BIOMEDICAL RESEARCH PROTOCOL

1. Title of the Biomedical Research

Co-creating school community intervention program on physical activity to increase health equity in children and adolescents (*Connection*).
Protocol No: 1
Version: 1
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2. Hypothesis of the Biomedical Research

Community-implemented social and physical environmental interventions promoting higher physical activity will have a positive effect on the health of children and adolescents living in disadvantaged social and economic conditions and will contribute to improving health equity in this group.

3. Objective of the Biomedical Research

The Connection project aims to develop, implement, and evaluate co-created community-based social and physical environmental interventions that promote healthier eating and increased physical activity among children and adolescents living in disadvantaged social and economic conditions, with the main goal of improving health equity.

4. Tasks of the Biomedical Research

The tasks of the Connection study are:

1. Collect data on residential air pollution (PM2.5, PM10, and NO2) and determine its associations with children's physical health.
2. Gather information on children's physical activity, dietary habits, sleep quality, and health behaviour.
3. Assess parents' and children's attitudes toward health and the living environment.
4. Evaluate the impact of physical activity and sleep on children's health.
5. Assess the effectiveness of smart wristbands as a tool for monitoring physical activity, sleep, and heart function.
6. Reassess children's health indicators after 3 months and compare them with baseline data.

5. **Detailed Description of the Study Outcomes** (Primary and Secondary Study Endpoints)

The Connection project will evaluate the following outcomes

Primary outcomes: Children's blood pressure, anthropometric data (height, weight), body fat percentage, physical activity levels, depending on exposure, socioeconomic status, and healthy lifestyle.
Secondary outcomes: Children's well-being depending on exposure, socioeconomic status, and healthy lifestyle.

6. **Justification of the Biomedical Research**

This new international study is conducted at Vytautas Magnus University under the European Commission's ERA4health call, funded by the Research Council of Lithuania. The international project coordinator is the University of Porto, Portugal. Poor nutrition and insufficient physical activity are among the main behavioural risk factors for non-communicable diseases.[1]. A higher prevalence of unhealthy behaviours in lower socio-economic groups is one of the mechanisms linking disadvantaged social and economic conditions to poorer health indicators. Furthermore, diet and physical activity are potentially modifiable behavioural factors that partly explain socio-economic differences in morbidity and mortality[2]. Promoting positive behaviours, particularly among people of lower social status, is a public health priority. Therefore, changes in social norms and living environments that shape behaviour, encouraging individuals to adopt more balanced dietary habits and be physically active, should be considered essential primary prevention measures to promote health and well-being. Target populations and various stakeholders should actively participate in designing, implementing, and evaluating measures aimed at creating healthier and more sustainable environments[3].

Based on the WHO's "health in all policies" concept, these interventions should integrate public health approaches to tackle complex problems and emphasize the importance of scientific progress, public awareness and advocacy, consumer demand, industrial innovations, government regulation, and cultural changes[4].

The effectiveness of public health strategies may vary among social and economic groups and may even increase inequality[5]. Adverse environmental influences and negative social incentives are particularly strong and have a profound impact on children and adolescents growing up in disadvantaged neighbourhoods, exposing them to higher health risks. Young people living in unfavourable conditions are particularly difficult to engage in current programs and therefore do not benefit from existing community interventions. Changing nutrition, physical activity, and movement habits is a complex and time-consuming process that requires involving community members and local authorities and empowering them. The engagement process should be particularly attentive to people living in vulnerable conditions.

Moreover, previous research shows that, in youth populations, there is increasing interest in addressing food surplus and food-sharing practices in school catering facilities and food education activities as a way to tackle social nutritional disparities.

7. Description of Study Participants

The Connection study will include children aged 12–16 attending VDU Atžalynas Progymnasium. Selection will be random, involving approximately 200 children (±10%) who will participate in the initial cross-sectional study. From these participants, about 10% (around 20 children ±2) will be invited to take part in an in-depth interventional study. All children participating in the study

[1] Stanaway JD, Afshin A, Gakidou E, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Stu. Lancet. 2018 Nov;392(10159):1923–94. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673618322256

[2] Stringhini S, Carmeli C, Jokela M, et al. Socioeconomic status and the 25 × 25 risk factors as determinants of premature mortality: a multicohort study and meta-analysis of 1·7 million men and women. Lancet. 2017 Mar 25;389(10075):1229- 1237. doi: 10.1016/S0140-6736(16)32380-7.

[3] Leask CF, Sandlund M, Skelton DA, et al; GrandStand, Safe Step and Teenage Girls on the Move Research Groups. Framework, principles and recommendations for utilising participatory methodologies in the co-creation and evaluation of public health interventions. Res Involv Engagem. 2019 Jan 9;5:2. doi: 10.1186/s40900-018-0136-9.

[4] Lang T, Rayner G. Beyond the Golden Era of public health: charting a path from sanitarianism to ecological public health. Public Health. 2015 Oct;129(10):1369–82. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0033350615003029

[5] Lorenc T, Petticrew M, Welch V, et al. What types of interventions generate inequalities? Evidence from systematic reviews. J Epidemiol Community Health. 2013;67(2):190–3.

will be required to sign informed consent forms together with their parents (or legal guardians) and will be allowed to choose in which phase of the study they wish to participate.
Children will be excluded from the study if they do not meet the age criteria (younger than 12 or older than 16 years), if their parents or guardians refuse to sign the informed consent form, if they have health conditions that could interfere with the study or pose a health risk, or if they are unwilling to comply with study requirements, such as refusing to wear a smart wristband.

8. Methodology of the Biomedical Research

The Connection study consists of two stages: a cross-sectional study (initial research) and an in-depth interventional study. These stages are interconnected and aim to assess children's health and physical parameters as well as the impact of environmental factors:

1. **Cross-sectional study (initial research):** This stage will include children aged 12–16 attending VDU Atžalynas Progymnasium. Approximately 200 children (±10%) will be randomly selected to participate once.

Study procedures:
Children and their parents will be asked to complete questionnaires:

- **Child questionnaire:** Covers health behaviour, well-being, and environmental assessment.
- **Parent questionnaire:** Covers social and demographic indicators, home address (required for individual air pollution assessment).

Measurements for children will include:

- Blood pressure[6];
- Anthropometric measurements: height (cm) and weight (kg)[7];
- Body composition analysis[8].

All devices will have CE certification. Filling in the questionnaires will take up to 20 minutes, and measurements up to 10 minutes. The total procedure duration will be about 30 minutes. The collected questionnaire data will include social, demographic, health behaviour, well-being, and environmental assessment indicators. Information will be coded to prevent linking a child's name to the ID number. Data from paper questionnaires will be entered into computer software. All data will be recorded on digital data collection sheets and stored in the research database following data protection requirements.

2. **In-depth interventional study**: This stage will involve about 10% of the participants from the cross-sectional study (around 20 children) who agree to take part in a 7-day physical activity monitoring study.

Study procedures:
Participants will attend a two-visit program:
First visit: Initial assessment during which:

- A CE-certified smart wristband is placed on the participant to monitor physical activity, heart function, and sleep quality for 7 days.
- After 7 days: Participants return the wristbands and provide verbal feedback about their study experience.

Second follow-up visit after 3 months:

[6] Prietaisas Omron M3W (HEM-7202-E(V))
[7] Prietaisas Kern MPE (250K100HM)
[8] Prietaisas Tanita MC780

- Blood pressure, height, weight, and body composition are re-measured (duration up to 10 minutes).
- Participants wear smart wristbands again for 7 days.
- After 7 days: Participants return the wristbands and complete a short questionnaire about their experience.

Data on residential addresses collected during the cross-sectional study will be linked to the environmental pollution database (PM2.5, PM10, NO2) and children's physical health indicators. During the in-depth study, changes in physical activity and sleep will be analysed to assess the impact of the intervention on health. All participants will be informed about the study aims and procedures. Participation is voluntary, and all data will be coded and protected according to data protection regulations. No methods used in either stage are expected to cause adverse or long-term health effects.

9. Description of Locations and Institutions Where Biomedical Research Will Be Conducted

Participants of the Connection Project:
Porto, Portugal: Population Health Integrated and Applied Research Laboratory, University of Porto, Institute of Public Health – *Research Institute* – National Science and Technology Fund
Ghent, Belgium: Ghent University, Faculty of Bioscience Engineering, Department of Food Technology, Safety and Health – *University* – Regional Fund Wetenschappelijk Onderzoek (FWO)
Turin, Italy: Department of Medical Sciences, University of Turin – *University* – National Ministry of Universities and Scientific Research of Italy
Amsterdam, Netherlands: Center for Research and Innovation in Child and Adolescent Public Health; Department of Public and Occupational Health; Health Behavior and Chronic Diseases; Amsterdam Public Health Research Institute; Stichting VUmc – *University* – Netherlands Organization for Health Research and Development
Frederiksberg, Denmark: Department of Geosciences and Natural Resource Management, University of Copenhagen – *University* – Danish Innovation Fund
Kaunas, Lithuania: Department of Environmental Sciences, Vytautas Magnus University (VMU) – *University* – Research Council of Lithuania
Riga, Latvia: Riga Stradins University, Department of Sports and Nutrition – *University* – National Research Council of Latvia
Barcelona, Spain: ISGlobal Research Institute – *Research Institute* – Associated Participant

10. Planned Duration of the Entire Biomedical Research

The study will last 36 months.

11. Duration of Participant Involvement in the Biomedical Research

Participant involvement depends on the study stage:
Cross-sectional study: One-time participation lasting up to 30 minutes (20 minutes for questionnaires, 10 minutes for measurements).

In-depth study: Two 7-day periods of wearing a smart wristband, two visits, and a follow-up assessment after 3 months (total: ~20 minutes per visit).

12. Criteria for Terminating Participation in the Biomedical Research

Participants may withdraw at any time. Consent can be revoked by the participant or their parent/legal guardian if the participant is deemed incapable of making reasonable decisions due to health conditions. Withdrawal does not require justification. Data collected before withdrawal will not be deleted.

13. Procedure for Inviting Participants to the Biomedical Research

The invitation of participants to the biomedical research will be organized in close cooperation with VDU Atžalynas Progymnasium, whose students constitute the target study group. The target group for this research is children aged 12–16.

The school administration and teachers will be introduced to the aim of the study, methodology, and participant selection criteria. With the school's assistance, an effective information dissemination channel will be ensured. Information invitations to participate in the study will be distributed to potential participants and their parents, clearly presenting the study's purpose, procedures, potential benefits and risks, and participation conditions. Parents will also be informed via school email or other internal communication systems. Invitations will be sent through electronic diaries or other school information channels.

Information meetings will be organized to allow parents and students to learn about the study's objectives, ask questions directly to the researchers, and receive detailed answers. These meetings aim to ensure that potential participants and their parents make an informed decision about participation. After these meetings, informed consent forms will be distributed to parents, who will be asked to complete and return them if they agree to participate. Children will also sign a consent form adapted to their level of understanding.

Participants for the cross-sectional study will be randomly selected from students who agreed to participate. Later, participants for the interventional part of the study will be selected based on the 10% sampling principle, from those who indicated willingness to take part in the in-depth study in the questionnaires.

This procedure ensures that participants and their parents receive comprehensive information, can make an informed choice about participation, and that the recruitment process is transparent and effective.

14. Procedure for Informing About the Study and Obtaining Informed Consent Both parents/legal guardians and children will receive detailed information about the study, its objectives, procedures, benefits, and risks.

The procedure for enrolling participants in the biomedical research and obtaining informed consent will strictly follow ethical and legal requirements, ensuring participants' awareness, voluntariness, and data confidentiality. Since the study involves minors (children aged 12–16), their participation requires both parental or guardian consent and the child's own assent.

During the initial meeting, if parents and children agree to participate in the biomedical research, informed consent forms will be provided. These forms will be given to both parents (legal

representatives) and children (12–16 years old). Before signing, parents and children will receive detailed information about the study's procedures and possible outcomes. The target population, study objectives, applied methods and procedures, duration, and significance for participants and society will be explained. They will also be informed about their rights, including the right to receive information about the study's progress, the right to withdraw without negative consequences, and the right to have all questions answered regarding the study. Children and parents will be informed about potential risks or inconveniences, such as possible side effects or unexpected discomforts. Ethical committee decisions and approvals will be presented to ensure the study adheres to the highest ethical standards and safeguards participants' well-being.
It will be clearly stated that parents and children have the right to withdraw their consent in writing at any time, regardless of the study stage, without affecting their rights or access to necessary services. All collected participant information will be kept confidential and used only for research purposes in compliance with applicable legal requirements.
After the meeting, once parents and children are fully informed and have no further questions, they will be asked to sign the informed consent forms. These forms will confirm that both parents (legal representatives) and children fully understand the study procedures, associated risks, benefits, rights, and obligations, and voluntarily agree to participate in the biomedical research. The informed consent forms will be prepared in two copies.

15. Possible Benefits of the Biomedical Research for Participants

Participants in the biomedical research will not receive direct personal benefits. However, they will contribute to important scientific discoveries that may, in the future, improve disease diagnosis, treatment, or prevention for themselves and the wider population. Participants and their parents will have the opportunity to receive detailed results of the body composition analysis, including individual values of the child's body composition (e.g., fat, muscle, bone mass) and a comparison with recommended norms.

16. Possible Risks and Inconveniences for Participants

Minimal inconvenience is expected (short time commitment, no routine disruption). Data will be anonymized and coded in line with data protection regulations.

17. Documentation and Assessment of Adverse Events

No harmful procedures are involved. If unexpected health issues arise, they will be reported to the family doctor and school administration.

18. Data Processing, Confidentiality, and Protection

During the biomedical research, socio-demographic data (age, sex, residential address), health data (blood pressure, height, weight, body composition indicators, physical activity, sleep, and heart rate data from the smart wristband), and subjective evaluations (health behavior, environmental assessment, and well-being questionnaire responses) will be collected. Data will only be obtained

from participants and their parents through questionnaires, physical measurements, and smart wristbands.
All collected data will be coded with a unique identification number (ID) not linked to the participant's name or surname. Paper documents will be anonymized, and digital data will be encrypted and stored in electronic systems. Access to uncoded data will be limited to researchers directly involved in the study, if necessary (e.g., contacting the participant's family). Oversight authorities or ethics committees may also access uncoded data during audits or monitoring.
Questionnaire data will be available to the principal investigator, authorized researchers, the biomedical research centre's investigator conducting health checks, and supervising authorities (bioethics committees). Coded health data will be accessible to researchers, scientists preparing reports and publications for academic and public dissemination, and the study sponsor solely for analytical purposes.
Data from questionnaires and clinical assessments will be entered into an electronic system. A database linking personal data and assigned codes will be created and stored on the principal investigator's password-protected computer at the VMU research center. Data collected will be transferred via USB every 10 days to the principal investigator's computer and linked to the assigned identification codes. The principal investigator will be responsible for storing data on electronic media for 5 years after study completion. Both the database containing identifiable information and the anonymized dataset will be securely stored at VMU. Access to data is only possible with the computer's password.
In line with the international protocol, anonymized coded data will be shared with consortium partners for complex data analyses and aggregated for joint publications.
The data controller is the study sponsor or the institution responsible for the research. For this study, the data controller is VMU, Faculty of Natural Sciences. Upon request, participants can access their personal data and request corrections or additions if inaccuracies are found by visiting the principal investigator or authorized staff at the VMU research center.
Project data will be stored for 5 years after study completion under the responsibility of the principal investigator. Participants or their parents can withdraw consent in writing at any time. Participation will then be immediately terminated, and all data will be deleted unless this conflicts with legal obligations. Withdrawal will not result in any negative consequences for the participant or their family. These principles ensure the protection of participants' rights, privacy, and data security throughout the study.

19. Criteria for Amending the Biomedical Research Protocol

Changes are only allowed with approval from the international supervisory committee and the Kaunas Regional Biomedical Research Ethics Committee. Minor modifications can be made under unforeseen circumstances with scientific justification.

20. Compensation for Time and Expenses

No compensation or payment will be provided. Participation is voluntary and non-disruptive.

21. Funding of the Biomedical Research

Funded by the Research Council of Lithuania under the European Commission's Era4Health program.

22. Compensation for Potential Harm (Insurance)

Not applicable. No harm to participants is expected.

23. Publication of Results

Results will be published in scientific journals, presented at conferences, and used to develop recommendations for increasing physical activity among students.

24. Description of Ethical Issues Related to the Biomedical Research, If Not Discussed Elsewhere

Ethical issues are discussed in Section 14, describing the process of informing participants about the biomedical research and obtaining informed consent to participate in the study.

25. Confirmation Regarding Use of Medicines Compensated from the Mandatory Health Insurance Fund

Not applicable.

26. Confirmation of Compliance with Legal Requirements

Researchers confirm adherence to Lithuanian biomedical research regulations and the approved protocol, with notification of any changes and reporting to the Kaunas Regional Biomedical Research Ethics Committee.

27. Explanation of the Documents from Institutions Granting Permission to Conduct the Biomedical Research and Confirmation that the Researcher (Institution) Will Allow Oversight, Audits, Ethical Supervision, and Inspections with Direct Access to Source Documents (Data Sources)

Documents Granting Permission to Conduct the Study and Confirmation of Oversight The study will only begin after receiving approval from the Kaunas Regional Biomedical Research Ethics Committee. Necessary institutional permissions from VDU Atžalynas Progymnasium will be obtained to allow control, audits, ethical supervision, and direct access to source data.

28. Signatures of the Biomedical Research Protocol Author(s), Principal Investigator, and Sponsor's Representative

Protocol Author: Dr. Sandra Andrušaitytė

Principal Investigator: Dr. Sandra Andrušaitytė
Sponsor's Representative: Vice-Rector for Research, Vytautas Magnus University – Prof. Dr. Julija Kiršienė