cycle approach was followed; in the first cycle an initial extended version of the question list was developed within T2.3 based on the scope of the co-creation workshops, in the second cycle a larger group of experts from various scientific and technical fields (partners of the BIO-STREAMS consortium) rated the importance of questions and voted for those that should be utilised in the workshops, while in the third cycle questions were refined and logically ordered to produce the final list. The 15 questions covered 5 thematic areas, namely 1) healthy lifestyle

(general) and motivation, 2) healthy eating, 3) physical activity and sedentary behaviour, 4) healthy lifestyle literacy, and 5) trust in interventions and guidance (adherence) (Table 2.4).

Table 2.4 School co-creation workshop questions.

A	Healthy lifestyle (general) and motivation
1	What is healthy lifestyle to you?
2	What kinds of active and enjoyable activities do you like that can also help with your health?
B	Healthy eating
3	How much fruit and vegetables do you eat per day?
4	Do you eat snacks or sweets? Why? Do you take a sweet or a snack by yourself or does somebody give it to you?
5	Can you think of any healthy snacks that you like?
C	Physical activity and sedentary behaviour
6	Do you like physical activity? If yes, what do you like to do to be physically active? If not, what do you think prevents you from being physically active?
7	Why do you like these activities?
8	What physical activities do you most like to do in school with your classmates/peers?
9	What do you like in these activities?
10	Outside of school (on weekends and free time), do any of the things you do involve sitting? What kind of activities involve more moving and activity?
D	Healthy lifestyle literacy
11	What would you like to learn about healthy lifestyle?
12	Where/how would you like to learn about this? In what format do you prefer to receive information on healthy eating and physical activity (videos, games, stories)?
13	Would you prefer in-person-learning? Or through engaging activities?
14	Would you like to learn digitally? On which device?
E	Trust in interventions and in guidance (adherence)
15	Have you ever participated in some sort of healthy programs before in your school?

Each co-creation workshop was conducted by a minimum of 2 facilitators from the research team of each pilot site, so that at least one facilitator conducted the workshop and presented the questions to students, while the other facilitator(s) observed, took notes and reinforced students' participation. During the workshops, participants were reminded that they were allowed to not answer questions if they did not feel comfortable, and facilitators used positive and inclusive language to avoid stigmatisation. The exact methodology implemented for the delivery of the school co-creation workshops in each pilot site is presented in Table 2.5.

Table 2.5 Methodology of the school co-creation workshops per pilot site.

Country (partner)	**Description of methods**
Greece (HUA)	Students were divided in 4 groups (4-5 students per group) to work on each of the 15 questions and write their thoughts on paper (one carton was provided per group). One researcher, as coordinator of the semi-structured discussion, presented questions in a thematic order and guided groups to answer appropriately. Another 4 researchers were present to facilitate the process. The classroom teacher was also present and reinforced participation to avoid any student being excluded or underrepresented in the co-creation procedure. Students were given a specific timeframe to answer each question, and at the end each group presented their answers in random order (rotation of child-presenter was encouraged). The coordinator noted the range of answers on a portable board using keywords. During the process, the other 4 researchers kept detailed minutes of the discussion in paper. All cartons, the portable board and the detailed minutes were collected as raw data.

Slovenia (UM)	The workshop was conducted by two moderators (researchers in the project), while teachers were not present. First, the project, the purpose of the workshop and the voluntary nature of participation were presented and discussed. For an icebreaker, children were asked if they had participated in a similar workshop before. Then, they were asked to split into two groups of 4 and 5 students, each group receiving a big A1 sheet of paper with half of the workshop questions written on one sheet and the other half on the second. The moderators briefly presented the questions to children to familiarise them. Children were given colourful pencils and were asked to write down their own answer, however they were allowed to talk to each other and discuss. If they had a question, the moderators answered. When groups were finished with putting answers down, the papers were switched so that all children had a chance to provide their opinion to all questions. A couple of more complex questions were also presented to students in open discussion at the end of the workshop. These questions were: "What do you think prevents you from being physically active?", "Why do you like these [physical] activities?", "What kind of activities involve more moving and activity?", "In what format do you prefer to receive information on healthy eating and physical activity?".
Portugal (NUCLIO)	The co-creation workshop was conducted during Citizenship and Development classes. Two facilitators from the research team led the session: one facilitated the workshop and posed the questions, while the other observed, took notes, and supported student participation. A class teacher was present to provide support but did not intervene. The workshop used a brainstorming approach based on the KJ method to explore the designated topics. The KJ method is an idea generating and prioritising technique named after its inventor, Jiro Kawakita. This technique is one of the most popular brainstorming variations for design, team, retrospective, and project meetings. It includes 4 steps, i.e. individual brainstorming, sharing ideas, grouping/clustering of ideas/concepts, and voting on ideas/concepts that matter most [6]. Posters grouped by thematic categories were displayed on the walls. Students initially reflected on the questions individually before collaborating in pairs and groups. They recorded their responses on separate post-it notes, which were then placed on the corresponding thematic posters. Students were subsequently encouraged to lead discussions on each question, fostering inclusive participation.
Netherlands (ESHA)	Questions about activities enjoyed and health literacy were covered during an activity where students were asked to build their healthy school using all kinds of recycled materials. For the healthy lifestyle questions, 9-11-year-old students were asked to create a cartoon strip with the title "A Healthy Day" based on a short story they created in a few sentences, while 12-14-year-old students were asked to choose cards from a relevant Dixit selection, discuss and note down their associated thoughts for the different questions. After each activity, students were invited to present their work. They worked in 3 groups of 4. The facilitator asked the questions that were not directly answered in the presentation for extending their input. The workshop was conducted by one facilitator and children's replies were captured by a note-taker. The group was diverse in nationalities but English was a language everybody was comfortable using, and thus the workshop was conducted in English. The workshop started with a trust-building activity using a hula-hoop and at the end of the session feedback from participants was collected using the Bear Emotion Cards. The class teacher was available, but did not participate in the workshop.
Denmark (DCHE)	At the beginning of the session a brief presentation was given to the whole class by the 3 facilitators (researchers) regarding the project and the reason

	for conducting the workshop. The class was then divided in two groups of students with 1 and 2 facilitators, respectively. Students were then seated in pairs, sharing a big A2 divided in four squares – each square representing one of the sections, A, B, C, D. In the group with two facilitators, one ran the workshop while the other took notes. In the group with one facilitator, he/she did both alone. Most questions were asked by the facilitator to the whole group and a timeframe for drawing their answers on paper was given. After the time was up, students briefly presented their drawings individually. Some questions that made more sense answering orally were asked during the presentation of the drawings to the previous question and the answers were noted by the facilitators. The workshop was conducted in the native language, i.e., Danish. The class teacher was present, but only observed and made sure students behaved properly.

Data collection and synthesis

No audio or visual recordings of the workshops were taken, and no personal data, other than students' answers to the questions, were collected. Workshop facilitators ensured that no data was collected relating, directly or indirectly, to individual study participants, such as names, locations, or data specific to the physical, physiological, genetic, mental, economic, cultural or social identity of individual study participants, and responses from participants that, in combination with other available data (such as those relating to the school or age range of participants) could single out a participant were not processed. Data were qualitatively synthesised to identify common themes and patterns of answers within each question.

2.2.3 Results

In the following subsections, the qualitative synthesis of the data collected through the school co-creation workshops is presented in three levels. Initially, detailed results are reported for each of the 10 workshops conducted in the form of structured summaries, highlighting common themes and patterns of students' answers within each thematic area of questions. Then, a country- and age-specific synthesis of the results is provided with the aim to identify similarities and differences in students' answers between the 5 pilot sites, i.e. Greece, Slovenia, Portugal, the Netherlands and Denmark, and the 2 student age groups, i.e. 9-11 years and 12-14 years. The section concludes with a total synopsis of the findings of the school co-creation workshops and relevant implications for the development of the school pilot study protocol.

Detailed results per co-creation workshop

Greece (HUA), 9-11 years

Healthy lifestyle (general) and motivation: All student groups identified the adoption of a balanced diet and regular engagement in physical activity as essential elements of a healthy lifestyle. A balanced diet was primarily described as one that includes high amounts of fruits and vegetables, while adequate water intake, frequent consumption of legumes, and adequate intake of macronutrients (i.e., carbohydrates, proteins) and micronutrients (i.e., vitamins, calcium, iron) were additionally reported. Limiting total sedentary time, limiting screen time (i.e., TV), and reading books were also mentioned as components of a healthy lifestyle by some students. In terms of healthy lifestyle activities that they enjoy, students' primary focus was on exercise (organised team sports and lifestyle/recreational activities). Cooking and grocery shopping with parents were the most frequently mentioned diet-related activities, although students provided very few responses for such activities overall.

Healthy eating: Consumption of fruits and vegetables varied among students, with individual responses ranging from 0 to 5 servings of fruits or vegetables daily. The vast majority of students responded positively in consuming savoury or sweet snacks. Reasons for snack consumption included their good taste, hunger, convenience, cravings, and the need for

energy boost, while non-consumption was attributed to concerns about their high content in calories. Of the students who reported consuming snacks, half mentioned that they get them themselves, and the other half reported receiving them from others (i.e., parents). In terms of healthy snack preferences, rice cakes, eggs in various forms, fresh fruit (orange and lemon) juices, sandwiches, cheese pastries, and yogurt with oats and honey, were the most common responses, followed by fruits and tacos/tortillas with vegetables.

Physical activity and sedentary behaviour: All students reported enjoying physical activity, with basketball, football, swimming, running, dancing (including ballet, hip hop, and folklore dances), and strength exercises (such as push-ups, pull-ups, and ab workouts) being the most frequently mentioned activities. Less frequent responses included walking, hide-and-seek, tag, track and field, parkour, rhythmic gymnastics, and judo. These activities were perceived as enjoyable, able to promote fitness, and providing opportunities for social interaction with teammates. At school, students' favourite activities included those performed during physical education classes, various sports, such as basketball, football and dodgeball, as well as active games, such as hide-and-seek, mainly because they are fun and allow them to spend time with their classmates. Outside of school, during weekends and free time, the most usual sedentary activities reported were playing video games, reading books, and drawing, while less common sedentary activities included studying, playing music, discussing, watching TV, participating in choirs, and playing board games. The majority of activities involving movement were sports-related, with basketball, football, swimming, rhythmic gymnastics, volleyball, track and field, dancing, running, and judo being the most common, while less frequently mentioned activities included taking pets for a walk, playing ping pong, cycling, and riding an electric scooter.

Healthy lifestyle literacy: All student groups expressed a desire to learn about healthy lifestyle. Most students showed interest in how to improve their dietary habits and maintain a healthy diet. For example, they reported wanting to know whether they should eat breakfast every day, as well as how many meals they should have, how many fruits and vegetables they should eat, and how much water they should drink on a daily basis. Additionally, most students indicated an interest in learning more about physical activity/exercise. Specifically, they reported wanting to learn new activities/hobbies, how to enhance their sports performance, and the appropriate age for attending the gym. The majority of students indicated a preference for learning about healthy lifestyle in-person, from people with knowledge and experience in the field, such as researchers, experts, or teachers, while some also mentioned digital tools, such as videos and games. The most popular digital devices for learning were computers and tablets, while smartphones were mentioned by a minority of students.

Trust in interventions and in guidance (adherence): Students reported no prior experience of participating in any structured school-based health promotion programme, besides some field trips organised by the school. Examples of such included an annual visit to a stadium during the Week of Sport, where they engaged in various sport-related activities, such as judo, football, archery, and athletic competitions, as well as an excursion to a kiwi facility, where they were provided with free kiwis and watched a movie about their production and nutritional value.

Greece (HUA), 12-14 years

Healthy lifestyle (general) and motivation: A healthy diet and exercise were recognised by all student groups as fundamental elements of a healthy lifestyle. A balanced diet was defined as one that includes high amounts of fruits and vegetables. Students also identified carbohydrates, proteins and vitamins as important nutrients of a healthy diet. Most student groups highlighted the importance of adequate sleep and rest, two student groups emphasized on mental health and self-care, one group highlighted the importance of adequate water consumption, while another group emphasised the necessity of avoiding harmful substances (i.e., tobacco products), as crucial aspects of a healthy lifestyle. In terms of health-promoting lifestyle activities that they enjoy, students primarily focused on exercise, including various lifestyle/recreational activities and organised team sports. Regarding diet-related activities, student's responses were very limited and mostly focused on home/family culinary activities.

Healthy eating: Consumption of fruits and vegetables varied among students, with individual responses ranging from 0 to 8 servings of fruits and from 2 to 6 servings of vegetables daily. All students responded positively in consuming savoury or sweet snacks, most commonly due to their good taste, cravings for something salty or sweet, feeling hungry, or as a convenient food option, while some students also reported consuming snacks as a way to relax and alleviate stress. Regarding healthy snack preferences, fruits, salads, cereal bars, breadsticks, rice cakes, bread with honey, sesame seed bars with honey, and sunflower seeds were the most common responses, while milk, oat products, protein bars, crackers with cheese, sandwiches, bread with tahini or peanut butter, smoothies, fruit juices, homemade pastries (i.e., cookies), nuts, seeds, and spoon sweets were also reported by some students.

Physical activity and sedentary behaviour: All student groups mentioned enjoying physical activity, with football, volleyball, dancing, kickboxing, and swimming being the most common responses. Less frequent responses included running, walking, yoga, rhythmic gymnastics, airsoft, tennis, and judo. Students reported preferring these activities due to the opportunities they provide for recreation, physical and mental wellbeing, social interaction, formation of new relationships, stress relief, and the creation of new and pleasant experiences. During school hours, the most popular activities were group sports (i.e., volleyball, basketball, football) and walking/running in the school premises, which provide an opportunity to socialise with peers, have fun, and take a break from academic responsibilities. Outside of school, during weekends or free time, the most commonly reported sedentary activities were watching TV or movies, scrolling through social media, using smartphones or talking on the phone, sleeping, playing video games, and studying, while other sedentary activities included singing, drawing, playing music, reading books, listening to music, and discussing with friends. The most frequently mentioned activities involving movement were going out, exercising, and walking or playing with pets, while other activities included household chores, fishing, and attending concerts.

Healthy lifestyle literacy: Most students reported having a good level of knowledge regarding lifestyle-related issues, but they still expressed an interest in further learning, e.g., how to eat according to their age, weight, and height, with a particular focus on the appropriate caloric intake and the recommended amounts of fruits, meat, sugar, carbohydrates, proteins, fat, and vitamins. Other topics of interest included optimal water intake and the recommended frequency of exercise and screen time. Most student groups indicated a desire to learn about healthy lifestyle at school or through visits from experts in the field, while some students preferred meetings outside of school or receiving relevant information from dietitians-nutritionists at their workplace. Regarding the preferred format to receive information, the most common responses were videos or stories, while other formats included discussions, PowerPoint presentations, books, and games. The majority of students stated that they would prefer in-person learning and/or learning through engaging activities, while few mentioned that they would like to receive information digitally, through TV or another large screen.

Trust in interventions and in guidance (adherence): Students reported no participation in school-based health promotion programmes at the current (secondary) educational level, besides some sport-related activities (races) in the previous (elementary) educational level.

Slovenia (UM), 9-11 years

Healthy lifestyle (general) and motivation: When asked what is healthy lifestyle, students most frequently responded with eating healthy and being physically active (moving their body). Regarding active and enjoyable activities that are also healthy, all children noted sports. Most common answers were running and swimming, followed by karate, ballet, and judo.

Healthy eating: Individual student asnwers varied significantly. One stated that they eat 4 fruits and 3 vegetables, carrot and pepper, and an apple. One also stated that their fruit and vegetable intake depends on ‘when’. Others reported they eat a lot of fruit and vegetables. Students reported that they like to eat both sweets (mostly candy and chocolate) and salty snacks. As healthy snacks they noted dry fruit, dry bread snacks and fresh fruit (apples, pears).

Physical activity and sedentary behaviour: All students responded that they like physical activity. To be physically active, they reported that they like (in order of frequency) dancing, swimming, running, basketball, volleyball, athletics, and running with parents. As reasons for why they like these activities they stated that they are moving, exercising, and having fun. In open discussion they mentioned that they like to have fun with their friends while being active, and girls also mentioned that they like to exercise separately from boys (as boys are stronger and more competitive). As reasons that prevent them from being physically active, participants noted lack of time, doing homework and studying. One participant also mentioned that they feel ashamed to go to the playground. With their peers, they mostly like to run and play dodgeball, while other responses included volleyball, free play, and dancing. What they like in these activities is to be active, to move, to have fun and to have fun with their friends. Regarding what activities they do outside of school that involve sitting they reported studying most frequently, followed by waiting for someone (e.g., coaches), reading, watching TV, eating, and doing homework. As activities that include more moving, they mentioned various sports.

Healthy lifestyle literacy: Students would like to learn about healthy lifestyle in books, online, apps, TV, in workshops, or with teachers. In open discussion they mentioned phone, TV, apps, videos, and point collecting (like in Duolingo). When asked whether they would like to learn alone the majority disagreed, and when asked if they would like to learn via interactive activities all of them agreed and added it is more interesting. As preferable devices they mentioned computer, tablet, phone, and TV.

Trust in interventions and in guidance (adherence): Most children reported that they have not participated in a similar workshop, while some mentioned that they might have participated.

Slovenia (UM), 12-14 years

Healthy lifestyle (general) and motivation: When asked what is healthy lifestyle to them, students responded most frequently with sport, eat healthy, live healthy, move enough, regular food and relaxation. As healthy enjoyable activities they noted all activities where you move, where you do not sit, all physical activities, sport or all activities in general.

Healthy eating: Individual answers regarding fruit and vegetable consumption varied; children noted that they eat either little fruit and vegetables, or a lot, 3 times a day, or an apple. Students reported that they like to eat both sweets and salty snacks. As healthy snacks they noted dark chocolate, protein bars, vegetables (cucumber), nuts and fruits.

Physical activity and sedentary behaviour: All children responded that they like physical activity. To be physically active, participants reported that they like (in order of frequency) football, basketball, ping-pong, gym, swimming, golf, cycling, dancing, tennis, volleyball, and running. As reasons for why they like these activities they stated because they have fun, they hit a ball while doing it, they relax, they are not bored, they are not on their phone, they can express their feelings through sport, and they can think while doing it. As reasons that prevent them from being physically active, participants noted school (too much studying), not enough time and health. With their peers, they mostly like to play football, basketball, dancing, skiing, running, swimming, volleyball, golf, cycling, ballet, and tennis. What they like in these activities is that you need a team and that you hang out with our peers. Regarding what activities they do outside of school that involve sitting they noted video-games (i.e., Fortnight, Among us, Call of duty, FIFA, NBA, and Brawl stars), studying, watching TV, reading, playing an instrument (piano), and eating. As activities that include more moving, they mentioned walks (walking a dog or walking to get somewhere), practices, and cycling to get somewhere.

Healthy lifestyle literacy: Children would like to learn about how to eat healthy, how much longer would they live if they eat healthy, how much activity they need per day, where is the threshold to say that you exceed healthy activity, and whether it is healthy to be vegetarian/vegan. In open discussion they were additionally asked what they would like to learn about food, but they had no ideas and reported that they do not think about it much. When asked whether they would like to learn alone the majority responded positively, but positive responses were also given when

asked whether they would like to learn interactively and digitally. As channels for learning they mentioned internet (Google), social media (TikTok, Instagram), school, and their doctor, while as preferable devices they mentioned phone, computer, and tablet.

Trust in interventions and in guidance (adherence): Children mostly reported that they have not participated in a workshop like this one in the past.

Portugal (NUCLIO), 9-11 years

Healthy lifestyle (general) and motivation: A healthy lifestyle was predominantly described as a balance of physical activity, and healthy eating. Habits like hydration and sufficient sleep were mentioned less frequently. Specific mentions included eating fruits and vegetables, exercising regularly, and avoiding excesses, reflecting a holistic understanding of health-related practices. The respondents highlighted a variety of enjoyable, health-promoting activities, with cycling, running, and swimming being the most frequently mentioned. Other activities included football, dancing, and less conventional ones, such as playing the flute or karate, showcasing diverse preferences for physical and recreational engagement.

Healthy eating: Participants reported a diverse daily fruit and vegetable intake. Half consumed 1-2 servings, one third 3 servings, while the intake for the remaining ranged from an unspecified amount to 4 or more servings, with one participant reporting a maximum of 10 servings. While some students did not specify the exact quantity, all indicated regular consumption of fruits and/or vegetables. Vegetables were often consumed in soup and salads, while fruit preferences included apples, oranges and bananas. Some participants incorporated fruits and vegetables into every meal, while others mentioned minimal consumption. Most participants reported consuming snacks or sweets, citing enjoyment and taste as key motivators. Common preferences included crisps, cakes, and fried snacks, though some expressed moderation or avoidance due to health concerns. A few participants preferred savoury options over sweets. Healthy snack preferences varied, with fruit (e.g., bananas, oranges, apples) being the most commonly mentioned (almost half of answers). Other popular choices included wholemeal bread with eggs, salads, and rice-based bread. A minority highlighted culturally specific foods.

Physical activity and sedentary behaviour: The majority of participants reported enjoying physical activity, highlighting sports, such as football, running, and cycling as favourites. Activities such as skating, dancing, and yoga were also mentioned. A small proportion expressed disinterest, citing preferences for sedentary pastimes. Participants valued physical activities mostly due to their health benefits and fun factor, while others cited personal satisfaction and social engagement. Specific motivations included fitness, weight management, and enjoyment, with some aspiring to athleticism. Activities were often described as “cool,” “relaxing,” or “flexible.” The most popular school activity was playing catch, often combined with hide-and-seek or dodgeball. Participants appreciated its simplicity, inclusivity, and the enjoyment of running with classmates. Other preferences included football and general physical education activities in the class. Participants valued physical activities for being fun, social and promoting classmates’ cohesion. Activities like catch and football were enjoyed for fostering teamwork, creating bonds with peers, and supporting healthy habits without conflict or exclusion. Weekend and out-of-school activities included both sedentary pursuits, such as gaming, and active ones, such as cycling, walking, and dancing. Some combined both, balancing relaxation and movement. Pets, chores, and outdoor recreation were also common contributors to physical activity engagement.

Healthy lifestyle literacy: Participants expressed mostly interest in learning about healthy eating and physical activity. Specific topics, such as weight loss, disease prevention, and age-appropriate exercises, were less mentioned. Some declared practical skills, such as cooking healthy recipes or understanding the impact of unhealthy diets. Preferred learning formats included videos, games, and guidance from teachers or family. Interactive methods, such as storytelling or adventure-based games, were also favoured, highlighting a preference for

engaging, accessible, and visually stimulating educational resources. The majority preferred face-to-face learning, particularly through teachers or interactive activities with others. A smaller proportion of participants valued digital options, including games and virtual learning. Participants highlighted the importance of interpersonal interaction and hands-on engagement in their educational preferences. Most participants (70%) rejected digital learning, preferring traditional or interactive approaches. Of those open to digital methods, computers were the preferred device, with few mentioning mobile phones (some students do not have it at this age). The responses indicated a stronger preference for in-person or practical learning experiences.

Trust in interventions and in guidance (adherence): Students reported prior experience with school-based health promotion programs, including classroom activities and physical activity programs, such as cross-country, badminton, and dance, reflecting trust and adherence to these interventions. Fewer than half of the children reported non-participation, but still expressed interest in heathy lifestyle learning.

Portugal (NUCLIO), 12-14 years

Healthy lifestyle (general) and motivation: Participant's responses revealed a comprehensive understanding of healthy lifestyle that combines physical, mental, social, and environmental well-being. They frequently mentioned maintaining a balanced diet and regular exercise, emphasising the importance of physical activity, such as sports and outdoor activities. Mental health, including self-satisfaction, happiness, and emotional support from friends and family, was also mentioned as an important component. Some linked a healthy lifestyle to holistic concepts, like quality of life, good relationships, goals, and economic and environmental factors. A few responses extended the definition to include emotional, intellectual and spiritual well-being. Popular choices for enjoyable activities included team sports, such as football, volleyball, and basketball, alongside individual activities, such as swimming, cycling, running, hiking, and weight training. Some students mentioned outdoor or recreational pursuits, combining physical activity with social interaction, such as chatting or workout with friends.

Healthy eating: Students' responses indicated a significant variation in daily consumption of fruits and vegetables. Many students reported eating between 2 and 6 pieces of fruit, with some consuming vegetables primarily in soups or salads, at lunch or dinner. A few participants reported higher intakes, with up to 8 fruits and 6 vegetables daily, while others admitted eating little or none. Preferences for specific items, such as apples and tomatoes, were mentioned, and some associated their intake with efforts to maintain a balanced diet. Students identified a variety of healthy snacks they enjoy, with fruit being the most frequently mentioned option, including bananas, apples, and fruit salads. Other preferred healthy snacks included yoghurt, granola, nuts, and protein-rich options like eggs, avocado, and oats. Bread-based foods, such as bread with cheese or ham, were also mentioned. Most participants reported consuming snacks or sweets, primarily because they enjoy the taste, find them comforting, or associate them with specific moods, such as stress or anxiety. Some participants acknowledged the health risks of such snacks and emphasised moderation or occasional consumption. Chocolate, jelly beans, and crisps were frequently mentioned, with some participants noting emotional or situational factors influencing their choices, such as anxiety or celebratory contexts.

Physical activity and sedentary behaviour: Most participants expressed a positive attitude toward physical activity, favouring activities, such as volleyball, football, cycling, and walking. They cited health benefits, enjoyment, and stress relief as motivators. Barriers included lack of interest, motivation, or time. Some students reported enjoying exercise for relaxation or social engagement, while a few disliked it but still recognised its necessity. Participants valued physical activity for its positive impact on physical and mental health, social connections, and enjoyment. They described feeling healthier, happier, and more energised. Team sports fostered collaboration, camaraderie, and fun, while individual activities allowed self-reflection and personal challenge, creating a sense of achievement and emotional well-being. At school, team sports, especially volleyball, basketball, and football, were the most popular activities. Other preferred activities included walking and informal games like dodgeball. These activities

encouraged teamwork, social interaction, and friendly competition, providing a mix of enjoyment and physical fitness while fostering stronger peer relationships. Participants enjoyed school activities for their social and emotional benefits, including teamwork, fun, and opportunities to connect with peers. They valued the competitive and collaborative aspects of sports and appreciated the chance to create memorable experiences, maintain physical health, and share enjoyment with friends during group activities. Outside of school, participants engaged in a mix of sedentary and active pursuits. Sedentary activities included gaming, watching TV, and studying, while active pursuits included walking, cycling, team sports, and dance.

Healthy lifestyle literacy: Participants expressed interest in learning more about nutrition, healthy eating, and recipes, particularly for healthier alternatives to sweets and high-calorie foods. Some were interested about mental well-being, exercise benefits, and sustainable living. A minority believed they already knew enough. The preferred format for learning about healthy lifestyle included interactive formats, such as games, videos, and stories. School-based activities, internet resources, and documentaries were also cited, reflecting a desire for engaging and accessible educational approaches. Face-to-face learning was favoured by many, highlighting the value of direct interaction and in-person discussions. Others preferred digital interactive activities or a combination of both methods, emphasising flexibility in learning formats to suit diverse preferences. Mobile phones were the most preferred devices for accessing digital learning materials, followed by computers and tablets.

Trust in interventions and in guidance (adherence): All participants reported actively engaging in school-based healthy lifestyle initiatives, such as the biking club and other activities of the school curriculum, and expressed confidence in their effectiveness to address healthy lifestyle.

Netherlands (ESHA), 9-11 years

Healthy lifestyle (general) and motivation: Overall, students associated the concept of a healthy lifestyle with something that is outside of the school, mostly related to activities that they do together with friends and family. Elements of a healthy lifestyle mentioned were healthy nutrition, physical activity, enough sleep and lack of illness. Being together was also emphasised as an important element of a healthy lifestyle. However, it was clear that students would like to see more of this at school, and that they could easily imagine a school that is focusing more on healthy habits, healthy eating and physical activity. Togetherness is an element that featured in their general description of a healthy lifestyle, clearly showing that physical and mental well-being are very closely linked – even if unconsciously – in their mind. Students were quite confident that they are living in a healthy way or they would live in a healthy way if the circumstances – especially school arrangements – allowed it.

Healthy eating: Students expressed wanting to follow a balanced diet, i.e., enjoying “guilty pleasures” in moderation. In the Dutch context, school meals are not provided, but students would like to have more opportunities for having meals together. They would like to eat together with their teachers and peers, and have opportunities for trying food other students eat with special interest in the cuisine of countries migrant students come from. Due to their diverse cultural backgrounds, students’ experiences related to healthy eating differ. For example, some students of Far Eastern origin find the bread-based Dutch diet difficult to digest and are used to having warm food at every meal. For some students coming from Eastern European countries, the quality of meat has priority, diets based on white meat are considered healthy, and lunch is considered the main meal of the day. For some students coming from the Western Mediterranean region, Dutch meal times do not fit their view of healthy eating habits.

Physical activity and sedentary behaviour: Students would like to have more opportunities for outdoor activities at school, and being aware of Dutch climate they would like to see covered outdoors places in the school. Most students enjoy school opportunities for physical activity, especially school playgrounds and swimming lessons (that are an important part of Dutch schooling). They think that currently school is making them sit too much, and in general the settings at school are not supporting the goal of being healthy/healthier. Many activities that

are either sedentary or active, involve family members. Physically active programmes include excursions, dog walking, going to the woods, while sedentary activities include either collaborative activities, such as family meals and playing board games, or solitary sedentary activities, such as homework, reading or playing video games.

Healthy lifestyle literacy: Students were not aware of health literacy activities at school. They would like to see their teachers as role models, and they would like to do fun activities together with their peers and teachers. They think that they are learning by imitating their family as role models in the field of health literacy. They would also like to see a good collaboration between their family and teachers with the family leading health literacy in line with their own culture and customs. They expressed a clear preference for learning in person rather than digitally.

Trust in interventions and in guidance (adherence): Students reported no experience with health literacy programmes, and thus were not asked if they trusted such interventions. Following role models, primarily parents and family, was reported as a desired way of learning.

Netherlands (ESHA), 12-14 years

Healthy lifestyle (general) and motivation: Overall, students associated healthy lifestyles with something that is outside of the school, mostly related to activities that they do together with friends and family. Teachers do not play a major role in this field, which is an age-appropriate finding. However, students are concerned about family members, and some would like to see change of habits in their parents. Elements of a healthy lifestyle are enough sleep, proper food, doing sports, having a balanced timetable and fewer lessons, and regular health-checks. Being together and spending quality time together with friends and family were also mentioned as important elements. Students would like to have more time during the school day to be outdoors, do sports, and also to eat together with peers.

Healthy eating: Students like to eat healthy and pay attention to it. Some also enjoy preparing meals. Coming from diverse cultural backgrounds, their experiences regarding healthy eating differ. For example, some students of Far Eastern origin mentioned similar things to their younger counterparts and also think healthy eating means a greater variety in vegetables and cooking methods. A student of Eastern European origin mentioned that vegetarian or vegan diets are not suitable for children, and that the nutritional value of meals should decrease from breakfast to dinner, contrary to what it is in the Netherlands. Two students of Western Mediterranean origin emphasised the importance of food diversity within meals in the form of multiple courses, as well as the importance of hot lunch. Students would like to have proper school meals, but not the typical Dutch cheese sandwich. More than half of the students have attended school in other countries before coming to their current school, and they have mixed memories of school meals. They would like to have a choice, not a single set menu.

Physical activity and sedentary behaviour: All students reported doing sports regularly, most of them also in a competitive way, outside of school. They also enjoy sport opportunities at school. In their free time, they go to summer camps, excursions, museums, but they also enjoy other activities, mostly with friends and family. Their sedentary activities are partly related to school work – in school and also outside – that they consider too much. In their free time, they do things together, like family meals, playing board games or watching sport together. Students also spend time online, some of it for watching videos or playing games, but some of them also do active things like content creation.

Healthy lifestyle literacy: Students think that school needs to change to provide the necessary framework for health literacy development. They are not interested to only learn about healthy habits, but they want to see them possible at school. Some of them are concerned about having less time for activities they like and also think healthy due to demanding school workload. However, they also want to learn more about the science behind healthy habits and the way food helps or endangers health. They recall some theoretical knowledge shared in science lessons, but not in an engaging way. They are very familiar with a science museum in Leiden where you can explore how the body works and would like to learn there or in similar

settings, not only at the school. Some of them regularly gather information on the internet. Some follow influencers, some enjoy watching cooking videos. Some have participated in activity challenges and like collecting badges for achievements in them.

Trust in interventions and in guidance (adherence): Students' trust in interventions depends on the source and the content. They still mostly rely on family and their role modelling, but some already have other trusted sources, such as friends and influencers. Trusted sources include digital ones, but for learning there is a clear preference for in-person learning in a participatory way (learning by doing). There is a high level of interest in the science behind, and scientific explanation is attractive and trusted.

Denmark (DCHE), 9-11 years

Healthy lifestyle (general) and motivation: Students identified a healthy lifestyle as eating plenty fruits and vegetables and in particularly fruits were highlighted. They also mentioned different kinds of activities like swimming, golfing, going for walks and cycling. Reading and learning in general were also considered as being part of a healthy lifestyle. In regards to healthy activities they liked, boys mainly answered football (soccer), while girls were into dancing, gymnastics and playing in the schoolyard on the trampoline. Other activities included walks, swimming, golf, handball and cycling.

Healthy eating: Most students reported that they eat a lot of fruit during a day, part of which is consumed at school but brought from home in their lunch pack. Common vegetables brought to school in lunch pack were cucumber, tomatoes and bell peppers. Regarding sweet and savoury snacks, only one student reported getting these during weekdays, while all other students reported having them on Fridays or weekends by their parents. The most common snacks mentioned were crisps, candy and chocolate. Regarding snacks that they like, students answered with a big variety of fruits and vegetables, as well as oatmeal and ryebread. In general, nearly all student answers were healthy choices (some kind of fruit or vegetable), while one student mentioned homemade müslibar and another smoothies as snacks they liked.

Physical activity and sedentary behaviour: All students reported being physically active and doing some sort of sports during the week. In general, dancing, football, swimming, gymnastics, trampoline and cycling were popular activities among most students, while a few also mentioned horseback riding and scouting as enjoyable. In school, students often reported they like to play hide and seek, running around playing "stikbold" (a Danish game in which you throw with a ball, and if it hits you, you are out) and being on the school playground. These activities are perceived as fun and help them relax. Outside of school, the most commonly reported sedentary activities involved some sort of technology, such as TV, tablet, VR or mobile phones. A few students (mostly girls) also mentioned doing pearls, writing a diary, drawing or being creative with their hands.

Healthy lifestyle literacy: Students' responses highlighted a diverse range of preferences for learning about healthy eating and physical activity, with a blend of traditional and digital approaches. Many students stated that they prefer learning at school or home or a combination of those. The majority of students answered that their preferred way of learning was using a computer (e.g., computer games). Others mentioned VR as a means of learning and at scouts or gymnastics. As to what students would like to learn about, the answers were quite broad with a main interest in learning how to live and eat healthy in general. One student also mentioned they would like to know how to do sports better.

Trust in interventions and in guidance (adherence): N/A.

Denmark (DCHE), 12-14 years

Healthy lifestyle (general) and motivation: Students identified a healthy lifestyle as eating plenty fruits and vegetables, getting enough sleep and doing some sort of physical activity. In regards to healthy activities they like, responses included sleeping, fitness, cycling, football, tennis, basketball, and eating well.

Healthy eating: Most students reported eating more fruits than vegetables and approximately 1-2 pieces a day. Regarding sweet and savoury snacks, students reported getting them both on weekends and weekdays themselves, as most of them are alone when they get home from school. Only one student reported snacks were given to them on weekends by their parents. Regarding healthy snacks they like, students answered with a big variety of fruits and vegetables, as well as sandwiches with ryebread, rice cakes and ryebread crisps. Protein bars, water as well as sweet and savoury snacks, like chocolate, popcorn and chocolate covered marshmallows, were also mentioned by some students.

Physical activity and sedentary behaviour: All students reported being physically active and doing some sort of sports during the week. In general, fitness football, horseback riding (girls only) and basketball were the most popular activities. A few students also mentioned walking their dogs, while one student mentioned building an annex in their garden as a fun mean of physical activity. In school, all students mentioned baseball and table tennis as favourite physical activities. Outside of school, technological activities dominated, with watching TV/Netflix, playing games on computer and VR, and being on their phone playing games or chatting, being the most commonly reported activities. The aforementioned sedentary activities were reported as being fun, social and "never boring".

Healthy lifestyle literacy: Students reported wanting to learn about how sleeping affects the body, how to eat properly, how to be active and fit in addition to what healthy/unhealthy is. The majority of students reported they would like to learn in school through activities and in-person learning, whilst a few mentioned computer and online videos. In general, students were prone to exclaim "not online" when mentioning this format as a type of learning. A few students mentioned that they would like to learn about healthy lifestyle topics at home with their parents.

Trust in interventions and in guidance (adherence): N/A.

Data synthesis by country and age group

Country

Healthy lifestyle (general) and motivation: Across all 5 pilot sites, students consistently recognised a healthy lifestyle as a clustering of balanced nutrition, increased physical activity, adequate sleep, and mental well-being. They emphasised on a healthy diet with a strong focus on fruits and vegetables, while in some countries, like Greece, they also exhibited a more detailed understanding of essential nutrients like carbohydrates, proteins, and vitamins. The importance of hydration and avoiding excesses was also mentioned in most countries, while family involvement and socialisation in diet-related activities, such as cooking with family and eating together, were valued more in some countries, such as Greece and the Netherlands, compared to others, like Denmark and Slovenia, where the focus was on general healthy eating habits. Physical activity was also recognised as part of a healthy lifestyle across all countries, with football and swimming being common favourites, while some cultural differences were observed as indicated by students' preferences for specific activities (e.g. ballet in Slovenia and gymnastics in Denmark). Students in Portugal and the Netherlands also emphasised on social and environmental well-being as integral aspects of a healthy lifestyle.

Healthy eating: In all 5 countries students reported varying levels of daily fruit and vegetable consumption, ranging from inadequate to optimal compared to dietary guidelines. Common preferences across the countries included fruits like apples, oranges, and bananas, and vegetables like cucumbers and bell peppers. Snacking habits were similar across the 5 countries, with students enjoying healthy options, such as fruits, yogurt, whole grains and nuts, but also consuming both sweet and savoury processed snacks like crisps, chocolate, and candy. Sweet and savoury snacks were generally viewed as indulgences, with students citing taste, convenience, and emotional factors as primary reasons for their consumption. Despite similarities, country-specific patterns in food choices also emerged. Specifically, students in the Netherlands exhibited diverse cultural influences and expressed a desire for shared meals and an interest in migrant cuisines. Students in Greece and Portugal featured a wider range

of traditional and culturally specific healthy snacks, students in Slovenia leaned towards simpler snack options (mainly fruits and vegetables), while students in Portugal and Slovenia acknowledged the health risks of unhealthy snacks and emphasised on moderation.

Physical activity and sedentary behaviour: In all 5 pilot sites, students reported enjoying physical activity. Common popular choices included football, swimming, basketball, cycling, and dancing, which were valued for their health benefits, fun component, and social interaction character. In-school activities included various games and sports, while outside school, in their free time, students reported engaging in both sedentary activities, like playing video games or watching TV, and active pursuits like cycling, swimming, and dancing. The main differences observed between countries lied in specific preferences and cultural contexts; in Denmark, students reported engaging in activities like horseback riding and VR games, in the Netherlands, they focused on competitive sports and group activities with family, in Greece and Portugal they highlighted the enjoyment of a wide range of sports, with those in Portugal noting a particular interest in cycling and team sports, while in Slovenia they reported enjoying dancing and running, with some gender-specific preferences, as girls preferred different exercises from boys. Despite enjoying physical activity, students in all countries reported that academic commitments and time constraints limited their engagement in sports.

Healthy lifestyle literacy: Students in all 5 pilot sites shared a similar interest in learning about healthy lifestyle. In Denmark, they focused on sleep, proper eating, staying active, and identifying healthy habits, in Greece, they were mostly interested in improving dietary and exercise habits and understanding personalised health needs based on age, while in the Netherlands, they emphasised on role models and interactive activities to learn about nutrition and health. In Portugal, they were mostly interested in practical skills like cooking healthy meals, mental well-being, and sustainable living, while in Slovenia, they were curious about the long-term benefits of healthy eating and physical activity. Regarding the learning format, face-to-face learning was the preferred mode in most countries, as students expressed a clear interest in learning through engaging activities with teachers, experts or peers, with a strong emphasis on practical hands-on experiences. In the Netherlands, students also emphasised learning from role models like their teachers and families and wished for a more active collaboration between school and home to foster health literacy. However, students also expressed an interest in digital learning, with emphasis on the use of interactive formats, such as applications and games, particularly in Slovenia, Denmark and Greece. Overall, despite some country-specific learning topics and tools, students in all countries had a shared interest in learning about healthy lifestyle, favouring formats that allow for social interaction and direct guidance but still remaining open to more innovative and interactive digital approaches.

Trust in interventions and in guidance (adherence): Students' experiences with school-based health promotion programs varied across the 5 countries. In Greece and Slovenia, most students had limited or no exposure to structured health programs, with only occasional participation in individual health-related activities like sports events or field trips. In contrast, students in Portugal, especially older ones, reported a higher engagement and an active participation in school-based health initiatives, such as biking clubs and physical activities like cross-country and dance. Students in the Netherlands reported a mixed experience, with younger students relying on family role models for health guidance, and older students showing some trust in health literacy interventions, particularly those based on scientific explanations and in-person learning. Despite having different experiences, students from all countries expressed a common interest in learning about the principles of a healthy lifestyle, particularly through practical and engaging activities that align with their interests.

Age group

Healthy lifestyle (general) and motivation: Students of both age groups shared a similar understanding of healthy lifestyle, emphasising a balance between healthy eating, increased physical activity, adequate sleep, and social well-being. Both age groups recognised the importance of fruits and vegetables in their diet, as well as the beneficial role of various physical

activities, such as swimming, cycling, football, and dancing. However, older students had a more detailed understanding of healthy nutrition, also emphasising on the importance of optimal nutrient intake, such as carbohydrates, proteins, and vitamins, and also placed emphasis on other concepts, such as mental health, self-care, and emotional well-being, as integral parts of a healthy lifestyle. The younger age group mainly associated health with physical activities and family-based experiences, such as cooking with parents, while the older age group also linked health to broader concepts, such as quality of life and emotional support. Both age groups expressed a preference for engaging in health-promoting activities outside of school with family and friends, though the older age group indicated a desire for more school-based opportunities for outdoor activities, sports and health promotion in general.

Healthy eating: Students aged 9-11 years and 12-14 years both reported enjoying consuming fruits and vegetables, but the actual reported daily consumption varied significantly, with younger students typically consuming less than older ones. Both age groups preferred fruits, such as apples, oranges, and bananas, and vegetables, such as cucumbers and tomatoes, and reported consuming some of them at school as part of their home-prepared lunch packs. Regarding snack consumption, both age groups appreciated healthy snacks, such as fruits and yogurt. Younger students generally tended to prefer healthier snacks, while older students were more likely to indulge in processed salty and sweet snacks, such as crisps, chocolate, and protein bars, with most choosing these for taste and convenience. Older students tended to snack more frequently, sometimes for stress relief, while younger students snacked mostly on weekends. Cultural influences impacted both age groups, with students from diverse backgrounds expressing different meal preferences. Overall, both age groups aimed for moderation and a balance between making healthy food choices and enjoying treats.

Physical activity and sedentary behaviour: Both 9-11-year-olds and 12-14-year-olds reported enjoying physical activity, with common favourites including football, basketball, volleyball, swimming, and cycling, often motivated by fun, fitness, and social interaction. The younger age group also enjoyed less competitive activities like running, playing games (e.g. hide and seek) and trampoline, while the older age group tended to engage in more structured or competitive sports, such as volleyball, cycling, and tennis. At school, both age groups favoured group sports and reported enjoying the opportunity for socialising with peers, while outside of school, sedentary activities, such as video games and reading, were also common. Barriers to physical activity for both groups included lack of time, homework, and health issues, but the older age group specifically mentioned the academic load as a significant obstacle. However, they recognised the positive impact of exercise on their physical and mental well-being, with older students particularly valuing the impact of exercise on stress relief and personal challenges from individual activities. Sedentary activities like gaming, watching TV, and social media use were common for both age groups, with older students also expressing interest in content creation as an active online pursuit. Both age groups would like more outdoor and sports opportunities at school, but the older age group also desired a balance of active and sedentary activities outside of school, such as gaming with friends and family activities.

Healthy lifestyle literacy: Both age groups showed interest in learning about nutrition, exercise, and generally maintaining a balanced lifestyle, with older students additionally seeking information on sleep, mental well-being, and sustainable living. Both age groups emphasised the importance of role models, particularly family and teachers, and expressed a desire for more school-based lifestyle activities and expert-led learning. Students of both age groups expressed a preference for in-person interactive learning, favouring practical activities, such as cooking or exploring sports. Younger students leaned towards face-to-face learning with family, teachers or experts, and were less interested in digital formats, except for an occasional use of tools like games and videos. Older students, on the other hand, were more open to digital learning through videos and online resources, but still preferred in-person experiences.

Trust in interventions and in guidance (adherence): Both 9-11-year-olds and 12-14-year-olds reported having some involvement in individual lifestyle-related school activities, such as

sports-related events, but limited experience with structured comprehensive health literacy programs. Both age groups reported trusting family and role models for health guidance, though older students also mentioned turning to friends and influencers. While younger students reported preferring to learn mostly from family, older students showed a preference for in-person participatory learning that includes hands-on activities, with a particular interest in the scientific aspects of health. In light of limited exposure to formal health education, both age groups expressed a desire for more structured health learning opportunities.

Total synopsis of findings and implications

Healthy lifestyle (general) and motivation: Students understand the concept of healthy lifestyle as a combination of healthy eating, regular physical activity, sufficient sleep, and mental well-being. They mostly emphasise on activities that involve movement, both organised (team sports) and lifestyle (recreational exercise), as enjoying activities that can contribute to health promotion. Though they desire more opportunities for healthy activities at school, they also emphasise that a healthy lifestyle extends to other social environments, most importantly the home setting. Based on the above, the school pilot intervention study should focus on promoting healthy lifestyle literacy through educational activities that emphasise the principles of a healthy diet, regular physical activity, reduced sedentariness and sufficient sleep, while highlighting that a healthy lifestyle is crucial for optimal development, physical health and mental well-being. The intervention should aim at promoting a heathy lifestyle not only within the school environment but also at home, by encouraging and reinforcing family involvement.

Healthy eating: Students exhibit varying levels of daily fruit and vegetable consumption and a preference for both healthy and processed snacks, seeking a balance between healthy food choices and comfort food. Common processed snack choices include crisps and chocolates, which are mostly consumed as palatable convenient foods that can contribute to stress relief. Cultural differences in food preferences and eating habits exist, with students from diverse backgrounds preferring different foods or meal structures but also showing interest in other food cultures. Students also value the social character of diet and seek more opportunities for shared meals. Based on the above, the school pilot intervention study should focus on promoting a healthy diet, educating students about the nutritional value and optimal consumption of basic food groups, the concept of balanced meals, and healthy snack choices. The dietary component of the intervention should emphasise on the importance of moderation, mindful eating practices and family/social meals, and promote cultural food awareness by encouraging students to explore traditional healthy meal recipes and diverse cuisines.

Physical activity and sedentary behaviour: Students generally value and enjoy activities that involve movement, with emphasis on various sports (e.g. football, basketball, volleyball), active games (such as dodgeball) and other lifestyle activities, such as swimming and dancing. However, they also face barriers for physical activity, most importantly high homework load and time constraints, and they also frequently engage in sedentary activities at home, such as playing video games and watching TV. Activities that involve movement are generally perceived as fun and beneficial for fitness, while sedentary activities are often associated with relaxation and stress relief during free time. Most students value team sports for social interaction, while some prefer solo activities and those that can be performed outdoors. Based on the above, the school pilot intervention study should aim at promoting a healthy balance between active and sedentary time throughout the day. Focus should be paced on any kind of physical activity, both within and outside the school setting, emphasising on social activities that encourage teamwork and social interaction with peers and family. Education on the health benefits of exercise and promoting a variety of activities tailored to different preferences, cultural backgrounds and age groups should be key components of an intervention aiming at promoting physical activity. Strategies to reduce recreational sedentary time and address common barriers for adopting a physically active lifestyle should also be utilised.

Healthy lifestyle literacy: Students are interested in topics like healthy eating, physical activity, sleep, and their link to physical and mental health, and value learning from experts, teachers, and family. They show a preference in learning through traditional in-person methods, but also welcome technology-based tools with interactive features. Based on the above, the school pilot intervention study should aim to promote healthy lifestyle literacy, including nutrition-, exercise- and sleep-related topics, through expert-led sessions and a family-centric approach that facilitates the involvement of parents/caregivers. Focus should be placed on fostering an interactive and engaging learning environment. Healthy lifestyle literacy should be promoted via in-person learning (e.g. in the form of workshops or discussions with experts), while also integrating digital formats as supplementary tools. By combining in-person and digital learning methods, the study would cater to diverse learning preferences, encouraging students to adopt healthier habits and enhance their health literacy in both school and home setting.

Trust in interventions and in guidance (adherence): Most students have limited or no experience with comprehensive healthy lifestyle programs/interventions. However, they have some experience with individual school-based healthy activities which they appreciate and value, and they show a strong interest in learning about healthy lifestyle, relying on family role models and expressing trust in experts. Based on the above, a school pilot intervention study focusing on healthy lifestyle literacy and taking into account student's needs and preferences seems needed. Such a study would probably have a high chance of acceptance by the target population (schoolchildren), which can contribute to a feasible implementation in real-world educational settings and a success in promoting heathy lifestyle habits in youth populations.

2.2.4 Conclusions

A series of school co-creation workshops were conducted as part of the BIO-STREAMS living lab methodology, to gain insight into the perspectives, preferences, and needs of schoolchildren in relation to the adoption of a healthy lifestyle, and to actively involve them as co-creators in the process of developing the project's school pilot intervention. The findings of the workshops revealed that promoting a healthy lifestyle among schoolchildren requires a holistic approach that focuses on nutrition, physical activity and sleep as major pillars, highlights the importance of heathy lifestyle habits for optimal development and physical/mental/emotional well-being, targets both the school and the home/family environment, utilises in-person, interactive and engaging educational activities led by experts as the main learning format but also exploits innovative digital methods as complementary intervention tools to promote healthy lifestyle literacy, and takes into account cultural differences in lifestyle choices and potential barriers for adhering to a healthy lifestyle. This input, combined with that produced through co-creation activities among representatives of other important stakeholder groups, will be used to inform the project's school pilot intervention study protocol, as described in detail in Section 4.2 of the deliverable, in an effort to ensure an optimal deployment and real-world applicability across educational settings in Europe.

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3. SECTION 3 OTHER CO-CREATION ACTIVITIES

3.1 Clinical setting

3.1.1 Background/aim

As in the project, the aim of co-creation workshops was to include a wide array of stakeholders into development of study methodology as well as digital interventions. In WP2 parents of children with OV/OB and healthcare professionals were identified as crucial stakeholders in the context of BIO-STREAMS, which is why their inclusion in the project's co-creation activities is necessary. Clinical sites have conducted workshops with parents of children aged 5-18 and healthcare professionals, who work with children aged 5-18.

3.1.2 Methodology

Workshops with parents and healthcare professionals have been conducted in the same time period as workshops with children - from November 2024 to March 2025. 6 clinical pilot sites conducted workshops with parents, i.e. Slovenia (UKCM), Greece (NKUA, PENTELI), Belgium (CHUL), Sweden (KI), and Bulgaria (BLOCKS) and one with healthcare professionals (NKUA).

Ethical approval for these workshops was either obtained within the same approval as for the workshops with children or the approval was not needed.

Setting and participants

Workshops with parents have been carried out in clinical setting and participants were chosen by convenience. Mostly, participants were parents of children with OV/OB that were treated or examined in the pilot site's facilities or parents of children without OV/OB that were treated or examined in the pilot site from some other reason not related to OV/OB. In total, 47 parents have participated in all workshops across cultural context (25 in Greece, 6 in Bulgaria, 6 in Slovenia, 6 in Belgium, and 4 in Sweden). 13 healthcare professionals (including pediatricians, nurse, biostatistician, dietitians, etc.) participated in workshops in Greece.

Workshop content and delivery

Parents

The workshop with parents consisted of two parts. First, participants were presented with open-ended questions to which they have responded on paper (see procedure below). Second, participants were presented with the digital interventions, developed within BIO-STREAMS (ActiveHealth app for delivering recommendations and tracking healthy habits and Serious games). Workshops were carried out by at least two facilitators, where at least one facilitator took detailed notes of participants' answers and one interacted with them. In case of smaller group, one facilitator was able to effectively lead the workshop.

In the first part of the workshop, the procedure was the following. Parents were split into 3 groups and each group received a set of questions on paper from each section (see sections below). Groups had 10-15 minutes to answer the questions using post-it notes. They were instructed to write only one idea/thought on one post-it. Then, groups switched the questions and participants added ideas that were not yet provided to the new set of questions. This was repeated two times. Then, groups were asked to categorize the post-it notes that address similar topics under the same question. Lastly, each participant has been given 4 sticker dots which they were instructed to distribute to the category on any paper they find the most relevant. Questions and pre-defined categories were as the following:

<u>Awareness and engagement</u>

- Which goals do you have for your child regarding health and wellness?

- How do you help your child to achieve healthy eating habits and increased physical activity?
- How do you currently stay informed about your child's health and wellness, particularly regarding obesity or weight-related issues?

Digital platform and communication

- What resources or tools (if any) have you used in the past to address your child's health regarding eating habits and physical activity?
- How would you prefer to access a digital platform for managing your child's health or eating habits (mobile app, web-based, both)?
- What type of features would you find most helpful in a digital platform for childhood obesity prevention or treatment (personalized goals and tracking, educational resources, meal planning tools, behaviour modification tips, social support)?

Tools and features

- How comfortable are you with using technology to monitor and track your child's health-related behaviours?
- How would you like to track your child's health including lifestyle habits (daily logs, weekly or monthly summaries, automated data collection)? Are there specific metrics you want to track, such as weight, physical activity, or dietary habits?
- What behaviour modification tips would you find helpful (tips for increasing physical activity, reducing screen time, making healthier food choices)?

In the second part of the workshop parents tested the BIO-STREAMS ActiveHealth app and Serious games. Results of this activity will be analyzed by the consortium technical partners and reported elsewhere.

Healthcare professionals

First, we measured healthcare professionals' attitude towards technology as most of the workshop aimed to receive healthcare professionals' opinions on the digital interventions, developed in BIO-STREAMS. Such opinions could be greatly influenced by participants' general attitude towards technology, which is why we decided to control for it. The questionnaire we used is presented in Table 3.1. Questions were adapted from the UTAUT2 and the SUS (System Usability Scale) questionnaires for measuring acceptance and usability of technology, respectively [1,2]. First three items measure general perception of technology acceptance and the next three items measure general perception of technology usability.

Table 3.1 General attitude towards technology questionnaire used in the workshop.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Most technologies are reliable.	1	2	3	4	5
I trust most technologies.	1	2	3	4	5
I use technology in my daily life.	1	2	3	4	5
I find most technologies unnecessarily complex.	1	2	3	4	5
I find most technologies easy to use.	1	2	3	4	5
I feel confident using most technologies.	1	2	3	4	5

Note. * - the item needs to be inversely coded, before being computed into total score.

Second, the ActiveHealth app and Serious games were presented to healthcare professionals, while facilitators collected spontaneous feedback on the digital tools.

Third, since the Dashboard is a central digital component of BIO-STREAMS, which healthcare professionals will mostly interact with, we aimed to gather their feedback on it. Participants were presented with three short videos (see screenshots in Appendix 3.1), presenting BIO-STREAMS Information Management System (IMS), environment for accessing retrospective data, and a page designed to import participants for prospective study. Then, we asked them to respond to two questions:

- What specific features of the Dashboard do you find most beneficial, and why?
- Is there anything else you would like to see improved or added to the Dashboard to better support patients' follow-up/progress?

Fourth, participants were asked about the prospective study itself. On a PowerPoint presentation, they were presented with the study background, research questions, study outcomes (number of new biological pathways conferring efficacy of preventive behaviour, acceptability and usability of the mobile application and interventions measured, sensitivity and specificity of defining the subsets of patients at risk for metabolic dysfunction, reduction in body weight, improvement of health/food literacy, improvement in quality of life, improvement in well-being, increase in self-regulation, decreased mental distress, including anxiety, depression, and self-perceived stigma, medical costs related to OV/OB management), a list of self-reported questionnaires for measuring outcomes, study design process in graphical format, and inclusion criteria for participant selection for the study. Healthcare professionals were asked to provide their feedback/thoughts on each of the presented components.

Fifth, participants have also been presented with Child, Parent, Doctor, and Dietitian Persona, developed in WP2 and asked to provide feedback and suggestions for modifications.

Finally, healthcare professionals were encouraged to provide further open feedback on open-ended questions developed in WP2 (adapted from questions developed for Doctor and Dietitian Persona). The questions and pre-defined topics were as follows:

<u>Educational resources</u>

- What are the specific topics in evidence-based diagnostic/prevention/management approaches for management of childhood obesity that you would like to learn more about?

<u>Literature access</u>

- What are the specific types of *sources* on childhood obesity that you would like to have access to?
- What types of guidelines or research updates would you like to receive notifications about?

<u>Tools</u>

- What types of data do you think are relevant to collect from parents about their child's food intake and activity levels?
- What specific health metrics or parameters would you like to monitor in real-time for children undergoing weight management interventions?
- What are the most important features that you would want in a digital platform for treating children with overweight/obesity?
- What type of personalized health assessments would be most useful for your patients?
- How would you like to display this data to parents in a clear and understandable way?
- What personalized feedback or suggestions would you like to be able to provide to parents based on the data collected?
- What specific tasks or support do you expect from an AI-based assistant in the context of childhood obesity management?
- Are there particular functionalities or features you would like the AI assistant to have in helping you access literature and providing assistance in your work?

<u>Collaboration on the platform</u>

- How do you envision engaging with other healthcare professionals who specialize in childhood obesity management/prevention or other professionals in a collaborative space?

Stigma reduction

- In terms of communication with parents and children, what practices do you believe would be most effective in reducing stigma associated with childhood obesity?

Data collection and synthesis

No audio or visual recordings of the workshops were taken, and no personal data, other than participants' answers to the questions, were collected. Workshop facilitators ensured that no data was collected relating, directly or indirectly, to individual study participants, such as names, locations, or data specific to the physical, physiological, genetic, mental, economic, cultural or social identity of participants, and responses from participants that, in combination with other available data, could single out a participant were not processed.

In all contexts, data was qualitatively synthesis based on the pre-defined categories implied in the workshop questions. Additionally, in Slovenian and Bulgarian contexts, results are reported following the themes within each category that have emerged in the workshops themselves (being identified by participants). In Belgium, there was only one participant, so results are reported only in the total synopsis.

3.1.3 Results

In this section, the detailed results of the co-creation workshops with parents and healthcare professionals in the clinical context are presented. As the workshops with parents included considerably more participants (N=47) and were conducted in four different countries, as compared to the sole workshop with healthcare professionals (N=13) conducted in one country, emphasis in data synthesis is mainly on workshops with parents, while the resuts of the workshop with healthcare professionals are mentioned in Data synthesis per country section.

Data synthesis per country

Greece, workshops with parents

Awareness and engagement

Parents expressed a strong commitment to encouraging healthy dietary habits and physical activity in their children, often viewing these behaviours as important for long-term well-being and disease prevention. As goals they have for their children, they mention happiness, confidence (about physical appearance, self-esteem, and health), and losing weight. A common theme is to instill lifelong autonomy in making health-conscious choices. To achieve these goals, parents employ different strategies. Many report modeling healthy behaviours themselves. Another common approach is involving children in meal preparation, which helps familiarize them with healthy food options. Some parents actively educate their children about nutrition, using books, discussions, or online resources to enhance their understanding. Some receive information on healthy lifestyle from child’s pediatrician or dietitian. Encouraging physical activity is also a focus, frequently mentioning sports (football, swimming, or dance) and other activities (cycling, walking, or playing outdoors). However, barriers exist, particularly for divorced parents who report inconsistencies between households that make it difficult to maintain stable eating and exercise patterns.

Digital platform and communication

The most frequently cited sources of health and nutrition information are healthcare professionals, particularly pediatricians and nutritionists. Many parents reported regular follow-ups with specialists. Beyond professional consultations, parents frequently seek digital resources, including research articles, educational videos, and health-related social media

content. Some actively engage with scientific literature, while others prefer practical digital interventions such as health-tracking applications. However, some parents expressed skepticism toward internet-based information, preferring to rely on medical expertise over online advice. Among digital tools, mobile applications are favored over web-based platforms, primarily due to their ease of integration into daily routines. Some parents prefer both forms of digital interventions. Parents indicate that an ideal app should offer personalized goal setting, meal planning tools, behaviour modification strategies, and educational resources. Additionally, parents emphasized the role of sports and dietary interventions in promoting healthy behaviours. Some describe implementing specific dietary plans, such as a gluten- and casein-free diet.

Tools and features

Most parents felt comfortable tracking child's health-related behaviours and think this process can benefit their children, under certain conditions (security measures in place, etc.). They expressed different preferences regarding health-tracking frequency. While some prefer real-time daily tracking via mobile applications, others favor weekly summaries that provide an overview of dietary and exercise patterns. The most preferred tracking metrics include weight and BMI, physical activity levels, dietary habits, blood glucose levels (for children at risk of diabetes), and sleep patterns. Regarding behaviour modification tips, three categories emerge. First, many parents seek structured guidance to help children develop consistent healthy eating habits, particularly concerning portion control and balanced meal composition. Second, guidelines for reducing screentime due to the excessive digital device use would prove useful for some parents. Third, while some children are engaged in sports, parents highlight the challenge of encouraging other physical activities. Some parents also recognize stress and time management as significant factors affecting eating and exercise behaviours.

As regards voting for most relevant themes, most votes were assigned to the behaviour modification theme (tips for increasing physical activity, reducing screen time, making healthier food choice. The second most votes received the topic of tracking child's health (daily logs, weekly or monthly summaries, automated data collection). The third favorite topic was related to features of digital platform for childhood obesity prevention or treatment.

Greece, workshops with healthcare professionals

Attitude towards technology

Regarding the perceived general acceptance of technology, the average score on items ranged from 3.6 to 4.6 (where 1 stands for "strongly disagree and 5 for "strongly agree" with the respective item). This means that participants on average agree/strongly agree that technology in general is acceptable. Regarding the perceived general usability of technology, the average score on items ranged from 3.7 to 3.9, which means that participants on average agree with usability of technology in general. Based on these results, we can conclude that the participants' general attitude towards technology is satisfactory and that it probably did not have a negative impact on the opinions regarding technologies developed within BIO-STREAMS shared in the rest of the workshop.

Dashboard and micro-moments

Among the features that health professionals find most beneficial in the Dashboard are the features of recommendations and risk assessment and goal setting for patients. Participants also found important clinical data that is available for patients, including child's progress tracking (weight, activity, sleep, mood, and nutrition). In general, healthcare professionals found the Dashboard well organized, well designed and helpful for healthcare practitioners in terms of decreasing their workload. Nevertheless, participants mentioned multiple times that they would additionally like to see BMI z-scores, notifications on patients' progress and more detailed insights into child's overall lifestyle.

Study design

First, participants were asked whether they find the specific outcomes to be measured in the study relevant. Healthcare professionals stated that all presented outcomes are relevant to be estimated. Second, healthcare professionals generally agree with the proposed study process. There were only a couple of additional ideas, i.e. to include objective data from laboratory parameters in the study (what is already planned), to use animation in serious games instead of real people, and to send motivational messages to participants once a week. Third, healthcare professionals provided feedback on the inclusion criteria for the study, which was completely positive. Fourth, regarding the feedback on self-reported questionnaires to measure various outcomes in the study, healthcare professionals generally agreed with the selection of the questionnaires and planned time points for their administration. A couple of comments have been made on the FNLIT questionnaire (measuring food and health literacy) regarding inappropriate wording, i.e. “cancer” and “cold cuts”. Regarding dietary habits and physical activity questionnaires, many participants suggested administering the questionnaire via the app or the web-based platform and adding the measurement in time point 6 instead of time point 5. For the physical activity questionnaire, two participants also suggested adding a question about the reason why a child is not exercising. For the user experience (UEQ-S), acceptance and trust (UTAUT2), and usability (SUS) questionnaires participants have suggested that measurement at one timepoint (time point 6) could be sufficient. A similar suggestion was proposed regarding the perceived research burden questionnaire (PeRBA), i.e. to administer it in time point 6 instead of time point 5.

Personas feedback

We have received feedback from healthcare professionals on Child, Parent, Doctor, Dietitian, and Biomedical Scientist Personas. For Child Persona, participants generally agreed that the Persona represents children, however, several versions for different aged children would prove beneficial. For Parent Persona, healthcare professionals mostly agreed that the Persona represents parents. Some adaptations were suggested regarding adding parents’ own health (obesity) and their denial towards obesity in their children. Also, it has been mentioned several times that the aspect of psychological/emotional support and communication with their children is important for the Parent Persona. For the Doctor persona, the healthcare professionals unanimously agreed that the Persona presents doctors well and no modifications were suggested in principle. For Dietitian Persona, participants again mostly agreed that the Persona represents dietitians well and suggested adding family group meetings and support groups into their role as well as perhaps taking over the role of a psychologist (a general comments addressed the idea of adding a psychologist Persona into the team, which is necessary from healthcare professionals’ perspective). Lastly, the Biomedical scientist Persona has also been estimated to present people in this role well and no major comments have been made.

Open-ended questionnaire

Educational resources

There was significant interest in early screening and diagnosis, including evidence-based tools for identifying childhood obesity and its associated risks. Nutritional and behavioural interventions were frequently mentioned, with a focus on family-based strategies, physical activity guidelines, and behavioural therapy. Pharmacotherapy is another prominent theme, with professionals wanting to learn more about pharmacological treatments, including guidelines and indications. Interest in the pathophysiology of obesity was evident, particularly in understanding genetic factors and endocrinological complications. Several responses highlight the need for updated evidence and literature on both prevention and treatment, with a focus on integrating the latest research into daily clinical practice. Finally, some emphasized the importance of age-specific management, recognizing that diagnostic and treatment approaches should evolve as a child grows. Multidisciplinary collaboration is also mentioned, with many expressing the need to better understand cooperation between healthcare professionals and community-based approaches.

Literature access

Participants emphasized a strong demand for up-to-date clinical guidelines and evidence-based protocols. Professionals consistently expressed interest in receiving notifications about newly published or revised guidelines for the diagnosis, prevention, and treatment of childhood obesity. There was particular interest in pharmacological treatments. Another frequently mentioned theme is the need for access to peer-reviewed scientific literature. Participants highlighted the importance of resources from obesity-specific journals, public health reports, and large-scale epidemiological or longitudinal studies. Healthcare professionals also emphasized the value of information on genetic and epigenetic factors, and lifestyle-related behaviours of families dealing with childhood obesity. These topics were identified as crucial for understanding the multifactorial nature of the condition and for personalizing interventions. Participants also expressed the need for access to national population data, particularly body measurement statistics, to better understand and benchmark trends within the pediatric population.

Tools

The most frequently mentioned type of data to be collected from parents includes detailed dietary intake (food quality, quantity, meal timing, frequency of unhealthy food), physical activity levels (type, frequency, intensity), screen time, and sleep patterns. Professionals also emphasized the importance of understanding emotional and behavioural aspects, such as children's attitudes toward food and exercise, hyperphagia, and family habits. In terms of health metrics to monitor, the most commonly referenced parameters are BMI, weight, height, waist circumference, and body fat percentage, along with laboratory values relevant to cardiometabolic risk. Monitoring physical activity through wearables, hydration, sleep quality, and psychological wellbeing were also highlighted as valuable for real-time tracking during interventions. The inclusion of gamified challenges, reminders, educational content, and support for group sessions or virtual communication with the care team are viewed as essential to enhancing adherence and family involvement. When it comes to communicating data to parents, professionals prefer visual, easy-to-understand formats—including graphs, color-coded dashboards, progress bars, and interactive summaries. Explanations should avoid medical jargon and instead focus on feasible, actionable advice that aligns with families' routines. The feedback professionals want to offer based on collected data includes dietary and activity suggestions, behavioural coaching, and adjustments to sleep and hydration. They also want to flag risks such as poor adherence or behavioural resistance and propose solutions like family therapy or referral to specialists when needed. Expectations for AI-based assistants are high. Healthcare professionals want support in interpreting complex data, suggesting personalized interventions, and tracking patient progress. Importantly, AI tools should also support the dissemination of up-to-date evidence, offering summaries of clinical guidelines, citations, and research findings. There is clear interest in AI-powered literature searches, automated alerts, and assistance in developing treatment plans and communicating with families more effectively.

Collaboration on the platform

A central theme was the strong preference for multidisciplinary team structures. Professionals emphasized that effective management of childhood obesity requires coordinated input from pediatricians, endocrinologists, dietitians, psychologists, nurses, and physical activity specialists. Regular structured meetings would allow for discussion of complex or challenging cases, sharing of updates from clinical practice or research. Respondents envision using digital spaces to exchange data, treatment plans, and case notes in real time, enabling faster and more comprehensive team decision-making. Written communication through digital systems is seen as especially useful, providing a record of interactions. Additionally, there is significant interest in joint workshops, training, and forums to stay informed on the latest evidence and approaches. Lastly, while most responses focus on professional collaboration, a few also reflect on how such platforms could include components designed to involve children and families. These would need to be age-appropriate, engaging, and interactive to ensure participation and compliance.

Stigma reduction

A dominant theme was the use of non-stigmatizing language. Professionals consistently stressed the importance of avoiding blame directed at either children or parents and instead promoting an empathetic tone. Referring to “a child with obesity” rather than labeling them as “obese” is seen as essential. Another widely emphasized practice is shifting the narrative from personal responsibility to a broader understanding of obesity as a complex, chronic condition. Incorporating education on the biological, genetic, and environmental factors that contribute to obesity can help parents and children move away from shame or guilt and toward informed action. Another practice is equipping examination rooms with appropriate furniture and tools for children with obesity and fostering a respectful atmosphere during consultations. Collaboration with psychologists or social workers, is seen as a valuable practice. At the systemic level, responses emphasized the role of early intervention and societal education, particularly through schools. Implementing inclusive health promotion campaigns and creating interventions that target all children, regardless of BMI, are seen as critical in normalizing conversations around healthy behaviours and reducing bullying. Another key theme was the emphasis on family-centered approaches. Such strategies support behaviour changes while reinforcing the idea that the child is not facing the challenge alone.

Belgium

Awareness and engagement

Regarding the goals that parents have for their children, the following were mentioned with most emphasis, having good self-esteem, being independent in terms of healthy lifestyle, and achieving high degree of physical and mental well-being. Parents teach and support their children in adopting healthy lifestyle with motivating them into outdoor physical activities, by setting an example, demonstrating cooking and various meals, etc. Some parents use more traditional tracking methods with their children, such as having conversations with them or talking to their doctors and others digital methods such as tracking children’s sleep or step count via watch or a weighing scale.

Digital platform and communication

Parents receive and search for resources on lifestyle on Google or YouTube. If they had an alternative medium for educational materials and recommendations such as BIO-STREAMS digital tools available, they would prefer to access both through web-based application and a mobile application. As necessary features on such platform they list personalized objectives, meal planning tools with meal suggestions, personalized monitoring and app interface, and app reminders.

Tools and features

In general, parents felt comfortable with using such technology to monitor child’s health-related behaviour, however under the condition of security and transparency. Parents were consistent in their preference regarding the frequency of healthy habits tracking through the app, they prefer weekly tracking and summaries of physical activity, weight, sleep and hydration. In terms of behaviour modification, they would like to receive tips on reducing screen time, healthier diet alternatives, and ideas for other physical activities.

Bulgaria

Awareness and engagement

Three topics have emerged from this pre-defined category. First was building healthy habits, where parents listed goals to improve eating routines, increase physical activity, and establish consistent habits. Second was emotional and social well-being, where they more specifically highlighted focus on building confidence, emotional stability, and positive body image. Third one was preventive measures with emphasis on avoiding long-term health issues, improving stamina, and creating a balanced lifestyle.

Digital platform and communication

Three main topics emerged regarding digital platform preferences. First, resource preferences, where parents expressed a preference for materials from paediatricians or family physicians, alongside online resources like forums and apps, and printable materials such as charts and checklists to track health-related behaviours. Second, access preferences for a health platform, with a clear inclination towards mobile apps, though some also prefer web-based platforms or a combination of both for easier access. Lastly, desired features within a health platform, where parents emphasized the need for educational materials for both parents and children, tools for tracking physical activity and diet, along with progress tracking through visuals and notifications. Additionally, they seek reinforcement for behaviour change, such as social support features, and trackers for screen time and wellbeing, including aspects like stress management and mood.

Tools and features

Three key themes have emerged from the last category. First, tracking preferences, where parents expressed a desire for daily, weekly, or monthly tracking intervals, depending on their specific needs for monitoring. Second, metrics they wish to track, including weight and waist circumference, physical activity, diet and hydration, as well as mood and wellbeing and screen time measures. Lastly, behaviour modification tips, where parents prioritize strategies for increasing physical activity, improving diet and eating behaviours, and reducing screen time.

Regarding voting for themes, most votes were assigned to the access preference for a health platform being both in mobile app and web-based platform. Many votes have been also received by daily tracking preferences as opposed to the weekly tracking and monthly tracking. Among behaviour modification tips, increasing physical activity was most favorable, while tips regarding improving diet and reducing screen time were less favorable. In resource preferences, most parents favored materials from pediatrician/family physician against online or paper materials.

Slovenia

Awareness and engagement

Within this category, five topics emerged: nutrition (involving children in preparing meals, being mindful of portion sizes), proper education on health (teaching by example, support from pediatrician), mental health, sleeping habits, and exercise/physical activity (getting enough movement, being active, playing outside, active family activities).

Digital platform and communication

Regarding resource preferences, parents mentioned websites, mobile apps, school programs, and books. Regarding digital resources, parents like to access either via mobile apps or websites or both. As desired features that they would like to see in the app they listed meal suggestions (recipes), goals with tracking, and educative materials.

Tools and features

The first theme emerging within this category was attitude towards technology. Mostly, parents reported to be comfortable with using technology and health apps, however some still noted they would prefer simple and user-friendly apps. The second theme was the time frame of tracking and metrics, where some preferred daily tracking and some weekly tracking of meals, hydration, and exercise. Lastly, the theme of behaviour modification tips emerged, indicating that parents would like to receive tips on how to increase physical activity, improve diet/eating behaviour, and reduce screen time.

Regarding voting for themes, most votes were assigned to the access preference for a health platform being both in mobile app and web-based platform. Many votes have also been received for positive attitude towards technology. Parents were most in favor of education materials being delivered via app) and less in favor to meal suggestions and goal tracking. Regarding time frame and metrics, daily tracking preferences were more favorable as opposed to the weekly tracking.

Parents would appreciate tracking of physical activity most. Among behaviour modification tips, increasing physical activity and tips regarding improving diet were most favourable and reducing screen time somewhat less. In resource preferences, most parents favored apps.

Sweden

Awareness and engagement

Parents in the workshops expressed goals such as encouraging their child to be physically active, eat healthily, feel safe on social media and in school, reduce snack consumption, lower screen time, and improve sleep habits. To support healthy eating and physical activity, some parents reported organizing weekend activities involving movement, limiting screen time to one hour on weekdays, keeping fresh fruit at home, and offering a variety of foods during the week. Information about the child's health and wellness is mostly gathered through daily conversations, such as talking at the dinner table. One parent mentioned difficulty discussing obesity due to stigma and preferred focusing on behaviour and food instead.

Digital platform and communication

Parents reported using a range of resources to address their child's health, including recommendations from pediatricians, health apps, TV news, advice from other parents, and Facebook groups. All participants agreed that a mobile app would be the preferred way to access a digital platform for managing their child's health or eating habits. When asked about helpful features, they expressed interest in all suggested options: personalized goals and tracking, educational resources, meal planning tools, behaviour modification tips, and social support. Additional desired features included point systems, competitions, age-based content for both parents and children, and progress-based recommendations.

Tools and features

Parents expressed general comfort with using technology to monitor their child's health, provided that data privacy is ensured and that they have control over what information is collected. Preferences for tracking health behaviours varied based on the child's age and the method of data entry. Weekly summaries and automated data collection were preferred, especially for tasks like tracking meals and activities. For understanding progress, visual representations such as graphs showing weight changes over time were considered useful. Daily input was acceptable only if limited to a few questions. All suggested behaviour modification tips were seen as helpful, with specific interest in age-appropriate guidance, support for resisting social media influence, and strategies for improving sleep quality.

Data synthesis across countries

Awareness and engagement

The responses to the questions reveal several core themes regarding parents' goals for promoting a healthy lifestyle for their children, their current practices, and sources of information.

First, building healthy habits was a dominant theme. Parents are focused on improving their children's eating habits, promoting physical activity, and establishing consistent routines. Many mentioned the goal of fostering balanced eating patterns, such as ensuring their child consumes a variety of nutritious foods and drinks water during meals instead of sugary beverages. Additionally, parents emphasized the importance of creating routines that include meals, physical activity (activities like family walks and encouraging their child to try new sports, like tennis or swimming), and sleep, highlighting the need for consistent habits.

The second prominent theme was emotional and social wellbeing, where parents aim to improve their child's mental and emotional health alongside physical health. Many expressed a desire for their children to develop confidence, emotional stability, and positive body image. Some parents mentioned their concern with helping children understand the importance of mental health and stress management.

The third theme pertained to sources of information and resources. Parents rely on a mix of medical professionals, particularly pediatricians, and online platforms for guidance. Many parents mentioned consultations with pediatricians and specialists, such as those at obesity clinics, as key sources of reliable information about nutrition and fitness. Others use online resources like parenting blogs, social media accounts, and websites dedicated to childhood health.

Digital platform and communication

The responses from parents highlighted several key areas of focus in terms of dietary monitoring, physical activity, and the use of digital tools to support healthy habits.

The first theme within this category relates to dietary monitoring and physical activity. Parents emphasized the importance of creating a balanced diet and fostering physical activity. Many reported using practical tools, such as meal planning guides from pediatricians or schools, and apps to track meals and physical activity. Some parents noted the use of wearable devices to monitor steps, though a few mentioned that their children eventually stopped using them. Others prefer more traditional methods, such as cooking healthy meals at home, participating in family activities, or following the guidance of health professionals, including pediatricians and dietitians.

The second theme connects tools and resources. Parents have a mix of preferences regarding digital tools. Some use mobile apps or web-based platforms to track meals, exercise, and health progress. Preferences for platforms include mobile apps for their convenience, with features like meal planning, tracking, and personalized goals. Web-based platforms are preferred by others for detailed tracking and planning. Many parents also seek educational resources, such as articles, videos, or webinars, to help them better understand and manage their child's health.

The third emerging theme was desired features for a health platform. Parents desire platforms that offer a variety of features to support healthy living. Key features include meal planning tools with shopping lists, progress tracking, and behaviour modification advice. Parents also expressed interest in educational content, both for themselves and for their children, with some highlighting the importance of visual aids like infographics and videos. Social support features, such as forums or group challenges, were also mentioned as potentially motivating. Overall, parents seem to value a platform that is user-friendly, offers personalized goals, and can track progress over time.

As the fourth theme monitoring and goal setting emerged. The idea of personalized goals and continuous monitoring resonates with parents. Many expressed a preference for goal-tracking features that adapt based on their child's progress, along with tools for managing specific health issues, like cholesterol or eating habits. There is also interest in receiving reminders or notifications to stay on track with goals, such as daily steps or water intake.

Tools and features

The responses highlighted how technology can be seamlessly integrated into everyday life to support children's health, physical activity, and dietary habits.

Regarding parents' attitude towards technology, many parents expressed comfort with using technology, with some noting it is already part of their daily routines. There's a preference for user-friendly apps that don't require too much setup or complexity. Some parents admitted to occasional forgetfulness in using digital tools but suggest that gentle reminders or notifications could help maintain consistency. Parents with less tech-savvy backgrounds want something straightforward and easy to use, indicating a preference for simplicity in design.

When it comes to monitoring their children's health, parents suggest a mix of tracking frequencies—some prefer daily logs for consistency, while others find weekly or monthly summaries more manageable. Key aspects to track include weight, physical activity, dietary habits, hydration, and screen time. Some parents are interested in more specific health indicators, such as glucose or blood pressure, and appreciate the idea of automated data collection through devices to make tracking more efficient. There's also an emphasis on measuring trends over time rather than constant daily inputs, making the process less overwhelming.

Regarding behaviour modification tips, parents seek practical, actionable advice that can help them incorporate healthy habits into their children's lives. Common requests include tips for reducing screen time, such as setting screen-free zones, using timers, and replacing screens with engaging activities. Suggestions for healthy eating include ideas for simple meals, sneaking more vegetables into meals, making healthy snacks more accessible, and meal prep shortcuts. Ideas for increasing physical activity include family activity challenges, outdoor play, or turning chores into games. Parents also want guidance on handling emotional eating, managing stress related to school, and promoting overall well-being.

Parents were also keen on learning how to be better role models for their children's health. There's an interest in advice on how to model healthy behaviour, such as making better food choices or increasing physical activity. Motivating children to adopt healthier habits, such as reducing sedentary behaviour, requires innovative ideas to make these changes fun and engaging.

Parents showed strong interest in using a mobile application or web platform that offers progress tracking (e.g., daily logs or summaries on meals, physical activity, and screen time). They also want practical tips and suggestions for improving eating habits, increasing physical activity, and managing screen time. Personalized advice based on the child's health and activity patterns is important to them, with features like automated data collection (like steps or calories) and periodic reports for parents to review.

Total synopsis of findings and implications

Parents highlighted building healthy habits and providing emotional support to their children. Overall, they would like to see to receive holistic tips on guiding their children's healthy behaviour, ranging from physical activity, nutrition, sleep hygiene, to psychological aspects such as confidence and stress management. They like to receive information on healthy lifestyle via various sources, including reliable pediatricians' opinion to educational material on mobile apps, web-pages, etc. Parents themselves work on actively integrating healthy lifestyle into their children's life though setting an example themselves, setting consistent habits, and organizing active family activities. Parents were actively engaged in managing their children's health through a mix of digital tools (smart watches, mobile apps) and traditional methods (cooking healthy meals at home, participating in family activities). They value personalized, user-friendly platforms that provide comprehensive support, from meal planning to behaviour modification advice, and appreciate educational resources. Personalized goals are one of the features they would like to see in the app including receiving reminders. Parents were in general comfortable with using technology in the context of healthy lifestyle guidance, however they prefer a simple design and user interface. Preferences for the frequency of daily monitoring are various and range from daily to monthly tracking of activity and healthy meals. Parents would appreciate behaviour modification tips within the app regarding screen time, meals, increasing physical activity, etc. They are open to integrating more technology into their routines, especially if it simplifies the process of managing their child's well-being. They appreciate features that offer flexibility, are user-friendly, and provide actionable advice. Overall, parents want a blend of practical tools, tips, and easy-to-use technology to monitor their child's health and promote healthier lifestyles.

Healthcare professionals' general attitude towards technology was satisfactory, which we interpreted not to have added a negative bias on participants' opinions regarding technologies developed within BIO-STREAMS. Regarding the Dashboard that was presented to participants, healthcare professionals gave generally positive feedback, appreciating especially personalized features (recommendations, risk assessment, and goal setting for patients) and progress tracking. Participants expressed a positive opinion and agreement with the clinical study design and suggested some minor adjustments that can be easily implemented. Healthcare professionals also generally agreed with all presented Personas. They emphasized the need for early screening, evidence-based interventions, and age-specific educational resources. Key interests included behavioural strategies, pharmacotherapy, and the genetic

and hormonal basis of obesity. There was strong demand for updated guidelines, access to research, and national health data. Digital tools were expected to track diet, activity, sleep, and emotional well-being, and to provide visual summaries and tailored feedback. AI support was valued for data interpretation and treatment planning and multidisciplinary collaboration was seen as essential. Participants also stressed the importance of reducing stigma through empathetic language and family-centered approaches that reflect obesity's complexity.

3.1.4 Conclusions

To collect insight from other stakeholders relevant for the project in the clinical setting, co-creation workshops were conducted with parents and healthcare professionals. For workshops with parents, the same methodology was followed in all cultural contexts (Greece, Belgium, Bulgaria, Slovenia, Sweden, and Spain), while one workshop with healthcare professionals has so far been conducted only in Greece, serving as a pilot for this stakeholder group (this phased approach was adopted due to scheduling constraints and the limited availability of specialised pediatric healthcare professionals during the initial project timeline). Fourty-seven parents provided answers to the questions developed within WP2, the results of which we have presented in this chapter. We explored parents' preferences and attitudes towards technologies providing guidance on healthy lifestyle and strategies of teaching their children about healthy living. What they seemed to find important was to bring various aspects of healthy lifestyle to children (sleep, food, activity, etc.) without neglecting children's psychological well-being and self-esteem. Parents reported that they themselves feel responsible to teach children by example and incorporate healthy activities into family routine and activities. Overall, parents are in favor of using digital tools to receive behaviour modification tips, educational resources, and to track and monitor their children's and family's healthy habits (activity levels, meals, goal tracking, etc.). Most importantly, parents' preferences are various, which calls for flexible digital tools and educational materials that are able to address personalized needs of each family. Regardless of parents' desire to be assisted by technology, they still put high importance on opinions and guidelines from their doctors. In the workshop with healthcare professionals, they were asked about their opinion on BIO-STREAMS digital tools, clinical study design, and Personas and open-ended questions developed within WP2. Participants provided mostly positive feedback on all presented digital content and useful insights regarding their needs, expectations, and values regarding the digital tools and content to support their work in childhood obesity. Additional workshops with healthcare professionals are scheduled for Belgium, Bulgaria, Slovenia, Sweden, and Spain in the upcoming three months (May-July 2025), before expanding to other clinical settings, ensuring optimal stakeholder engagement across all sites. The timing of these workshops is also aligned with the clinical pilot study recruitment timeline, as the first subjects will enter the study in August 2025. Completing healthcare professional workshops prior to recruitment is critical for three key reasons: (1) it will enable integration of clinical expertise into the final execution, (2) it will facilitate better preparation of healthcare teams (i.e. dissemantion and promotion) who will support participants during the study, and (3) it will help establish local professional networks that will be instrumental for successful participant recruitment and retention. Insights gathered from these workshops will directly inform protocol refinements and implementation strategies, ensuring the intervention is optimally positioned within existing clinical workflows across participating countries.

3.2 School setting

3.2.1 Background/aim

In order to support the design of the school pilot intervention and the finalisation of the related study protocol, additional co-creation workshops were carried out by T6.1 partners (UM, NUCLIO, DCHE and ESHA), targeting representatives of other important stakeholder groups.

3.2.2 Methodology

A total of three workshops were conducted, each targeting representatives of a different group, namely school leaders, non-formal health education providers, and parents.

Setting and participants

The first workshop took place in Ljubljana, Slovenia in April 2024 as an addition to the ESHA yearly meeting. Participants were 50 school leaders, i.e. school heads, deputy school heads, or other individuals who are employees or officers of a school or an entity operating a school and are responsible for the daily instructional leadership and managerial operations in the school and its building. Participants were invited by ESHA via email.

The second workshop took place in Rotterdam, the Netherlands in September 2024 at the Global Health Literacy Summit. Participants were 14 non-formal health educational providers. These are professionals or semi-professionals who provide various forms of structured learning, which do not have the level of curriculum, institutionalisation, accreditation or certification associated with formal learning (e.g. school), but have more structure than that associated with informal learning, which typically take place naturally and spontaneously as part of other activities. Examples of non-formal learning include community-based sports programmes, programmes developed by organisations such as the scouts or the Red Cross, community or non-credit adult education courses, sports or fitness programmes, professional conference style seminars, and continuing professional development. Participants had a broad professional background but all were involved in the health or educational sector.

The third workshop took place in Telavi, Georgia at the Parents International Summit in October 2024. Participants were 19 representatives or leaders of parent organisations with an overview of parents' views in their respective countries, having been prompted about the topic of the workshop beforehand. A parent, in this text, is defined as a person who has parental responsibility for, or one who cares for, a child or a young person. Parents are usually the biological mother and father of the child or young person, but parental responsibility can be acquired by a person who looks after a child's safety and welfare. Thus, the definition includes legal guardians, adoptive and step-parents, as well as other people assuming the parental role in full or partially (e.g. grandparents, older siblings and more distant relatives).

Workshop content and delivery

All three workshops had a common methodological framework, described in detail below.

Each workshop was conducted by 3-5 facilitators and lasted for approximately 60 minutes. The workshops started with a brief presentation of the BIO-STREAMS project and the school pilot intervention, followed by a participatory part conducted based on the KJ-method [3] (a description of the method has been provided in section 2.2.2 of the deliverable).

The workshops were structured in the following 5 steps:

Step 1: Participants were divided into groups and given a topic of approximately 3-4 questions. The questions were chosen from the wider list developed within WP2 (T2.3) of the BIO-STREAMS project, as already described in Section 2.2.2, to fit the experiences and needs of the target population. For school leaders and parents, the predefined list of questions targeting these stakeholder groups were used. As non-formal health education providers had different educational and professional backgrounds and there was no pre-defined list targeting this stakeholder group, a mix of questions from the “parent” and “teacher” personas predefined lists were picked and used by the researchers conducting the workshop as most relevant. The questions used in the three workshops are presented in detail in Tables 3.2, 3.3 and 3.4.

Table 3.2 Co-creation workshop questions for school leaders.

A	Collaboration with project
1	In what way do you prefer to be approached by external parties offering collaboration?

2	Do you have a suggestion of how most effective recruitment of schools should look like?
3	What could be the barriers for such engagement?
4	What kind support would you or your team need to introduce our solution into the school and start a discussion with the teachers to include small health-related activities into the curriculum?
B	Intervention design and feasibility
5	Given the description of outcomes that we aim to influence with our activities and solutions, what design would be most feasible from your point of view?
6	What technology infrastructure is available in the school to support the implementation of the virtual learning tools and platform? Do you have a good internet connection? Do you have wireless access that the platform could use?
7	How open is your school's community to virtual workshops and webinars on health-related topics? If your school is not open to these initiatives, please elaborate on why not.
C	Past experience and engagement
8	Have you previously organized community-based events related to health and wellness in your school? If yes, what challenges did you face, and what resources were or would have been helpful?
9	To what extent could the school participate in the project? For how long? Do you think teaching and non-teaching staff can be engaged? What about parents and local community?
10	What strategies can you implement to motivate and engage teachers to utilize the platform effectively and to acknowledge their contributions to obesity prevention efforts?
D	Collaboration on platform
11	How do you currently communicate with parents, teachers, and students regarding health initiatives?
12	What tools or features would enhance this communication?
13	What features should the platform have to encourage collaboration between the school and community organisations to create a supportive ecosystem for obesity prevention?

Table 3.3 Co-creation workshop questions for non-formal health education providers.

1	Are there activities that promote both fun and a healthy lifestyle that you can do together?
2	How do you model healthy lifestyle behaviours for children? What practices can you implement to showcase the importance of a balanced diet and physical activity?
3	What kind of lifestyle tips would you want to be shared regularly with & within families?
4	What type of interventions would be most effective in helping students adopt healthier habits?

Table 3.4 Co-creation workshop questions for parents.

A	Obesity & healthy habits
1	What are your concerns about childhood obesity and its impact on your child's health and well-being?
2	Do you set family goals related to physical activity and healthy eating? How can you involve your child in setting and achieving these goals?
3	How do you encourage your child to adopt healthy habits, including making healthy food choices, reducing sedentary behaviour and improving sleep?
4	In what ways can you provide information and guidance on nutrition to install healthy eating habits in your child?

B	Digital platform and communication
5	How comfortable are you with using technology to monitor and track your child's health-related behaviours?
6	What type of features would you find most helpful in a digital platform for childhood obesity prevention or treatment (personalized goals and tracking, educational resources)?
7	What privacy concerns do you have about using a digital platform to manage your child's eating habits?
8	How would you feel about sharing your child's data with healthcare providers or professionals?
C	Tools and features
9	How would you like to track your child's healthy habits? Are there specific metrics you want to track, such as weight, physical activity, or dietary habits?
10	What types of educational resources would be most helpful to you?
11	What meal planning tools would be most useful to you?
12	How would you like to connect with other parents or caregivers who are also dealing with childhood obesity?
D	Providing information and positive reinforcement
13	What information is important for you to receive regarding your child's nutrition and preventing overweight and obesity?
14	How often do you think positive reinforcement and encouragement can be beneficial for your child's health journey, and in what form?
15	What resources or tools (if any) have you used in the past to address your child's eating habits and physical activity?
16	What behaviour modification tips would you find helpful (regarding physical activity, reducing screen time, making healthier food choices)?

Step 2 - Individual brainstorming: Everyone silently wrote down responses to each given question on separate post-its.

Step 3 - Sharing ideas: Participants took turns sharing the responses they had written and posting them to the group space.

Step 4 - Grouping or Clustering: Working together, the group clustered similar ideas or concepts. Each cluster then got named with a single word or short phrase that best captured the core concept underlying the ideas in that cluster.

Step 5 - Voting: The entire group participating in the workshop (all participants) then voted on which concepts matter most. Each person got a set number of votes (or “dots”) that they could place on the concepts they cared most about. The concepts that got the most votes/dots wined.

The workshops ended with a harvesting activity using the Bear Emotion Cards to also collect input on participants’ perception about the planned activities and the workshop itself. Participants were also asked to fill an evaluation questionnaire after the workshops.

Data collection and synthesis

Raw data were recorded into excel sheets and qualitatively synthesised to identify common patterns of answers in each stakeholder group based on the number of participant votes.

3.2.3 Results

The different stakeholder groups participating in the workshops highlighted different elements and identified slightly diverging strategies they consider potentially successful. The fundamental results of each workshop are presented in the following subsections.

School leaders

School leaders were open to engaging in research projects, such as BIO-STREAMS, however many expressed time, money, and capacity as the main barriers for actual participation. For schools to engage in health-promoting studies, it was emphasised that clear information regarding the study/project and what the school could gain from participating is key, as well as keeping the effort required from teachers, and the school in general, at a minimum. School leaders preferred a community-approach, engaging both the family, the whole school and wider local actors for a more holistic approach, shifting the responsibility from just one place (e.g. inside the classroom) to all places where students spend time throughout the day. The most popular activities related to healthy lifestyle mentioned during the workshop by school leaders were project/groupwork with health-related themes, and seeding projects in which students are able to grow their own food, learn about healthy eating and cooking.

Non-formal health education providers

Non-formal health educators expressed a preference for approaches that are both activity-based and family-centric. They considered challenges that are rooted in real life successful. Mutual learning of families (families learning from each other's healthy lifestyle practices in different ways from home visits to workshops) was highlighted a preferred approach to healthy lifestyle education. Relevance to the context and realistic approaches considering individual needs and preferences was also considered a must. This includes considerations for eating habits based on cultural diversity and traditions. Two school-initiated home-based activities were especially highly valued by this stakeholder group: growing your own fruit and vegetables, and openly celebrating healthy activities happening at home even in the form of a contest.

Parents

Parents showed a clear preference for a family-centric approach to school-based interventions. They emphasised on the importance of role modelling, leading by example, and activities that children are full and equal participants of (e.g. easy recipes that can be cooked together with children). They also expressed their wish to not track healthy habits in any technical way, but by communicating with children. However, technology supporting healthy food choices was highlighted as useful. Parents did not find targeted educational material, such as books or school-based presentations/sessions, useful. This was an expected outcome, as health and all related topics, including healthy eating, are considered by parents a responsibility of families and not schools. The role of sleep was highlighted as an element not necessarily important for educators other than parents - and that manifests for example in huge homework loads. Parents also highlighted the importance of balanced approaches not excluding or demonising any food. Two additional aspects were endorsed by this stakeholder group. One was the need for age-appropriate content that requires a diversified solution for school-based interventions. The other was to have risk mitigation measures in place to prevent school-based interventions or digital solutions from causing and/or worsening eating disorders.

3.2.4 Conclusions

Based on the outcomes of the workshops among school leaders, non-formal health educators and parents, there seems to be a clear preference for family-centric interventions with school playing a role in supporting the whole family in adopting healthier lifestyle habits. There is a need for the intervention to be delivered in a considerate way, minimising the effort for the schools and teachers involved. It seems imperative that the study and materials used consider cultural differences and value diversity. Age appropriateness also emerged as a key factor impacting the intervention, in terms of both the content and the potential risks related to sensitivities (especially for adolescents). Real life and role modelling should play an important role, with those delivering educational activities in school needing to act as role models. A balanced approach, acknowledging that there is a role of unhealthy habits even in healthy

lives, is important. Based on the input from various stakeholders, a gamified approach could be recommended, with participants setting personal and/or group goals, having rewards, ways to catch up in case of hiccups, and celebrating achievements, while avoiding stigmatisation. This input, combined with that of other co-creation activities, will be used to inform the project's school pilot intervention study protocol, as described in detail in Section 4.2.

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4. SECTION 4 IMPLICATIONS FOR THE DEVELOPMENT OF THE PILOT INTERVENTION STUDIES

4.1 Clinical pilot study

Results and findings from co-creation workshops with children in clinical context and healthcare professionals will be considered to influence the initial study protocols to ensure the study design to be tailored to specific needs of patients and healthcare systems. By doing this, we will ensure optimal pilot deployment across Europe.

4.1.1 Study design

In general, the study process and design were well-accepted from children's as well as healthcare professionals' side. First, we list some considerations regarding study protocol adaptations that yield from results of workshops with children and then from the ones with clinicians.

Children and adolescents in general did not oppose saliva collection with check swabbing, which does not interfere with our planned procedure. However, many children mentioned very different preferences regarding who would they rather see to take the sample (e.g. younger children would prefer their parents, older children would prefer themselves, and adolescents are indifferent). Given these various preferences, we will consider incorporating a small degree of freedom in the study procedure so the researchers can adapt the procedure for specific context. Children also shared their opinion regarding the number of activities they would be expected to engage in if taking part in the study. They generally responded positively, however older children expressed more concerns about the number of activities than younger children. Our estimation is that as long as we keep daily engagement requirements below 20 minutes for younger and 15 minutes for older children, we should not encounter issues with attrition. However, they reported that if the content is interesting enough, they would be willing to spend somewhat more time than that.

Regarding feedback from clinicians, they mostly agreed with presented study outcomes, study process, and inclusion criteria, which are the most important elements of clinical research. Given that clinicians of various profiles have been included in the workshops (medical doctors, pediatritians, dietitians, nurse, biostatistitian), we highly value their consolidated input. This is why we believe it would be counterproductive to apply changes in the three mentioned components, thus we intend not to do so.

4.1.2 Self-report questionnaires

We have collected feedback regarding the self-report questionnaires from children of all ages. Given the number of questionnaires intended to be included in the study, we intended to check whether the questionnaires are child-friendly enough to be understood and not to cause any discomfort while answering. With most questionnaires, no issues or only minor issues emerged that can be addressed on the pilot-site-level. This is for example minor adaptations of questions that turned out to not to be understandable in some languages.

Regarding cultural-context-specific changes that should be considered by the pilot sites, we list the following:

- Revision of UEQ-S and FNLIT questionnaires in Walloon context
- Revision of item 9 in SRQ-E questionnaire in Greek context
- Revision of WHO-5 questionnaire to minimize the slight discomfort reported in Greek context

Regarding general adaptation that should be considered across all cultural contexts, we list the following:

- Adding or replacing a numeric response scale with a a graphical one, especially for children below 14 years of age
- Removing or revising the PeRBA questionnaire that showed issues with understanding in the youngest group (below 8 years)
- Removing or revising WSSQ questionnaire as adolescents in Bulgarian context reported great discomfort while answering

The suggested changes and adaptations to the self-report questionnaires that are intended to be used in the clinical study are in general minor and do not pose a threat to our ability to measure the outcomes that we have promised to. Exceptions are the WSSQ and PeRBA questionnaires, by which we intended to measure fear/perception of stigmatisation and research burden, respectively. Less problematic is WSSQ, which is labelled as a secondary outcome in the GA (page 115 in part B), thus removal of this outcome won't greatly affect the value of our findings. However, burden of research (or behaviour modification, as stated in the GA on page 115, part B) is listed as a primary outcome. Whether removing this questionnaire for the youngest group of children that had issues understanding would greatly influence the value of findings within the clinical study should be discussed on consortium level.

4.2 School pilot study

Based on the findings of all relevant co-creation activities, i.e. Delphi studies among panelists (doctors, dietitians, headmasters, teachers, health researchers and policymakers) and co-creation workshops with children/adolescents, school leaders, non-formal health educational providers and parents, the school pilot intervention protocol, as described in part B of the GA, was modified in order to align the intervention with stakeholders' needs and preferences and ensure an optimal pilot deployment and across European educational settings. Refinements and amendments are presented in the following sections.

4.2.1 Study design

Co-creation activities confirmed various elements of the original school pilot intervention study design but led to amendments in some aspects as well.

The various stakeholders involved in co-creation shared the view of the school environment being an important setting for education on a healthy lifestyle. School stakeholders, in particular, were open to engaging in healthy lifestyle research projects, such as BIO-STREAMS, however time, money and capacity were identified as important barriers for participation. According to the original study design, the healthy lifestyle intervention would be based on joined parent-child classroom activities. However, such an approach would require additional effort by the school personnel outside official school hours and possibly additional cost. In light of this, the study protocol was amended so that the intervention will be delivered at the school setting, during school hours, through workshops with students, in order to keep the effort required from teachers, and the school in general, at a minimum. Moreover, given that students expressed trust in experts regarding healthy lifestyle education, it was decided that the intervention will be delivered by experienced researchers instead of teachers after appropriate training (train-the-trainer approach), in order to both ensure students' participation/trust and further minimise the effort for school personnel.

Regarding study groups, according to the original study design, the control group would receive no intervention; however, given that co-creation revealed that students in Europe greatly value and show a strong interest in learning about healthy lifestyle but have a very limited experience with healthy lifestyle interventions, the study protocol was amended so that both study groups would receive the same basic healthy lifestyle intervention in the form of workshops delivered at the school setting, and that the intervention group would receive a more intensified form of the intervention. Regarding the latter, findings from co-creation activities suggested that a gamified approach could enhance students' participation in the

intervention and that digital tools could be used as an adjunct to face-to-face education on healthy lifestyle. By combining in-person and digital learning methods, the study would cater to diverse learning preferences, encouraging students to adopt healthier habits and enhance their health literacy in both school and home setting. Therefore, the digital tools designed within the BIO-STREAMS project, i.e. the mobile health application and the serious game suite, will be used as additional elements of the intensive intervention, to reinforce students' adherence to a healthy lifestyle. The digital tools will have customisable features to meet individual needs/preferences and will provide tailored feedback and recommendations based on user data, with an aim to improve students' self- efficacy in meeting intervention goals.

The family-centric approach of the intervention was confirmed, since co-creation highlighted the value of parents'/caregivers' involvement in children's learning of a healthy lifestyle from both children's and health/educational professionals' perspective. In the context of the refined school pilot intervention study, school workshops will encourage family/parental engagement in various aspects of a healthy lifestyle (e.g. meal preparation and collective activities that involve movement). Moreover, the digital tools offered to the intervention group will further promote family engagement, since the mobile phone application will be used by both children and parents/caregivers for lifestyle self-monitoring and goal setting, and the serious games will facilitate collaboration between children and parents/caregivers in promoting children's dietary habits and increasing their physical activity level.

The initial duration of the intervention, i.e. one school year, was also confirmed by experts in the field as a realistic timeline, allowing 6 months for intervention per se and additional time before and after for the baseline and follow-up assessment of participants' characteristics.

4.2.2 Intervention content

The content of the intervention workshops has been determined based on the findings of the literature reviews performed within T2.1 and T2.2 (documented in detail in D2.1) and was further refined by the results of the co-creation activities described in the present deliverable.

According to the findings from the co-creation activities, the school pilot intervention study should focus on promoting healthy lifestyle literacy through educational and practical activities that emphasise the principles of a healthy diet, regular physical activity, reduced sedentariness and sufficient sleep, while highlighting that a healthy lifestyle is crucial for optimal development, physical health and mental well-being. With regards to diet, the intervention should educate students about the nutritional value and optimal consumption of basic food groups, the concept of balanced meals, and healthy snack choices. The dietary component of the intervention should emphasise on the importance of moderation, mindful eating practices and family/social meals, and promote cultural food awareness by encouraging students to explore traditional healthy meal recipes and diverse cuisines. With regards to physical activity, the school pilot intervention study should include education and practical components with the aim of promoting a healthy balance between active and sedentary time throughout the day. Focus should be paced on any kind of physical activity, both within and outside the school setting, emphasising on social activities that encourage teamwork and social interaction with peers and family. Strategies to reduce recreational sedentary time and address common barriers for adopting a physically active lifestyle should also be utilised. Based on the above, the four thematic domains of the workshops in the school pilot intervention will be as follows:

1. Hydration: adequate water intake; decrease in the consumption of sugar-sweetened beverages (e.g. soft drinks/sodas, flavoured juice drinks, flavoured milk drinks, sweetened tea, coffee drinks, energy drinks, sports drinks); preference in healthy drinks/beverages (e.g. natural fruit juices, milk, herbal infusions.

2. Breakfast: daily breakfast consumption and avoidance of breakfast skipping; consumption of a nutritionally complete breakfast; family/parental engagement in breakfast preparation and consumption.

3. Cooking at home and family meals: consumption of nutritionally complete main meals (lunch and dinner); preference in minimally processed, fresh, local and seasonal foods; decrease in the consumption of (ultra-) processed foods, fast food and takeaways; family/parental engagement in main meal preparation and consumption.

4. Physical (in)activity: promotion of physical activity throughout the day (e.g., at school breaks, at school physical education classes, at the playground, in organised sports); emphasis on activities of higher intensity; decrease in screen time (e.g., television, personal computer, mobile phone, tablet); substitution of recreational sedentary time with any kind of physical activity; family/parental engagement in collective activities that involve movement; the importance of sleep.

4.2.3 Study outcomes

According to the GA, data collection tools at baseline and after the end of the school pilot intervention would be determined based on feedback from co-creation activities.

As stated above, diet, physical activity/inactivity and sleep patterns emerged as important determinants of childhood OV/OB for all related parties, i.e. health and education professionals, children/adolescents and parents. Feasible methods of collecting information on the above parameters were determined mainly form the Delphi studies. Therefore, self-reported information on students' dietary habits (e.g. consumption of foods/food groups and meal patterns), physical activity habits (e.g. time spent in various physical activities before, during and after school and time spent in sedentary activities, such as TV and computer), and sleep duration will be collected through appropriate tools. Food/nutrition literacy, self-efficacy for healthy dietary and physical activity habits, and self-perception will also be assessed through appropriate questionnaires, in order to evaluate the effectiveness of the intervention in promoting students' capacity towards adhering to the principles of a healthy lifestyle.

The assessment of anthropometric endpoints emerged as significant and feasible in the Delphi studies; however, students did not emphasise on those and school stakeholders valued a non-stigmatising intervention. Therefore, self-reported, rather than measured, data on body weight and height will be collected to evaluate the effectiveness of the intervention towards OV/OB prevention. Moreover, since the feasibility of metabolic, genetic and epigenetic assessments in school settings lacked agreement in Delphi studies, the school intervention protocol has been refined so as to not include the voluntary collection of participants' blood/saliva samples.

Finally, since the use of digital tools in school-based interventions were deemed acceptable and useful, suitability of the digital interventions will be measured through a) usability, b) user experience, and c) trust and acceptance, as per GA. These outcomes will be evaluated at follow-up only in the intervention group, which will receive access to the digital solutions.

SYNOPSIS AND CONCLUSIONS

Within the BIO-STREAMS project, two pilot intervention studies focusing on the lifestyle prevention and management of childhood OV/OB will be designed and conducted in European school and clinical settings, respectively. Major health organisations emphasise on people-centredness as a core parameter for improving health outcomes and advocate the design of tailored interventions that are coordinated around people's needs and preferences. In this context, a living-lab methodological framework was developed within the project as part of T6.1 "Bio-Streams Strategy for Behavioural Change in Children in Clinical and Educational Contexts", in order to gain insight into the perspectives, preferences and needs of all relevant stakeholders from real-life settings. To this direction, two distinct well-established methodologies were developed and applied to engage all important key players as co-creators of the pilot study protocols, namely Delphi studies and co-creation workshops.

A total of 4 Delphi studies were designed to elicit consensus among experts on the evidence-based and feasible methods for the screening/assessment of childhood OV/OB and MUO and the characteristics of lifestyle interventions for their efficient prevention/management in school and clinical settings, respectively. Participants included professionals with clinical, research and educational background, i.e. doctors, dietitians, health researchers, teachers, headmasters and policymakers, who were identified by the project's partners as experts in the field. The Delphi studies were structured in 3 rounds. In round 1, the statements of the Delphi surveys were developed based on extensive reviews of the scientific literature performed within WP2 (T2.1 and T2.2) of the project regarding the assessment, aetiology, prevention and management of childhood OV/OB and MUO. In round 2, participants were provided with the electronic Delphi questionnaires and given a two-week timeframe to complete the survey. Results from round 2 were collected and analysed to evaluate participants' consensus for each statement based on specific criteria; when consensus was not achieved, statements were rephrased or removed. In round 3, participants were provided with the revised electronic Delphi questionnaires, including the statements in which consensus was achieved and the rephrased ones, and given a two-week timeframe to complete the survey. A total of 67 participants from 16 European countries completed round 2 and 57 participants from 16 European countries completed round 3. Attrition was low between round 2 and round 3 (12-25%), indicating that the majority of participants who took part in round 2 also contributed to round 3.

In the clinical setting, predictors of childhood OV/OB, such as dietary habits (in terms of dietary patterns, meal patterns and foods/food groups), physical activity habits and sedentary behaviour (self-reported instead of objectively measured), sleep habits, prenatal factors (e.g. maternal pre-pregnancy body weight and lifestyle habits), and characteristics of the social (e.g. teacher influence and parental practices) and built environment (e.g. availability of food/service retails and recreational/exercise spaces/facilities), as well as indicators of childhood OV/OB, such as body mass index and waist circumference, were indicated by experts as both important and feasible to evaluate for the assessment of childhood OV/OB risk. Contrariwise, the evaluation of predictors, such as postnatal factors, genetics, epigenetics and metabolomics, and indicators, such as skinfold thickness and body composition parameters, was deemed not important and/or feasible in the clinical setting. Regarding MUO, consensus was reached that it should be routinely included in the assessment of each case of OV/OB in clinical settings through evaluating the presence of hypertension, dyslipidaemia, (pre)diabetes, insulin resistance and MASLD. Experts reached consensus that lifestyle interventions for the management of childhood OV/OB in clinical settings should have a duration of at least 3 months, be delivered by a multidisciplinary team based on a family-centred approach, and focus on health education, behaviour modification and motivational interviewing. The content of such interventions should target multiple lifestyle habits, i.e. healthy dietary habits, increased physical activity and sufficient sleep, and would profit from the use of digital tools with user-friendly, engaging, gamified and personalised content. Anthropometric and body composition

indices, lifestyle habits, food literacy, quality of life, and mental wellbeing/distress emerged as important and feasible outcomes of such interventions. According to participants' expert opinion, lifestyle interventions for the management of childhood MUO in clinical settings should be more intense and prioritise potential comorbidities, while additional important and feasible outcomes for such interventions would include blood pressure and common metabolic biomarkers, such as glucose metabolism indices, lipidaemic profile and liver enzymes.

In the school setting, predictors of childhood OV/OB, such as dietary habits (in terms of meal patterns and foods/food groups), physical activity habits and sedentary behaviour (self-reported instead of objectively measured), sleep habits, and characteristics of the built environment (e.g. availability of food/service retails and recreational/exercise spaces/facilities), as well as indicators of childhood OV/OB, such as body mass index and waist circumference, were indicated by experts as both important and feasible to evaluate for the screening of childhood OV/OB risk. Contrariwise, the evaluation of predictors, such as perinatal factors, and indicators, such as body composition parameters, was deemed important but not feasible in the school setting. According to participants' expert opinion, the assessment of clinical/metabolic markers (e.g. blood pressure, glucose, lipids and liver enzymes) was deemed not feasible in the school setting and children at high risk or with a diagnosis of OV/OB should be referred to a clinical setting for a comprehensive assessment of MUO. Experts reached consensus that lifestyle interventions for the prevention of childhood OV/OB in school settings should have a duration of at least 1 school year, should be based on a family-centred approach that focuses on educational, experiential and policy components related to nutrition and physical activity, would profit from the use of digital tools with user-friendly, engaging, gamified and personalised content, and should take into account children's cultural and socioeconomic background. Anthropometric indices, lifestyle habits, food literacy, quality of life and mental wellbeing emerged as important and feasible outcomes of such interventions.

A series of co-creation workshops were conducted both in clinical and school settings among children and adolescents, to involve them as co-creators of the project's pilot studies.

Clinical co-creation workshops were conducted in 6 clinical pilot sites representing 5 European countries, i.e. Slovenia, Greece, Sweden, Belgium, and Bulgaria, among 113 participants aged 5-18 years. Each workshop was carried out by at least 2 facilitators in two parts of 90 minutes each. The first part included the following activities: open discussion on the Child Persona developed within WP2 (T2.3) of the project presented via a comic, evaluation of user requirements through a list of open questions developed within WP2 (T2.3) of the project, evaluation of children's perspective on the design and feasibility of the clinical pilot study presented via an infographic, and evaluation of children's understanding and concurrence with part of the clinical pilot study questionnaires. The second part of the workshop focused on technology and aimed to gather children's feedback on the use of digital tools. The clinical co-creation workshops revealed that children are mindful of healthy food and physical activity from a young age, where parents play an important role of introducing the concept of healthy lifestyle to them. At later age, children become very curious about various health topics with eagerness to learn more and become better in terms of physical health, strength, and mental well-being. According to children's feedback and given their affinity towards technology, the potential of digital tools to support the adoption of a healthy lifestyle was confirmed. Regarding feedback on the clinical pilot study protocol, children's attitude towards the presented content was positive with minor implications for adaptations in study design, methods and content.

School co-creation workshops were conducted in 5 school pilot sites representing 5 European countries, i.e. Slovenia, Greece, Denmark, Portugal, and the Netherlands, among 181 participants aged 9-14 years. The workshops took place in schools within school hours. Each workshop was conducted in 1 school class by a minimum of 2 facilitators and lasted for approximately 1-2 school hours. Participants were asked to reflect on and produce answers to a list of questions developed within WP2 (T2.3) of the project, covering 5 thematic areas, namely healthy lifestyle and motivation, healthy eating, physical activity and sedentary

behaviour, healthy lifestyle literacy, and trust in interventions and guidance. Data were qualitatively synthesised to identify common patterns of answers within each question. The school co-creation workshops revealed that promoting a healthy lifestyle among schoolchildren requires a holistic approach that focuses on nutrition, physical activity and sleep as major pillars and highlights the importance of heathy lifestyle habits for optimal development and the promotion of physical/mental/emotional well-being. Based on children's input, a school-based healthy lifestyle intervention should target both the school and the home/family environment, utilise in-person, interactive and engaging educational activities led by experts as the main learning format, additionally exploit innovative digital methods as complementary intervention tools to promote healthy lifestyle literacy, and take into account cultural differences in lifestyle choices and the potential barriers that students face for adhering to a healthy lifestyle.

Co-creation workshops were also conducted among other important stakeholder groups from both clinical and school settings, to further support the co-creation of the project's pilot studies.

Regarding the clinical setting, workshops targeting parents (n=47) were conducted in 6 clinical pilot sites representing 5 European countries, i.e. Slovenia, Greece, Belgium, Sweden, and Bulgaria. The workshops were carried out by at least 2 facilitators and involved participants' reflection on a list of questions developed within WP2 (T2.3) of the project covering 3 thematic areas, namely awareness and engagement, digital platform and communication, and tools and features. According to the outcomes of the workshops, parents emphasised on the importance of various aspects of healthy lifestyle, the consideration of children's psychological well-being and self-esteem, and their own responsibility as role models. Overall, they expressed trust in health professionals' guidance, but they were also in favour of using digital tools to receive behaviour modification tips, educational resources, and track/monitor their children's habits. Most importantly their preferences varied significantly, a fact that points towards the necessity of flexible intervention tools that can address personalised needs. A sole workshop targeting healthcare professionals (n=13) was conducted in Greece. It included the following activities: evaluation of their attitude towards technology, gathering of feedback on the project's digital tools (ActiveHealth app and serious games), gathering of feedback on the project's Dashboard, evaluation of their perspective on the design of the clinical pilot study, evaluation of the Child, Parent, Doctor, and Dietitian Personas, and evaluation of user requirements through a list of open questions developed within WP2 (T2.3) of the project for the Doctor and Dietitian Personas, covering 4 thematic areas, namely, educational resources, tools, collaboration on the platform, and stigma reduction. According to the outcomes of the workshop, healthcare professionals provided positive feedback on all presented digital tools, clinical study design, and Personas, as well as useful insights on their expectations and needs regarding the digital tools that would support their work on childhood OV/OB. Key interests included behavioural strategies, pharmacotherapy, and the genetic and hormonal basis of OB. Participants mostly reported the need for early screening tools, information on evidence-based interventions, age-specific educational resources, access to updated guidelines and research, and national health data. Digital tools were expected to track diet, activity, sleep, and emotional well-being, and to provide visual summaries and tailored feedback.

Regarding the school setting, a total of three workshops were conducted as part of bigger events in which school pilot sites participated, each targeting representatives of a different group, namely parents (n=19), school leaders (n=50), and non-formal health education providers (n=14). Each workshop was conducted by 3-5 facilitators, lasted for approximately 60 minutes and started with a brief presentation of the BIO-STREAMS project and the school pilot intervention, followed by a participatory part conducted based on the KJ-method. Participants were asked to provide feedback on a set of questions, developed within WP2 (T2.3) of the project for the Parent and Teacher Personas. Workshop outcomes pointed towards the value of family-centric interventions to combat childhood OV/OB, with school playing a role in supporting the whole family in adopting healthier lifestyle habits. The various stakeholders indicated the need for low-burden and considerate interventions, that minimise the effort for the school community and take into account cultural differences and diversity.

They also emphasised on age- appropriate content, role-modelling pertinent to those delivering educational activities, balance and moderation in all aspects of lifestyle, and a gamified non-stigmatising approach incorporating goal-setting and positive reinforcement, as important elements of a successful school-based healthy lifestyle intervention.

The outcomes of the BIO-STREAMS living lab methodology, as described in detail in the present deliverable, are currently being and will be further utilised in the context of T6.3 “Pilot Roll-out and Execution in Clinical Context” and T6.4 “Pilot Roll-out and Execution in Educational Context” for the refinement and finalisation of the project’s clinical and school pilot study protocols. The exploitation of insights and feedback obtained from the various involved stakeholders will allow pilot sites to align the actual requirements and needs of end-users with research objectives/aims, to facilitate an optimal pilot deployment and real-world applicability across clinical and educational settings in Europe, and to ensure that the pilot studies produce relevant evidence for decision-making in clinical practice and public health.

APPENDICES

Appendix 1.1. Statements with no consensus.

Study 1a: Consensus of experts on predictors and indicators for the assessment of childhood OV/OB and MUO in clinical settings

Round 2

Statement	% agreement	Action
Importance of the assessment of predictors of childhood OV/OB in clinical settings		
Engagement in light/moderate physical activity (objectively measured through accelerometery), extracurricular / leisure-time physical activity (self-reported) and outdoor play (self-reported) do not seem to be important predictors of childhood OV/OB.	18	Statement removed in Round 3
Total time spent in sedentary activities (objectively measured through accelerometery) does not seem to be an important predictor of childhood OV/OB.	12	Statement removed in Round 3
Skipping breakfast is an important detrimental risk factor for childhood OV/OB.	63	Statement remained the same in Round 3
The majority of data on dairy consumption are indicative of no association with the risk of childhood OV/OB.	40	Statement removed in Round 3
Findings remain inconsistent regarding the impact of consumption of other foods or food groups than the abovementioned (e.g. fruits and vegetables, including fruit juice) and water on childhood OV/OB risk.	67	Statement remained the same in Round 3
Findings regarding the role of macronutrients, such as total carbohydrates, sugars, protein, fat and fibres, as risk factors for childhood OV/OB are heterogeneous and inconclusive.	27	Statement removed in Round 3
There is a lack of studies exploring the role of micronutrients intake as risk factor for childhood OV/OB.	58	Statement removed in Round 3
There is a lack of studies exploring the role of maternal postnatal lifestyle in their offsprings OV/OB risk.	50	Statement removed in Round 3
Findings regarding the role of breastfeeding in children's OV/OB risk remain conflicting and inconclusive.	38	Statement removed in Round 3
There is a lack of studies exploring social environment characteristics (educational setting, e.g. teacher influence and home environment, e.g. parental practices, family structure) as predictors of childhood OV/OB.	47	Statement removed in Round 3
Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children's	73	Statement remained the same in Round 3

weight status but findings are inconsistent, from small heterogeneous studies.		
Data regarding the impact of the methylation of genes (e.g. of PPAR-γ, NTSM and CHFR) on childhood OV/OB risk remain scarce and inconclusive.	70	Statement remained the same in Round 3
Feasibility of the assessment of predictors of childhood OV/OB in clinical settings It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Objectively measured physical (in)activity through accelerometery (e.g. sedentary time, and time spent in light/moderate/vigorous physical activity).	69	Statement remained the same in Round 3
Dietary habits in terms of nutrients (i.e. macronutrients and micronutrients).	73	Statement removed in Round 3
Genetic variants associated with increased adiposity (e.g. MMP3, LEP, LEPR and FTO).	42	Statement removed in Round 3
Methylation of genes associated with increased adiposity (e.g. PPAR-γ, NTSM and CHFR).	42	Statement removed in Round 3
Metabolites associated with increased adiposity (e.g. amino acids, fatty acids and lipoproteins/cholesterol metabolites).	46	Statement removed in Round 3
Importance of the assessment of predictors of childhood MUO in clinical settings		
Some genetic variants have been associated with insulin resistance (e.g. TCF7L2, CDKAL1, IGF2BP2, HHFX and HNF1A) based on a small number of studies.	55	Statement removed in Round 3
Feasibility of the assessment of predictors of childhood MUO in clinical settings		
It is feasible to evaluate genetic variants associated with insulin resistance (e.g. TCF7L2, CDKAL1, IGF2BP2, HHFX and HNF1A) when assessing childhood MUO in clinical settings.	37	Statement removed in Round 3
Importance of the assessment of indicators of childhood OV/OB in clinical settings		
For the diagnosis of childhood OV, body mass index z-score equal to or more than 1 and less than 2 standard deviations above the median of the World Health Organisation (WHO) growth reference for children and adolescents is an important indicator.	73	Statement remained the same in Round 3
It is important to measure waist circumference for the assessment of childhood OV/OB.	75	Statement remained the same in Round 3
It is important to measure skinfold thickness for the assessment of childhood OV/OB.	36	Statement removed in Round 3
It is important to evaluate body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry) for the assessment of childhood OV/OB.	73	Statement remained the same in Round 3
Feasibility of the assessment of indicators of childhood OV/OB in clinical settings It is feasible to evaluate the following indicators when assessing childhood OV/OB in clinical settings:		
Skinfold thickness.	44	Statement removed in Round 3

Body composition parameters (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	71	Statement remained the same in Round 3

Round 3

Statement	% agreement	Action
Importance of the assessment of predictors of childhood OV/OB in clinical settings		
Daily consumption of breakfast is an important protective factor against childhood OV/OB.	73	Statement removed
Skipping breakfast is an important detrimental risk factor for childhood OV/OB.	64	Statement removed
Findings remain inconsistent regarding the impact of consumption of other foods or food groups than the abovementioned (e.g. fruits and vegetables, including fruit juice, dairy products) and water on childhood OV/OB risk.	50	Statement removed
Maternal prenatal smoking and alcohol consumption are important detrimental factors for childhood OV/OB.	67	Statement removed
Data regarding the impact of epigenetic factors such as the methylation of genes on childhood OV/OB risk remain scarce and inconclusive	75	Statement removed
Data regarding the impact of novel biomarkers [e.g. amino acids (glutamine, alanine, tyrosine, phenylalanine), fatty acids and lipoproteins/cholesterol metabolites] on childhood OV/OB risk remain scarce and inconclusive.	67	Statement removed
Feasibility of the assessment of predictors of childhood OV/OB in school settings It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Objectively measured physical (in)activity through accelerometery (e.g. sedentary time, and time spent in light/moderate/vigorous physical activity).	73	Statement removed
Importance of the assessment of indicators of childhood OV/OB in school settings		
It is important to evaluate body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry) for the assessment of childhood OV/OB.	57	Statement removed
Feasibility of the assessment of indicators of childhood OV/OB in clinical settings It is feasible to evaluate the following indicators when assessing childhood OV/OB in clinical settings:		
Body composition parameters (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	57	Statement removed
Feasibility of the assessment of indicators of childhood MUO in clinical settings It is feasible to evaluate the following indicators when assessing childhood MUO in clinical settings:		

Liver steatosis through imaging techniques (e.g. ultrasound) for the diagnosis of metabolic dysfunction-associated steatotic liver disease (MASLD).	73	Statement removed
The apnea-hypopnea index through polysomnography for the diagnosis of obstructive sleep apnoea (OSA).	62	Statement removed

Study 1b: Consensus of experts on predictors and indicators for the screening of childhood OV/OB and MUO in school settings

Round 2

Statement	% agreement	Action
Importance of the assessment of predictors of childhood OV/OB in school settings		
Active commuting to school (self-reported) is an important protective factor against childhood OV/OB.	64	Statement remained the same in Round 3
Engagement in light/moderate physical activity (objectively measured through accelerometery), extracurricular / leisure-time physical activity (self-reported) and outdoor play (self-reported) do not seem to be important predictors of childhood OV/OB.	0	Statement removed in Round 3
Total time spent in sedentary activities (objectively measured through accelerometery) does not seem to be an important predictor of childhood OV/OB.	21	Statement removed in Round 3
Daily consumption of breakfast is an important protective factor against childhood OV/OB.	64	Statement remained the same in Round 3
Skipping breakfast is an important detrimental risk factor for childhood OV/OB.	62	Statement remained the same in Round 3
The majority of data on dairy consumption are indicative of no association with the risk of childhood OV/OB.	75	Statement remained the same in Round 3
Processed food consumption seems to unfavourably impact children's weight status, but data are limited to a very small number of studies.	69	Statement remained the same in Round 3
Findings remain inconsistent regarding the impact of consumption of other foods or food groups than the abovementioned (e.g. fruits and vegetables, including fruit juice) and water on childhood OV/OB risk.	67	Statement remained the same in Round 3
Being born with increased weight/large for gestational age (indicating overnutrition during pregnancy) is an important detrimental factor for childhood OV/OB.	71	Statement remained the same in Round 3
Maternal prenatal smoking and alcohol consumption are important detrimental factors for childhood OV/OB.	58	Statement remained the same in Round 3
Findings regarding the role of breastfeeding in children's OV/OB risk remain conflicting and inconclusive.	21	Statement removed in Round 3

There is a lack of studies exploring social environment characteristics (educational setting, e.g. teacher influence and home environment, e.g. parental practices, family structure) as predictors of childhood OV/OB.	71	Statement remained the same in Round 3
Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children's weight status but findings are inconsistent, from small heterogeneous studies.	64	Statement remained the same in Round 3
Data regarding the impact of genetic, epigenetic and metabolomic parameters on childhood OV/OB risk remain limited and inconclusive.	39	Statement removed in Round 3
Feasibility of the assessment of predictors of childhood OV/OB in school settings It is feasible to evaluate the following predictors when screening childhood OV/OB in school settings:		
Dietary habits in terms of nutrients (i.e. macronutrients and micronutrients).	43	Statement removed in Round 3
Prenatal exposures (e.g. maternal prenatal body weight status and lifestyle habits).	57	Statement rephrased in Round 3: "Prenatal exposures (e.g. maternal prenatal body weight status, smoking and alcohol consumption) (information taken from parents/guardians)"
Postnatal exposures (e.g. infant birth weight, maternal postnatal lifestyle habits and breastfeeding).	64	Statement rephrased in Round 3: "Postnatal exposures (e.g. infant birth weight) (information taken from parents/guardians)"
Genetic, epigenetic and metabolomic parameters.	55	Statement removed in Round 3
Importance of the assessment of indicators of childhood OV/OB in school settings The following parameters are important indicators of childhood OV/OB:		
Skinfold thickness.	57	Statement removed in Round 3
Body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	71	Statement remained the same in Round 3
Feasibility of the assessment of indicators of childhood OV/OB in school settings It is feasible to evaluate the following indicators when screening for childhood OV/OB in school settings:		
Waist-to-height ratio.	72	Statement remained the same in Round 3

Skinfold thickness.	50	Statement removed in Round 3
Body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	36	Statement removed in Round 3
Importance of the assessment of indicators of childhood MUO in school settings The following parameters are important indicators of childhood MUO:		
High blood pressure.	69	Statement remained the same in Round 3
Feasibility of the assessment of indicators of childhood MUO in school settings It is feasible to evaluate the following indicators when screening for childhood MUO in school settings:		
Blood pressure.	64	Statements rephrased in Round 3; combined in one statement: "It is not feasible to evaluate blood pressure, blood lipids, blood glucose or blood liver enzymes in school settings."
Blood lipids (i.e. total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and triglycerides).	39	
Blood glucose.	54	
Blood liver enzymes.	15	

Round 3

Statement	% agreement	Action
Importance of the assessment of predictors of childhood OV/OB in school settings		
Active commuting to school (self-reported) is an important protective factor against childhood OV/OB.	71	Statement removed
Daily consumption of breakfast is an important protective factor against childhood OV/OB.	64	Statement removed
Skipping breakfast is an important detrimental risk factor for childhood OV/OB.	64	Statement removed
Eating meals with family (e.g. breakfast, dinner) is an important protective factor against childhood OV/OB.	57	Statement removed
The majority of data on dairy consumption are indicative of no association with the risk of childhood OV/OB.	75	Statement removed
Findings remain inconsistent regarding the impact of consumption of other foods or food groups than the abovementioned (e.g. fruits and vegetables, including fruit juice) and water on childhood OV/OB risk.	64	Statement removed
Findings regarding the role of macronutrients, such as total carbohydrates, sugars, protein, fat and fibres, as risk factors for childhood OV/OB are heterogeneous and inconclusive.	64	Statement removed
Maternal prenatal smoking and alcohol consumption are important detrimental factors for childhood OV/OB.	69	Statement removed

There is a lack of studies exploring the role of maternal postnatal lifestyle in their offsprings OV/OB risk.	71	Statement removed
There is a lack of studies exploring social environment characteristics (educational setting, e.g. teacher influence and home environment, e.g. parental practices, family structure) as predictors of childhood OV/OB.	75	Statement removed
Feasibility of the assessment of predictors of childhood OV/OB in school settings It is feasible to evaluate the following predictors when screening childhood OV/OB in school settings:		
Objectively measured physical (in)activity through accelerometery (e.g. sedentary time, and time spent in light/moderate/vigorous physical activity).	57	Statement removed
Prenatal exposures (e.g. maternal prenatal body weight status, smoking and alcohol consumption) (information taken from parents/guardians).	71	Statement removed
Postnatal exposures (e.g. infant birth weight) (information taken from parents/guardians).	57	Statement removed
Social environment characteristics (e.g. teacher influence and parental practices).	57	Statement removed
Feasibility of the assessment of indicators of childhood MUO in school settings It is feasible to evaluate the following indicators when screening for childhood MUO in school settings:		
It is not feasible to evaluate blood pressure, blood lipids, blood glucose or blood liver enzymes in school settings.	50	Statement removed

Study 2: Consensus of experts on the assessment and lifestyle management of childhood OV/OB and MUO in clinical settings

Round 2

Statement	% agreement	Action
Parameters for the assessment of childhood OV/OB in clinical settings The assessment of childhood OV/OB in clinical settings should include the evaluation of:		
Built environment characteristics (e.g. street intersection density, presence of greenspace, neighbourhood safety, access to fresh food and proximity to fast food).	63	Statement removed in Round 3
Epigenetic exposures (e.g. the methylation of genes associated with increased adiposity).	75	Statement rephrased in Round 3: "Epigenetic exposures (e.g. e.g. the methylation of genes associated with increased adiposity) should be assessed to guide treatment options and facilitate treatment decisions. Also, statement on the evaluation of genetics

		was rephrased: "Genetic background (e.g. genetic variants associated with increased adiposity) should be assessed to guide treatment options and facilitate treatment decisions".
Parameters for the assessment of childhood MUO in clinical settings The assessment of childhood MUO in clinical settings should also include the evaluation of:		
Novel metabolic biomarkers (e.g. amino acids, fatty acids, lipoproteins and cholesterol metabolites).	60	Statement removed in Round 3
Characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings Lifestyle interventions for the management of childhood OV/OB in clinical settings:		
should have a duration of at least 3 months with ideally >26 contact hours.	71	Statement rephrased in Round 3: "Should have a duration of at least 3 months".
should utilise digital tools (e.g. web-based platforms and smartphone applications).	60	Statement rephrased in Round 3: "Would profit from the use of digital tools as a complementary feature (e.g. web-based platforms and smartphone applications)".
Digital tools for the lifestyle management of childhood OV/OB in clinical settings should:		
Be available in multiple devices (e.g. smartphones, tablets and computers).	73	Statement remained in Round 3
Have engaging content.	75	Statement remained in Round 3
Use gamification to enhance motivation and engagement.	56	Statement rephrased in Round 3: "Use serious games to enhance motivation and engagement".
Genetic predisposition has an impact on the effectiveness of behaviour modification in the lifestyle management of childhood OV/OB in clinical settings.	62	Statement removed in Round 3
Outcomes of lifestyle interventions for the management of childhood MUO in clinical settings Outcomes of lifestyle interventions for the management of childhood MUO in clinical settings should also include:		
Novel metabolic biomarkers (e.g. amino acids, fatty acids, lipoproteins and cholesterol metabolites).	67	Statement removed in Round 3

Round 3

Statement	% agreement	Action
Parameters for the assessment of childhood OV/OB in clinical settings		
Genetic background (e.g. genetic variants associated with increased adiposity) should be assessed to guide treatment options and facilitate treatment decisions.	69	Statement removed
Epigenetic exposures (e.g. e.g. the methylation of genes associated with increased adiposity) should be assessed to guide treatment options and facilitate treatment decisions.	50	Statement removed
Parameters for the assessment of childhood MUO in clinical settings The assessment of childhood MUO in clinical settings should also include the evaluation of:		
the presence of obstructive sleep apnoea (OSA).	69	Statement removed
the presence of polycystic ovary syndrome (PCOS).	67	Statement removed
Characteristics of lifestyle interventions for the management of childhood MUO in clinical settings		
Lifestyle interventions for the management of childhood MUO in clinical settings should have the same general characteristics as those for the management of childhood OV/OB.	67	Statement removed
Outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings Outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings should include:		
direct medical costs related to OV/OB.	67	Statement removed

Study 3: Consensus of experts on the screening and lifestyle prevention of childhood OV/OB and MUO in school settings

Round 2

Statement	% agreement	Action
Parameters for the screening of childhood OV/OB in school settings The screening of childhood OV/OB in school settings should include the evaluation of:		
Children's dietary habits in terms of intake of nutrients (e.g. carbohydrates, lipids, proteins, dietary fibres, vitamins and minerals).	60	Statement removed in Round 3
Children's dietary habits in terms of adherence to dietary patterns (e.g. the Mediterranean diet and the Western-type diet).	68	Statement remained the same in Round 3
Children's prenatal exposures (e.g. maternal pre-pregnancy weight, maternal dietary habits during pregnancy and gestational diabetes).	63	Statement rephrased in Round 3; combined in one statement "11. Other information on important risk factors that can be provided by parents/caregivers (e.g. perinatal factors such as pre-pregnancy weight,
Children's postnatal exposures (e.g. infant birth weight, breastfeeding, formula feeding and child weight gain during infancy).	68	
Parental body weight status (e.g. body mass index)	70	

		presence of gestational diabetes, infant birth weight, breastfeeding, formula feeding, parental body weight status)".
Characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings Lifestyle interventions for the prevention of childhood OV/OB in school settings:		
Should include a physical activity training component (e.g. football training).	75	Statement rephrased in Round 3: "Should include a hands-on, experiential, practical physical activity component (e.g. participation in group sports)". Also, the same statement on the inclusion of nutrition component was rephrased: "Should include a hands-on, experiential, practical nutrition component (e.g. nutrition games)".
Facilitate sharing children's progress with parents/caregivers.	72	Statement rephrased in Round 3: "Encourage collaboration between children and parents/caregivers in the context of a family-centric approach, targeting more inclusive interventions."

Round 3

Statement	% agreement	Action
Parameters for the screening of childhood OV/OB in school settings The screening of childhood OV/OB in school settings should include the evaluation of:		
children's dietary habits in terms of adherence to dietary patterns (e.g. the Mediterranean diet and the Western-type diet).	73	Statement removed
Other information on important risk factors that can be provided by parents/caregivers (e.g. perinatal factors such as pre-pregnancy weight, presence of gestational diabetes, infant birth weight, breastfeeding, formula feeding, parental body weight status)	73	Statement removed
Parameters for the screening of childhood MUO in school settings		
The screening of childhood MUO in school settings should also include the evaluation of	71	Statement removed

family history of non-communicable diseases (e.g. diabetes mellitus and cardiovascular diseases).		
Parents/caregivers of children at high risk or with a diagnosis of OV/OB in school settings should be informed and encouraged to proceed to a clinical setting (e.g. hospital) for the child's comprehensive screening/assessment of MUO.	73	Statement removed
Characteristics of lifestyle interventions for the management of childhood OV/OB in clinical settings Lifestyle interventions for the prevention of childhood OV/OB in school settings:		
should be designed based on a theoretical model for behaviour change (e.g. the social cognitive theory or the social ecological model).	71	Statement removed
Outcomes of lifestyle interventions for the prevention of childhood MUO in school settings Outcomes of lifestyle interventions for the prevention of childhood MUO in school settings should include:		
blood pressure.	64	Statement removed
common metabolic biomarkers (e.g. glucose metabolism indices, lipidemic profile and liver enzymes).	71	Statement removed

Appendix 1.2. Additional statistical data for agreed statements (median, mode)

Study 1a: Consensus of experts on predictors and indicators for the assessment of childhood OV/OB and MUO in clinical settings

Statement	Median	Mode
Physical activity and inactivity		
Engagement in moderate-to-vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB.	4	4
Substituting sedentary time with light/moderate/vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB.	5	5
Participation in organised physical activity or sports (self-reported) is an important protective factor against childhood OV/OB.	5	5
Active commuting to school (self-reported) is an important protective factor against childhood OV/OB.	4 ǂ	4
Total screen time and time spent in specific screens (e.g. TV, DVD, video and computer) (self-reported) is an important detrimental risk factor for childhood OV/OB.	5	5
Diet		
Eating meals with family (e.g. breakfast, dinner) is an important protective factor against childhood OV/OB.	4	4
Eating while watching TV is an important detrimental factor for childhood OV/OB.	5	5
Increased adherence to a “healthy” dietary pattern (characterised by increased consumption of vegetables, fruits, legumes, fish and wholemeal products) or to patterns like the Mediterranean or the DASH diet, is an important protective factor against childhood OV/OB.	5	5
Increased adherence to an “unhealthy” dietary pattern (characterised by increased consumption of processed foods or energy-dense foods like takeaways, high fat and sugars intake), is an important detrimental factor for childhood OV/OB.	5	5
Sugar-sweetened beverage consumption shows positive associations with adiposity measurements and should be regarded as a risk factor for childhood OV/OB.	5	5
Processed food consumption seems to unfavourably impact children’s weight status, but data are limited to a very small number of studies.	4 ǂ	4
Sleep		
Increased sleep duration and quality may have a protective effect against childhood OV/OB, though findings are limited by the very small number of studies.	4	4
Perinatal factors		
Maternal perinatal OV/OB status is an important detrimental factor for childhood OV/OB.	5	5
Maternal glucose abnormal metabolism (including gestational diabetes mellitus) is an important detrimental factor for childhood OV/OB.	4	4

Being born with increased weight/large for gestational age (indicating overnutrition during pregnancy) is an important detrimental factor for childhood OV/OB.	4	4
Other factors		
Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children's weight status but findings are inconsistent, from small heterogeneous studies.	4	4
Based on a small number of studies, some genetic variants (e.g. MMP3, LEP, LEPR and FTO) have been associated with increased adiposity in children and adolescents.	4 ǂǂ	4

ǂ n=14 ǂǂ n=13

Statement	**Median**	**Mode**
It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Physical activity and inactivity		
Self-reported physical (in)activity (e.g. participation in organised physical activity / sports, active commuting to school and screen time).	4	4
Diet		
Dietary habits in terms of meal patterns (e.g. consumption of breakfast, eating meals with family and eating while watching TV).	4	4
Dietary habits in terms of dietary patterns (e.g. adherence to "healthy", such as the Mediterranean diet, or "unhealthy", such as the energy dense pattern).	4	4
Dietary habits in terms of foods and food groups (e.g. sugar-sweetened beverages and processed foods).	4	4
Sleep		
Sleep habits (e.g. sleep duration and quality).	4	4
Perinatal factors		
Prenatal exposures (e.g. maternal prenatal body weight status and lifestyle habits).	4	4
Other factors		
Social environment characteristics (e.g. teacher influence and parental practices).	4	4
Built environment characteristics (e.g. availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density).	4	4

Statement	**Median**	**Mode**
Body mass index is an important indicator of childhood OV/OB.	4	5
For the diagnosis of childhood OV, body mass index z-score equal to or more than 1 and less than 2 standard deviations above the median of the World Health Organisation growth reference for children and adolescents is an important indicator.	4	4
For the diagnosis of childhood OB, body mass index z-score equal to or more than 2 standard deviations above the median of the World Health Organisation growth reference for children and adolescents is an important indicator.	5	5

It is important to measure waist circumference for the assessment of childhood OV/OB.	4 ǂ	5
Waist-to-height ratio ≥0.5 is an important indicator of childhood OV/OB.	4 ǂ	4

ǂ n=14

Statement	Median	Mode
It is feasible to evaluate the following indicators when assessing childhood OV/OB in clinical settings:		
Body mass index.	5	5
Body mass index z-score.	5	5
Waist circumference.	5	5
Waist-to-height ratio.	5	5

Statement	Median	Mode
The following parameters are important indicators of childhood MUO:		
High blood pressure / hypertension.	5	5
Abnormal blood lipids (i.e. high total cholesterol, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol and high triglycerides) / dyslipidaemia.	5	5
Impaired fasting glucose / impaired glucose tolerance / diabetes mellitus.	5	5
Hyperinsulinaemia.	5	5
High blood liver enzymes.	5 ǂ	5
Metabolic dysfunction-associated steatotic liver disease.	5 ǂ	5
Obstructive sleep apnoea.	5 ǂ	5
Polycystic ovary syndrome.	4 ǂ	4
Metabolic syndrome is an important indicator of childhood MUO and its presence should be evaluated on top of the assessment of its individual components.	5 ǂ	5

ǂ n=13

Statement	Median	Mode
It is feasible to evaluate the following indicators when assessing childhood MUO in clinical settings:		
Blood pressure.	5	5
Blood lipids (i.e. total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and triglycerides).	5	5
Blood glucose metabolism indices [e.g. fasting plasma glucose, 2-h plasma glucose after 75-g oral glucose tolerance test, or glycosylated haemoglobin].	5	5
Blood insulin.	4	5
Blood liver enzymes.	5 ǂ	5
Menstrual irregularities and evidence of hyperandrogenism (clinical or biochemical) for the diagnosis of polycystic ovary syndrome.	4 ǂ	4
Presence of the metabolic syndrome.	4	4

ǂ n=14

Study 1b: Consensus of experts on predictors and indicators for the screening of childhood OV/OB and MUO in school settings

Statement	Median	Mode
Physical activity and inactivity		
Engagement in moderate-to-vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB	5	5
Substituting sedentary time with light/moderate/vigorous physical activity (objectively measured through accelerometry) is an important protective factor against childhood OV/OB.	5	5
Participation in organised physical activity or sports (self-reported) is an important protective factor against childhood OV/OB.	4	4
Total screen time and time spent in specific screens (e.g. TV, DVD, video and computer) (self-reported) is an important detrimental risk factor for childhood OV/OB.	4	4
Diet		
Eating while watching TV is an important detrimental factor for childhood OV/OB.	4	4
Increased adherence to a “healthy” dietary pattern (characterised by increased consumption of vegetables, fruits, legumes, fish and wholemeal products) or to patterns like the Mediterranean or the DASH diet, is an important protective factor against childhood OV/OB.	4.5	4
Increased adherence to an “unhealthy” dietary pattern (characterised by increased consumption of processed foods or energy-dense foods like takeaways, high fat and sugars intake), is an important detrimental factor for childhood OV/OB.	5	5
Sugar-sweetened beverage consumption shows positive associations with adiposity measurements and should be regarded as a risk factor for childhood OV/OB.	5	5
Processed food consumption seems to unfavourably impact children’s weight status, but data are limited to a very small number of studies.	4 ǂ	4
There is a lack of studies exploring the role of micronutrients intake as risk factor for childhood OV/OB.	4 ǂǂ	4
Sleep		
Increased sleep duration and quality may have a protective effect against childhood OV/OB, though findings are limited by the very small number of studies.	4	4
Perinatal factors		
Maternal perinatal OV/OB status is an important detrimental factor for childhood OV/OB.	4	4
Maternal glucose abnormal metabolism (including gestational diabetes mellitus) is an important detrimental factor for childhood OV/OB.	4	4
Being born with increased weight/large for gestational age (indicating overnutrition during pregnancy) is an important detrimental factor for childhood OV/OB.	4	4
Other factors		
Neighbourhood characteristics, such as availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density, may impact on children’s weight status but findings are inconsistent, from small heterogeneous studies.	4 ǂ	4

ǂ n=13 ǂǂ n=11

Statement	Median	Mode
It is feasible to evaluate the following predictors when assessing childhood OV/OB in clinical settings:		
Physical activity and inactivity		
Self-reported physical (in)activity (e.g. participation in organised physical activity / sports, active commuting to school and screen time).	4	4
Diet		
Dietary habits in terms of meal patterns (e.g. consumption of breakfast, eating meals with family and eating while watching TV).	4	4
Dietary habits in terms of dietary patterns (e.g. adherence to "healthy", such as the Mediterranean diet, or "unhealthy", such as the energy dense pattern).	4	4
Dietary habits in terms of foods and food groups (e.g. sugar-sweetened beverages and processed foods).	4	4
Sleep		
Sleep habits (e.g. sleep duration and quality).	4	4
Other factors		
Built environment characteristics (e.g. availability of food and service retails, recreational spaces, physical activity facilities, green spaces and intersection density).	4	4

Statement	Median	Mode
Children at high risk or with a diagnosis of OV/OB in school settings should be referred to a clinical setting (e.g. hospital) for a comprehensive assessment of predictors of MUO.	4	4

Statement	Median	Mode
The following parameters are important indicators of childhood OV/OB:		
Body mass index.	4	4
Body mass index z-score.	5	5
Waist circumference.	4	4
Waist-to-height ratio ≥0.5.	4.5	5
Body composition (e.g. fat mass and fat-free mass) through more sophisticated methodologies (e.g. bioelectrical impedance analysis and dual-energy X-ray absorptiometry).	4	4

Statement	Median	Mode
It is feasible to evaluate the following indicators when screening for childhood OV/OB in school settings:		
Body mass index.	5	5
Body mass index z-score.	5	5
Waist circumference.	4	4
Waist-to-height ratio.	4	4

Statement	Median	Mode
The following parameters are important indicators of childhood MUO:		
High blood pressure / hypertension.	5	5

Abnormal blood lipids (i.e. high total cholesterol, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol and high triglycerides) / dyslipidaemia.	4	4
High blood glucose.	4	4
High blood liver enzymes.	4 ǂ	4

ǂ n=12

Study 2: Consensus of experts on the assessment and lifestyle management of childhood OV/OB and MUO in clinical settings

Statement	Median	Mode
The assessment of childhood OV/OB in clinical settings should include the evaluation of:		
Dietary habits in terms of intake of nutrients (e.g. carbohydrates, lipids, proteins, dietary fibres, vitamins and minerals)	4	4
Dietary habits in terms of consumption of foods and food groups (e.g. fruits, vegetables and sugar-sweetened beverages).	5	5
Dietary habits in terms of adherence to dietary patterns (e.g. the Mediterranean diet and the Western-type diet)	4	4
Dietary habits in terms of meal patterns (e.g. meal frequency, meal context, meal setting and meal quality).	5	5
Physical activity (e.g. time spent in light/moderate/vigorous activities, participation in sports and active commuting).	5	5
Physical inactivity (e.g. total sedentary time and screen time – TV, computer, cell phone).	5	5
Sleep habits (e.g. daily sleep duration, sleep quality and presence of sleep disorders).	5	5
Prenatal exposures (e.g. maternal pre-pregnancy weight, maternal dietary habits during pregnancy and gestational diabetes)	4	4
Postnatal exposures (e.g. infant birth weight, breastfeeding, formula feeding and child weight gain during infancy)	4	4
Social environment characteristics (e.g. parental practices and peer support/pressure).	4	4
Anthropometric indices (e.g. body weight and waist circumference).	5	5
Body composition parameters (e.g. body fat and fat-free mass).	4	5
Parental body weight status (e.g. body mass index).	4	4
Parental/family socioeconomic status (e.g. educational level and income).	4	4

Statement	Median	Mode
The assessment of MUO should be routinely included in the assessment of each case of childhood OV/OB in clinical settings.	5	5
The assessment of childhood MUO in clinical settings should also include the evaluation of the presence of:		
Hypertension	5	5
Dyslipidaemia	5	5
(pre) Diabetes.	5	5
Insulin resistance (e.g. HOMA-IR)	4 ǂ	4
Metabolic dysfunction–associated steatotic liver disease (MASLD)	4.5 ǂ	5

ǂ n=12

Statement	Median	Mode

Lifestyle interventions for the management of childhood OV/OB in clinical settings:		
Should be delivered by a multidisciplinary team (e.g. paediatricians and/or paediatric health care providers with training in OV/OB, as well as other professionals with training in behaviour and lifestyle fields, such as dietitians, exercise specialists, psychologists and behavioural health practitioners).	5	5
Should follow a family-centred approach (i.e. the parent/caregiver or family is involved in the treatment).	5	5
Can be delivered through group sessions, individual sessions or a combination of both.	5	5
Should have a duration of at least 3 months.	5	5
Should incorporate health education and skill building.	5	5
Should incorporate behaviour modification and counselling.	5	5
Should be based on motivational interviewing (i.e. a patient-centred counselling style that identifies and reinforces patient's own motivation for change) to engage patients in treating OV/OB.	5	5
Should be multicomponent, i.e. target multiple lifestyle habits (e.g. diet, physical activity and sleep).	5	5
Should target a healthy diet (e.g. low consumption of energy-dense foods rich in sugars and fat, low consumption of sugar-sweetened beverages, daily consumption of fruits and vegetables).	5	5
Should target a physically active lifestyle (e.g. engagement in ≥60 minutes of moderate to vigorous physical activity per day and <1-2 hours of screen time per day).	5	5
Should target sufficient sleep (i.e., appropriate amount of sleep for age).	5	5
Would profit from the use of digital tools as a complementary feature (e.g. web-based platforms and smartphone applications).	4	4
In case digital tools are available for lifestyle management of childhood OV/OB in clinical settings, they should:		
Be available in multiple devices (e.g. smartphones, tablets and computers).	4	4
Have engaging content.	5	5
Use serious games to enhance motivation and engagement.	4	5
Have customizable features to meet individual needs and preferences.	5	5
Provide tailored feedback and recommendations based on user data.	5	5
Facilitate sharing patients' progress with healthcare professionals and parents/caregivers.	5	5

Statement	**Median**	**Mode**
Lifestyle interventions for the management of childhood MUO in clinical settings should be more intense and prioritise the existing comorbidities.	5	5

Statement	**Median**	**Mode**
Outcomes of lifestyle interventions for the management of childhood OV/OB in clinical settings should include:		
Anthropometric indices (e.g. body weight and waist circumference).	5	5
Body composition parameters (e.g. body fat and fat-free mass).	5	5

Lifestyle habits (e.g. diet, physical activity and sleep).	5	5
Food literacy (i.e. the knowledge, skills, and attitudes necessary to make informed decisions about food and its impact on health).	5	5
Health-related quality of life.	5	5
Mental wellbeing (emotional and psychological).	5	5
Mental distress (e.g. anxiety, depressive symptoms and self-perceived stigma).	5	5

Statement	**Median**	**Mode**
Outcomes of lifestyle interventions for the management of childhood MUO in clinical settings should also include:		
Blood pressure	5	5
Common metabolic biomarkers (e.g. glucose metabolism indices, lipidemic profile and liver enzymes).	5	5

Study 3: Consensus of experts on the screening and lifestyle prevention of childhood OV/OB and MUO in school settings

Statement	**Median**	**Mode**
The screening of childhood OV/OB in school settings should include the evaluation of:		
Children's dietary habits in terms of consumption of foods and food groups (e.g., fruits, vegetables and sugar-sweetened beverages.	5	5
Children's dietary habits in terms of meal patterns (e.g. meal frequency, meal context, meal setting and meal quality).	5	5
Children's physical activity (e.g. time spent in light/moderate/vigorous activities, participation in sports and active commuting).	5	5
Children's physical inactivity (e.g. total sedentary time and screen time – TV, computer, cell phone).	5	5
Children's sleep habits (e.g. daily sleep duration, sleep quality and presence of sleep disorders).	5	5
Children's social environment characteristics (e.g. parental practices and peer support/pressure).	4	4
Children's built environment characteristics (e.g. street intersection density, presence of greenspace, neighbourhood safety, access to fresh food and proximity to fast food).	4	5
Children's anthropometric indices (e.g. body weight and waist circumference).	4	4
Parental/family socioeconomic status (e.g. educational level and income).	4	4

Statement	**Median**	**Mode**
Lifestyle interventions for the prevention of childhood OV/OB in school settings:		
Can be delivered by a wide range of individuals (e.g. health researchers, classroom teachers and physical education teachers) after appropriate training.	4 ǂ	4
Should include teachers' training (train-the-trainer approach).	4	4
Should include the active participation/involvement of children's parents/caregivers.	4	4
Should have a duration of at least 1 school year.	4 ǂ	4

Should include a nutrition education component (based on dietary recommendations).	5	5
Should include a hands-on, experiential, practical nutrition component (e.g. nutrition games).	4 ǂ	4
Should include a nutrition policy component (e.g. limited availability of unhealthy snacks in school canteens).	5	5
Should include a physical activity education component (based on physical activity recommendations).	4	4
Should include a hands-on, experiential, practical physical activity component (e.g. participation in group sports).	4	5
Should include a physical activity policy component (e.g. universal access of students to a sports facility).	4.5 ǂ	5
Should utilise digital tools (e.g. web-based platforms and smartphone applications).	4.5 ǂ	5
Digital tools for the lifestyle prevention of childhood OV/OB in school settings should:		
Be available in multiple devices (e.g. smartphones, tablets and computers).	4	4
Be characterized by user-friendly interfaces and engaging content.	5	5
Have customizable features to meet individual needs and preferences.	5	5
Use gamification to enhance motivation and engagement.	4	4
Provide tailored feedback and recommendations based on user data.	4	4
Encourage collaboration between children and parents/caregivers in the context of a family-centric approach, targeting more inclusive interventions.	4	4
Cultural characteristics have an impact on the effectiveness of interventions in changing the lifestyle habits (dietary and physical activity) of children and adolescents in school settings.	4	4
Socioeconomic status has an impact on the effectiveness of interventions in changing the lifestyle habits (dietary and physical activity) of children and adolescents in school settings.	4	4

ǂ n=14

Statement	**Median**	**Mode**
Lifestyle interventions for the prevention of childhood MUO in school settings should have the same general characteristics as those for the prevention of childhood OV/OB.	4	4

Statement	**Median**	**Mode**
Outcomes of lifestyle interventions for the prevention of childhood OV/OB in school settings should include:		
Anthropometric indices (e.g. body weight and waist circumference).	4 ǂ	4
Body composition parameters (e.g. body fat and fat-free mass).	4 ǂǂ	4
Lifestyle habits (e.g. diet, physical activity and sleep).	4	4
Food literacy (i.e. the knowledge, skills, and attitudes necessary to make informed decisions about food and its impact on health).	4	4
Health-related quality of life.	4	4
Mental wellbeing (emotional and psychological).	4	4

ǂ n=14 ǂǂ n=13

Appendix 2.1. Informed consents for clinical workshops.

BIO-STREAMS Workshop Information Letter to Parents/Guardians and Competent Children
[Date]

Introduction

We are inviting you (or your child) to take part in a **co-creation workshop** relating to the **BIO-STREAMS project**, which aims to help you (or your child), your peers, and your family, to maintain a healthy lifestyle through education and digital tools. BIO-STREAMS also aims to facilitate and conduct scientific research on childhood obesity based on data collected from children with and without obesity across the EU.

A significant part of BIO-STREAMS is to get input from children directly about our plans to research and improve weight-related health. We plan to organize two different co-creation workshop sessions lasting for 90 minutes each to engage, collaborate with, and gather feedback from children between 5 and 18 years old about topics related to health. This way, you (or your child) will shape the direction of our project and – we hope – help to create a positive impact on public health.

As you may be aware, overweight and obesity rates have reached epidemic proportions across the EU, and continue to grow. Innovative solutions are required to prevent, improve, and better understand this epidemic. The BIO-STREAMS project is primarily dedicated towards understanding genetic and environmental causes of obesity and excess weight, and whether digital tools like apps and games can improve children's and adolescents' health. Early-age interventions are known to be a key piece of this puzzle, potentially having long-term beneficial outcomes for health throughout life, which is why we are focusing on children under the age of 18.

The co-creation workshop that you are invited to is aimed at making sure our plans are user-centric, culturally sensitive, ethical, and effective. We will do this by introducing a series of topics, such as an idea for a health-related phone application, and discussing with you (or your child), together with children of similar age, in a collaborative and age-appropriate manner.

Before you decide whether to participate in this study and sign the consent form, or do so for your child, please take your time to read this information letter. If there is something you do not understand, or if you would like more information, please ask us. It is important that you fully comprehend what participation in this project entails. Please also note that there is a simplified version of this information letter.

Who are we?

We are researchers from [organisation] working under the European Union Horizon Europe Program funded BIO-STREAMS project (*Multi-Pillar Framework For Children Anti-Obesity Behaviour Building On An EU Biobank, Micro Moments And Mobile Recommendation Systems, Approval Number 101080718)* together with 29 partners from 15 European countries. Our team is led by [Name] and you can reach us using this e-mail address: [email].

We are one of seven clinical research partners based across Belgium, Bulgaria, Greece, Spain, Sweden and Slovenia. The BIO-STREAMS project also involves other European organisations with other forms of expertise, such as in technology, education, law, and project management. However, we at [organisation] will be the main organisation that you will interact with, and you should reach out to us if you have any issues or questions.

What does the study involve?

We are recruiting children aged 5-18, both with and without overweight or obesity.

You (or your child's) participation will involve their attendance at, and participation in, two 90-minute workshop sessions. In these, we aim to introduce ourselves, our project, and talk about the need for children's and adolescents' voices to shape health-based initiatives like BIO-STREAMS. After, we will brainstorm ideas and concepts for BIO-STREAMS through discussion, games, role-playing and/or drawings;

From these interactions, we will collect information about the responses using child-friendly methods (we will not take audio or visual recordings of the workshops) and use that to refine our future plans. We will also share these insights with other including educators, healthcare professionals, and policymakers, to ensure that children and adolescents' voices are heard in the design and implementation of obesity prevention interventions.

Benefits of Participation

Whilst the main benefits of the project are the betterment of public health, and the improvement of scientific knowledge, you and/or your child may benefit from improved understanding of health-related behaviours. No compensation, beyond certain costs related to the study, will be provided.

Risks and Discomforts of Participation

Your child may experience some emotional distress from discussing sensitive topics. As with any medical research project that involves personal data, there is also a risk of a data breach. However, we have taken, and will take, steps to minimize these risks, including the provision of psychological support if necessary, implementation of strict confidentiality measures and protocols, and the right to withdraw from the study at any time.

Privacy and Confidentiality

Our goal is not to collect detailed individual responses from participants, but to gather an overall picture of the responses to discussion in the workshop sessions. Therefore, directly identifying information such as addresses, dates of birth and full names will not be collected as part of the workshop's results.

However, we will still process certain personal data about you and/or your child, including identifying information, in order to ensure you are (or your child is) suitable for the workshop, to gather requisite consent, and to ensure we can contact you if the need arises. We may also process further data that relates to you (or your child), including sharing with our project's partners, but only we at [organisation] will have access to information that allows the direct identification of you (or your child).

All personal data will be kept confidential and stored securely in compliance with applicable law, including the General Data Protection Regulation (GDPR). Please see the Privacy Notice attached to this form for further information.

Voluntary Participation

Participation in the co-creation workshop is entirely voluntary, and participants have the right to refuse or withdraw at any time without consequences. Refusal to participate, or withdrawal from participation, will not affect your child's access to healthcare or other services.

Consent

Participation in the study requires giving consent, which means that you allow you (or your child's) personal information for the purposes of the workshop.
Legal guardians must provide consent on behalf of children and adolescents under X years of age. If the participant is between the ages of Y and X years, we would like them to also sign the consent form, to show that they are willing to participate. If the child is under Y years, we will also ask them to assent to participation in the study, depending on their ability to understand the project.

Contact Details

If you would like more information, you may call us. You are welcome to call us at any time before or during the study, with questions and/or concerns, or if you would like to withdraw yourself (or your child) from the study. You can contact [insert contact details here].

Conclusion

We very much appreciate your consideration in participating in BIO-STREAMS co-creation workshops, which we hope will have a meaningful impact on public health and scientific research. If you agree to your child's participation, please read and sign the consent form below.

BIO-STREAMS Simplified Information Letter
[Date]

Hello!
We're inviting you to join a workshop for a project called BIO-STREAMS. This project is all about helping kids like you, your friends, and your family to stay healthy and happy. We're also doing some important research about childhood overweight.

What's the project about?

You might know that there are more and more kids and adults in Europe who have problems with weight. This is a big problem, and we need new ways to help people to maintain a healthy lifestyle. That's where BIO-STREAMS comes in. We're trying to understand how digital tools like apps and games can help kids stay healthy.

What will you do in the workshop?

We're planning two fun workshops that will last for 90 minutes each. In these workshops, we'll talk about health and come up with ideas for the BIO-STREAMS project. You'll get to share your thoughts and ideas, and do some fun activities too!

Who are we?

We're a team of researchers from [organisation], and we're working on this project with lots of other people from 15 different countries in Europe. If you have any questions or if something is bothering you, you or your parent or guardian can always reach out to us.

What will happen in the study?

If you decide to join us, you'll take part in two workshop sessions. We'll talk about health, do some fun activities, and you'll get to share your ideas about how we can help kids stay healthy. We won't record the workshops, but we'll take notes so we can remember all the great ideas you come up with!

What's good about joining?

By joining, you'll learn more about staying healthy. Plus, your ideas could help other kids stay healthy too!

Are there any risks?

Sometimes, talking about sensitive topics can make people feel uncomfortable. But don't worry, we'll do our best to make sure everyone feels safe and respected. If you don't feel comfortable, please let us know. And remember, you can always choose to stop participating at any time.

What about your privacy?

We won't collect any personal information like your full name or address during the workshops. But we will need some information about you to make sure you can participate and to get your permission to join. We promise to do our best keep all your information safe and private.

Do you want to join?

Joining is totally up to you, and it's okay to say no. If you want to join, you and your parents will need to give permission by signing a consent form.

Need more info?

If you have any questions, you can always ask us. You can contact us at [insert contact details here], or ask your parent or guardian to do so for you.

Thank you!
We really appreciate you considering joining our BIO-STREAMS workshops. We hope you'll decide to join us in making a positive impact on health and science!

Declaration of Consent – Parent or Legal Guardian

Participation of a minor in the BIO-STREAMS project study:

Child's name: .....

Child's date of birth: .....

	YES	NO
I understand what this research is about.		
I understand what my child's role in the research will be, what they will be doing.		
I know what data will be collected about my child, and how it will be processed.		
I have been able to ask questions and get answers.		
I am happy for my child to participate in this activity and be part of the research.		
I know that I can withdraw my consent at any time and I know who to contact.		
I agree that my child may participate in the BIO-STREAMS project workshop at [organisation] led by [name and email] at [date].		
I consent to my child's personal data being processed for the purposes of the BIO-STREAMS project workshop.		

Name of parent or legal guardian**:** .....

I agree that my child may participate in the BIO-STREAMS project on site at the clinic/hospital, led by [name and email] at [date].
I acknowledge that my child has agreed to participate and as his/her parent/guardian I agree with it. I may withdraw my consent at any time.

Signature of parent or legal guardian: .....

Place and date: .....

Signature of the researcher: .....
Researcher leading the BIO-STREAMS workshop in [country]: Name, Institution, Email.

For researcher only: If parent or legal guardian is not consenting (e.g. because minor has capacity to consent), please indicate why:

.....

Declaration of Consent – Minor

Participation of a minor in the BIO-STREAMS project study:

Child's name: .....

Child's date of birth: .....

	YES	NO
I understand what this research is about.		
I understand what my role in the research will be, what I will be doing.		
I know what data will be collected about me, and how it will be processed.		
I have been able to ask questions and get answers.		
I am happy to participate in this activity and be part of the research.		
I know that I can withdraw my consent at any time and I know who to contact.		
I agree to participate in the BIO-STREAMS project workshop at [organisation] led by [name and email] at [date].		
I consent to my personal data being processed for the purposes of the BIO-STREAMS project workshop.		

I agree that my child may participate in the BIO-STREAMS project on site at the clinic/hospital, led by [name and email] at [date].
I acknowledge that I agree to participate. I may withdraw my consent at any time.

Signature or equivalent of child: .....

Place and date: .....

Signature of the researcher: .....
Researcher leading the BIO-STREAMS workshop in [country]: Name, Institution, Email.

For researcher only: If child is not consenting (e.g. because minor has no capacity to consent), please indicate why:

.....

Privacy Notice of [Clinical Partner] - BIO-STREAMS Project

1. **Introduction**

This Notice explains how [organisation] processes your or your child's personal data due to your participation in the co-creation workshops of the BIO-STREAMS project, funded within the framework of the Horizon Europe Programme (approval number: *101080718*).

2. **Personal data we collect about you / your child**

The following personal data may be processed throughout the BIO-STREAMS workshops:
Basic demographic information (e.g. age, gender and school grade)
Data collected during co-creation workshops from data subjects' responses to questions

Purposes of processing and legal bases

Your / your child's personal data is processed for the following purposes:

- To fulfil the purposes of the co-creation workshop, i.e., to gather insights about BIO-STREAMS intervention and the BIO-STREAMS study
- To comply with, and demonstrate compliance with, legal and ethical obligations to which we are subject
- To pseudonymize and anonymize personal data to ensure confidentiality

The lawful basis for processing of personal data is **informed and explicit consent** given by children and/or legal guardians, depending on the capacity of the child to lawfully consent to data processing.

Any such personal data will be processed in accordance with the European General Data Protection Regulation (GDPR, 2016/679). The responsible entity (i.e. controller) under the for the processing of personal data as part of the study is [PARTNER], [contact details].

Your data will be stored at [PARTNER] for [X period].

3. **Your privacy rights**

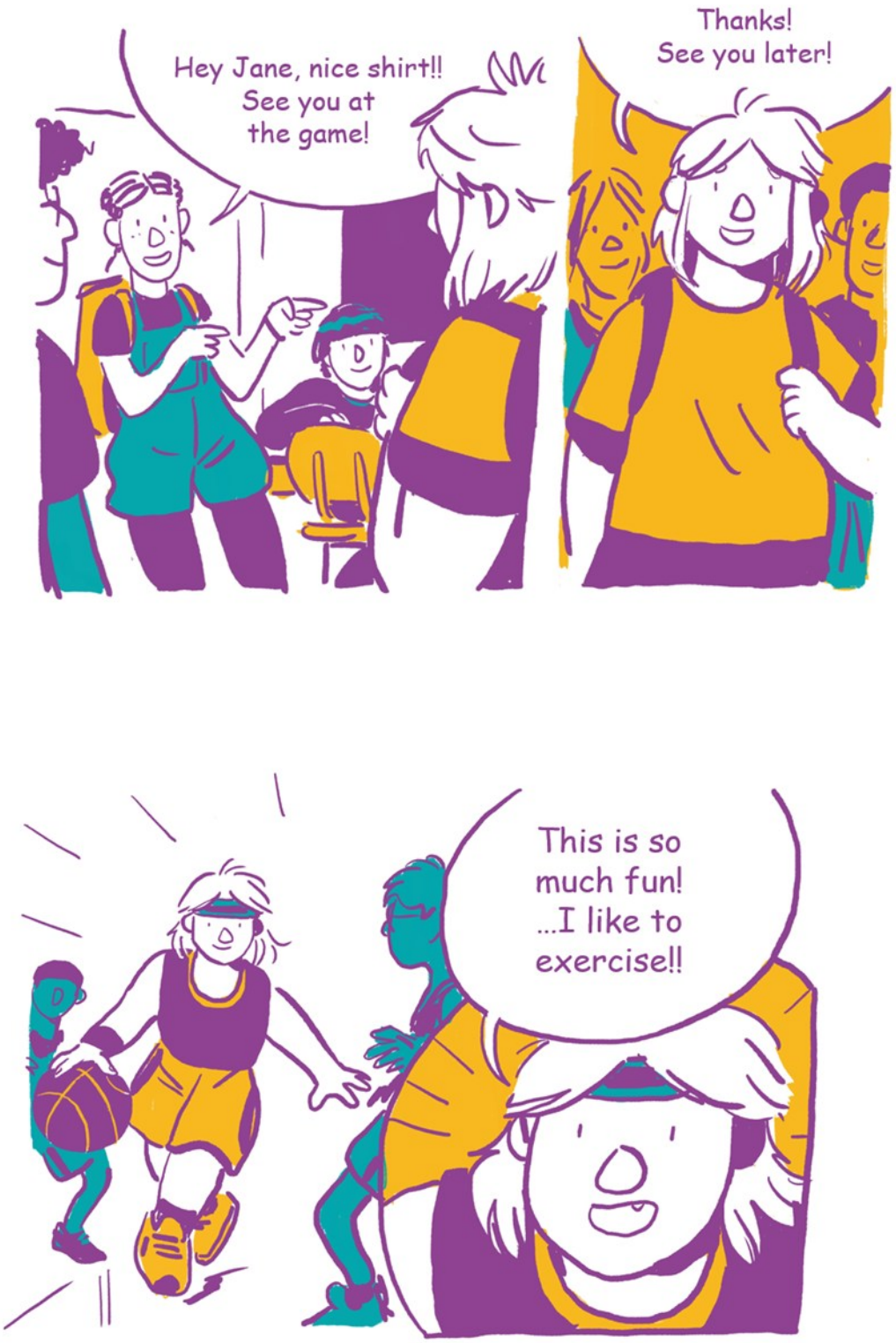
You / your child have data protection rights, including the right to access your / your child's Personal Data, the right to obtain a copy of such Personal Data, to request rectification, deletion or restriction of processing, to withdraw your consent the processing, to transfer it to another data controller.

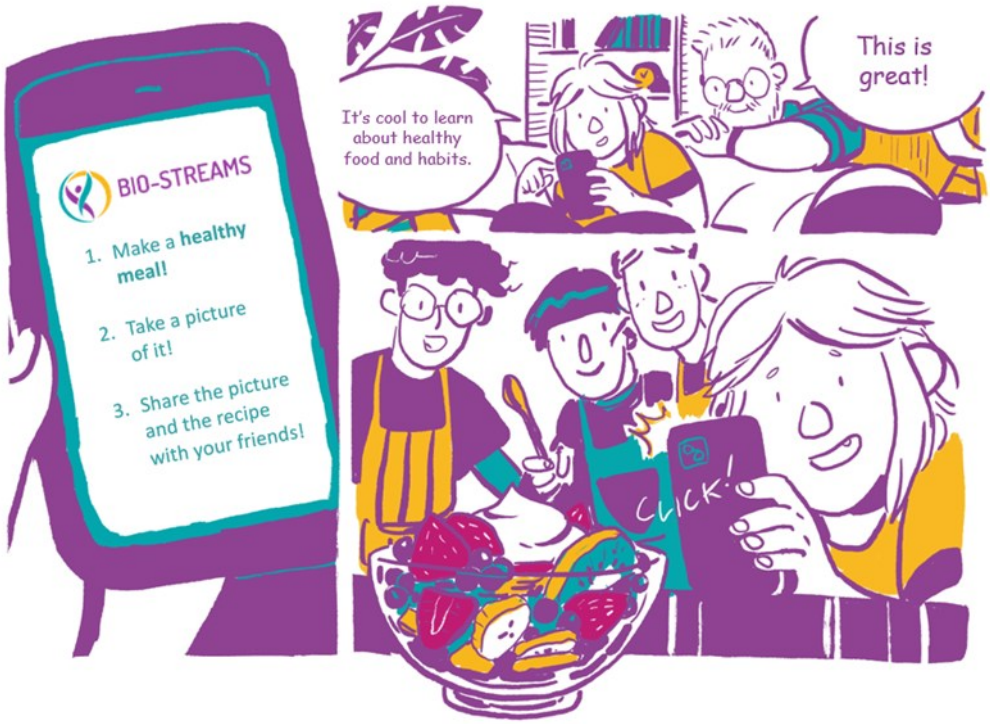
Participants also have the right to lodge a complaint or seek remedial measures with the supervisory authority [name of authority in the country].

4. **How to contact us to exercise your rights**

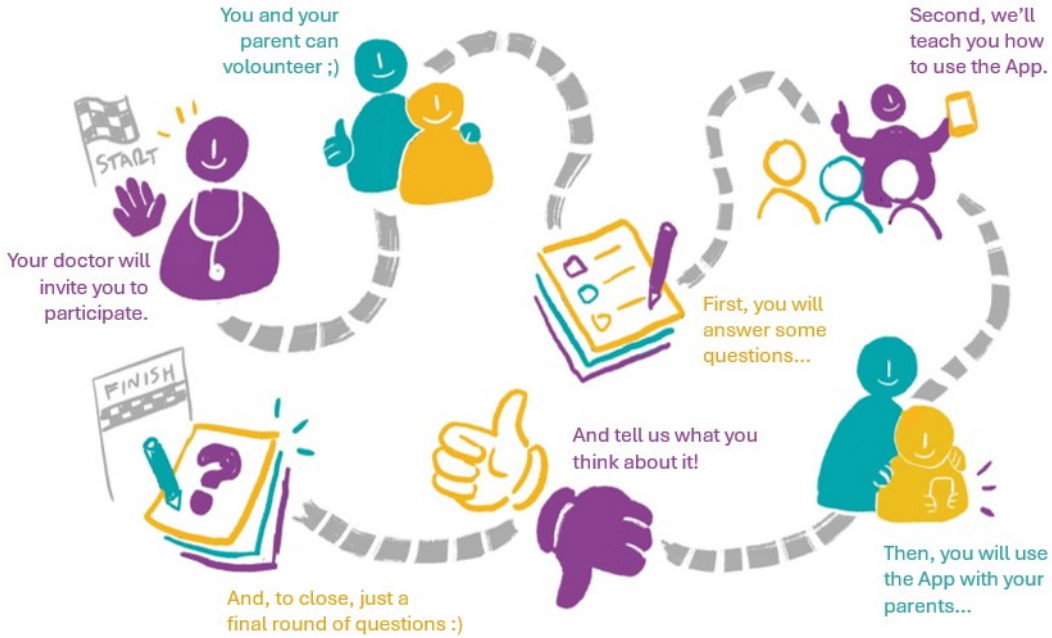
If you wish to contact us and/or exercise the rights listed above, you may submit a request by contacting: [List contact details for privacy contact at partner here]

Appendix 2.2. Child Persona comic in clinical setting.





Appendix 2.3. Clinical Study Process Infographic.



Appendix 2.4. ActiveHealth app questionnaire.

We invite you to share your impressions of the ActiveHealth mobile application by completing the following questionnaire and open questions.

First, we ask you to answer a questionnaire that contains pairs of contrasting attributes that describe different aspects of the app. The circles between each pair represent varying degrees of agreement between the two attributes. Please indicate your impression by selecting the circle that best matches your experience with the app.

Example:

attractive	○	⊗	○	○	○	○	○ unattractive

This selection suggests that you find the app more attractive than unattractive.

Please respond instinctively, without overthinking your choices, to capture your true first impression of the app. Even if you're unsure about a particular attribute or feel it doesn't completely apply, please choose a circle in every line.

Remember, there are no right or wrong answers—your personal opinion is what matters most!

General Feelings about the App

Please assess the app by ticking one circle per line.

	1	2	3	4	5	6	7		
obstructive	■	■	■	■	■	■	■	supportive	1
complicated	■	■	■	■	■	■	■	easy	2
inefficient	■	■	■	■	■	■	■	efficient	3
confusing	■	■	■	■	■	■	■	clear	4
boring	■	■	■	■	■	■	■	exciting	5
not interesting	■	■	■	■	■	■	■	interesting	6
conventional	■	■	■	■	■	■	■	inventive	7
usual	■	■	■	■	■	■	■	leading edge	8

Now, we ask you to answer some open-ended questions about the ActiveHealth app. Use your own words and try to capture your impressions accurately.

2. Adherence to Recommendations
How easy would it be to follow the health recommendations provided by the app? Do you have any tips for improvement?
……
……
……

3. Behavioural Change Support
How well do you see the app supporting you or motivating you to change unhealthy behaviours? Would you propose to change it in some way?
……
……
……

4. Feedback on Progress
How clear and helpful is the feedback provided by the app on your health progress? How could we make it better?
……
……
……
5. Daily activities
Would you propose a better way of tracking your daily activities (meals, exercise, etc.)
……
……
……
6. What specific features of the ActiveHealth app do you find most beneficial, and why?
……
……
……
7. Is there anything else you would like to see improved or added to the ActiveHealth app to better support your health and wellness goals and the way you track your nutrition habits?
……
……
……

Appendix 2.5. Information letter to students for school workshops.

The Bio-Streams project aims to help you and your peers to maintain a healthy lifestyle through education and digital tools.

Who are we?

We are researchers working on the Bio-Streams project. Our team is led by [Name] and you can reach us using this e-mail address: [email]. A researcher is a very curious person who does all kinds of interesting things to find answers to important questions.

Why are we doing this workshop?

The main goal is to learn more about what kind of activities would help students to keep a healthy lifestyle. We want to know more about what you would find fun and educational, so that we can develop activities for your school and other schools.

How will you work with us?

If you want to participate and your parents/guardians also agree, you can get involved and help with what we call co-creation. We will have a fun lesson together with your classmates, that will last about an hour, where we will discuss things related to your lifestyle. Depending on what we discuss, we will create activities for our project that you, your friends, and also students in other schools can do to stay healthy.

If you decide to participate, you will help us understand what children like you think about healthy living, eating healthy food, doing physical activity, and how you would want to learn more about these topics.

Why is this a good project?

In Europe, more and more children are eating poorly and are too physically inactive. This project is trying to help you and other students to do things that can help you become healthier and happier. We want you to be part of planning these things, as you know best what you like to do and what is the best way for you to learn.

Collection and storage of personal data

For what we call good research, we need to collect some information about you. In this case, we are asking you to share your name, date of birth and the name of your parent/guardian. We will not share this information with anyone outside of the project.

If you feel that something is not right, or something has not happened as it should, you can talk to the researcher, your parent/guardian, or your teacher or school leader to help solve the problem.

We will not take photos, make videos or any audio recording of you.

Your information will be stored in a secret place with us and only after a certain time, after maximum 4 years, when it is no longer needed, it will be removed and destroyed, a bit like when your favourite food expires and you throw it out of the cupboard.

If you or your parent/guardian decide that you will not take part in the project anymore you can tell us at any time and we will delete your data as well. It's like when you play a game and decide to quit when you don't feel like it anymore.

Appendix 2.6. Information letter to parents/guardians for school workshops.

The Bio-Streams project aims to help your child and his/her peers as well as families to maintain a healthy lifestyle through education and digital tools.

Who are we?

We are researchers working on the Bio-Streams project. Our team is led by [Name] and you can reach us using this e-mail address: [email]. A researcher is a very curious adult who works in systematic way to find answers to questions through evidence-based method.

Why are they doing this workshop?

The main goal is to learn more about what kind of activities would help students to keep a healthy lifestyle. We want to know more about what students, including your child, would find fun and educational to do, so that we can develop activities for your school and other schools.

How will your child work with us?

If your child wants to participate and you also agree, he/she can get involved and help with what we call “co-creation”. The co-creation workshop will be a fun lesson at school where your child will be together with his/her classmates. It will take about an hour, and they will participate in discussions related to their lifestyle. Based on the discussion, we will create activities that your child, his/her friends, and also students in other schools can do to help them stay healthy.

If your child participates, it will help us to understand what children think about healthy living, eating healthy food, doing activities, and how they would want to learn more about these topics.

Why is this a good project?

In Europe, more and more children are eating unhealthy foods and are physically inactive with too much screentime. This project is trying to help your child and other students to do things that can help them become healthier and happier. We want your child to be part of planning these things as children know best what they like to do and what is the best way for them to learn.

Collection and storage of personal data

The project collects information about participants, such as their name, age and your name as parent/guardian. How we handle data is written in the official “Privacy Policy” of the project and you can read it on the next page, but here is a short summary in simpler, not legal language:

We are following two international regulations that are also in force in your country: the General Data Protection Regulations (GDPR) and the United Nations Convention on the Rights of the Child (UNCRC). These guide how we handle data.

We will not take photos, make videos or any audio recording of your child.

If you feel that something is not right, or something has not happened as it should, you can talk to the researcher, the teacher or school leader of your child or reach out to the project coordinator (ICCS, e-mail) to help solve the problem.

Your and your child’s information will be stored in a secure place with us and after a certain time, maximum 4 years, when it is no longer needed, it will be removed and destroyed.

If you or your child decide that you do not wish to participate in the workshop, you can tell us at any time and we will delete your data as well.

BIO-STREAMS PRIVACY POLICY

1. PURPOSE OF THE INVESTIGATION

The Bio-Stream project is a European Union funded project within the framework of the Horizon Europe Programme (approval number: 101080718). The coordinator and scientific leader of the Bio-Streams project is the Institute of Communication and Computer Systems, Athens, Greece.

The project aims to create a holistic approach to address childhood obesity.

2. COLLECTION AND PROCESSING OF PERSONAL DATA

During the workshops, [PARTNER] will only collect aggregated, anonymous information based on the responses of students and parents. Therefore, no personal data (i.e. data relating to an identified or identifiable individual) will result from the co-creation workshops. Anonymous data arising from the workshop may be shared between relevant members of the Bio-Streams consortium, and disseminated for scientific research.

Nonetheless, for the purposes of obtaining and recording consent for participation in the co-creation workshop, [PARTNER] will collect the following personal data:

- Students' names,
- Students' date or year of birth, and
- Parents' names.

This personal data will only be processed for specified purposes, e.g. the purpose of meeting and demonstrating compliance with our legal and ethical obligations, and will only be stored for as long as necessary to fulfil those purposes.

Any such personal data will be processed in accordance with the European General Data Protection Regulation (GDPR, 2016/679). The responsible entity (i.e. controller) under the for the processing of personal data as part of the co-creation is [PARTNER], [contact details].

3. YOUR RIGHTS

You have the right to access your personal data, including the right to obtain a copy of such personal data, to request rectification, deletion or restriction of processing, to transfer it to another data controller.

Survey respondents also have the right to lodge a complaint or seek remedial measures with the supervisory authority [name of authority in the country] in the event of non-compliance with data protection rules through the following two procedures:

1. Survey participants will be provided with the contact details of project's management so that they can contact them directly. Specifically, the information guide for teachers and the informed consent form for students and parents/guardians will include contact details for both the researcher responsible for the research design of the project and the field researcher for direct contact.
2. Survey participants will be contacted directly at the school address where, in addition to the above information, the contact details of the project's research supervisor will be provided.

4. REFUSAL/WITHDRAWAL

Children's participation in the survey is optional. The student, and their parent\guardian, has the option to withdraw at any stage of the workshop. Withdrawal from the study shall not adversely impact children's school experience.

Appendix 2.7. Information letter to teachers for school workshops.

Co-creation workshop with students at your school

Multi-Pillar Framework for Children Anti-Obesity Behaviour Building on an EU Biobank, Micro Moments and Mobile Recommendation Systems (BIO-STREAMS) Project

Project No: 101080718

Your students are invited to participate in a co-creation workshop with the aim of supporting the development of school-based interventions related to healthy life habits in the Bio-Streams project.

This activity is part of a larger project which aims to create a holistic approach to address childhood obesity in Europe. One of the components of the Bio-Streams project is the development and piloting of a school-based intervention. The project consortium will seek to examine the effect of 4 workshops within a school-year in 5 pre-selected partner countries in addition to providing access to the Bio-Streams platform.

The co-creation workshop we are conducting in your school is part of a series of such activities in the 5 partner countries and designed to gain in-depth insights into the needs and preferences of the target population – school students aged 9-14 years -, and to actively involve them in the process of developing the Bio-Streams school-intervention to ensure suitability for the target group. This activity will help the researchers to fine-tune the school intervention, ultimately leading to a higher probability of successful implementation.

We are asking you to find a class that is willing to participate in this co-creation workshop. Their participation will require about an hour of their time, and we need the active consent of both students and their parents/guardians to participate. It is not necessary to engage all students of a class in the activity, but we need at least 10 students who agree to take part. As their teacher, you can participate in the workshop as an observer, but in that case, you have to also consent to your data being handled by the consortium, and also agree to follow the project's data management regulations. The workshop will be conducted by a minimum of two trained researchers.

If students are interested in participating and their guardians agree, they will both receive plain language information on the following:

1. what the research is about;

2. how long the whole research will take and how long students are asked to participate;

3. who we share their data with;

4. how we ensure the confidentiality and protection of their data.

In accordance with Articles 3 and 12 of the Convention on the Rights of the Child, participation in the co-creation workshop is voluntary, and children have the final say on whether they are ready to participate or not.

Participating students and their parents/guardians will be required to sign an informed consent that follows the ERIC (Ethical Research Involving Children) principles, acknowledging that they will have been fully informed about the project. Before giving consent, they will have the opportunity to ask questions from the main investigator in your country [Name, E-mail, Phone number].

BIO-STREAMS PRIVACY POLICY

1. PURPOSE OF THE INVESTIGATION

The Bio-Stream project is a European Union funded project within the framework of the Horizon Europe Programme (approval number: 101080718). The coordinator and scientific leader of the Bio-Streams project is the Institute of Communication and Computer Systems, Athens, Greece.

The project aims to create a holistic approach to address childhood obesity.

2. COLLECTION AND PROCESSING OF PERSONAL DATA

During the workshops, [PARTNER] will only collect aggregated, anonymous information based on the responses of students and parents. Therefore, no personal data (i.e. data relating to an identified or identifiable individual) will result from the co-creation workshops. Anonymous data arising from the workshop may be shared between relevant members of the Bio-Streams consortium, and disseminated for scientific research.

Nonetheless, for the purposes of obtaining and recording consent for participation in the co-creation workshop, [PARTNER] will collect the following personal data:

- Students' names,
- Students' date or year of birth, and
- Parents' names.

This personal data will only be processed for specified purposes, e.g. the purpose of meeting and demonstrating compliance with our legal and ethical obligations, and will only be stored for as long as necessary to fulfil those purposes.

Any such personal data will be processed in accordance with the European General Data Protection Regulation (GDPR, 2016/679). The responsible entity (i.e. controller) under the for the processing of personal data as part of the co-creation is [PARTNER], [contact details].

3. YOUR RIGHTS

You have the right to access your personal data, including the right to obtain a copy of such personal data, to request rectification, deletion or restriction of processing, to transfer it to another data controller.

Survey respondents also have the right to lodge a complaint or seek remedial measures with the supervisory authority [name of authority in the country] in the event of non-compliance with data protection rules through the following two procedures:

1. Survey participants will be provided with the contact details of project's management so that they can contact them directly. Specifically, the information guide for teachers and the informed consent form for students and parents/guardians will include contact details for both the researcher responsible for the research design of the project and the field researcher for direct contact.
2. Survey participants will be contacted directly at the school address where, in addition to the above information, the contact details of the project's research supervisor will be provided.

4. REFUSAL/WITHDRAWAL

Children's participation in the survey is optional. The student, and their parent\guardian, has the option to withdraw at any stage of the workshop. Withdrawal from the study shall not adversely impact children's school experience.

Appendix 2.8. Student declaration of consent for school workshops.

Multi-Pillar Framework for Children Anti-Obesity Behaviour Building on an EU Biobank, Micro Moments and Mobile Recommendation Systems (BIOSTREAMS) Project

Participation of a minor (a student under the age of 18) in the co-creation workshop

Name: .....

Date of birth: ..... year..... month ..... day

	YES	NO
I understand what this research is about.		
I understand what my role in the research will be, what I will be doing		
I know what data will be collected about me		
I have been able to ask questions and get answers		
I am happy to participate in this activity and be part of the research		
I know that I can withdraw my consent at any time and I know who to contact		
I know that my consent is only valid and that I can only participate if my parent/guardian also agrees to with my participation		

(Name of legal representative: .....)

I agree that my child may participate in the Bio-Streams project on site at his/her school, led by [name] in September or October 2024.

I acknowledge that my child has agreed to participate and as his/her parent/guardian I agree with it. My consent is only subject to the terms and conditions set forth in the Privacy Policy that I had the opportunity to explore, and the data collected during the co-creation workshop may be used for analysis and publication only in the form and anonymously as specified in the Bio-Streams Data Management Guide.

I may withdraw my consent at any time. The withdrawal of consent does not affect the legal basis for the processing carried out before the withdrawal.

Place and date: ....., 20 .....year.....month .....day

....

Signature of a minor Signature of legal representative

.....

Signature of the researcher/date

Researcher leading the Bio-Streams workshop in [country]: Name, Institution, Email.

Appendix 3.1. Dashboard screenshots for healthcare professionals.