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ORIGINAL ARTICLE

Road map towards a harmonized pan-European surveillance of obesity-related lifestyle behaviours and their determinants in children and adolescents

Antje Hebestreit[1] · Barbara Thumann[1] · Maike Wolters[1] · Jens Bucksch[2] · Inge Huybrechts[3] · Joanna Inchley[4] · Cornelia Lange[5] · Nanna Lien[6] · Kristin Manz[5] · Nadia Slimani[3] · Hidde P. van der Ploeg[7] · Wolfgang Ahrens[1,8] on behalf of DEDIPAC Consortium

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Abstract

Objectives To develop a road map towards a harmonized pan-European surveillance system for children and adolescents.

Methods Representatives of five European surveillance systems and the German Health Interview and Examination Survey for Children and Adolescents contributed to the road map through a structured workshop in 2016.

Results A conceptual framework for this road map was developed with seven action points (APs) guiding the successive cross-country harmonization. First, key indicators of health behaviour and their determinants in children and adolescents will be identified (AP1, 2); short screening instruments will be developed and implemented to assess and monitor key indicators (AP3, 4). In parallel, optional supplementary modules could be implemented to provide objective data (AP5). This would allow mutual calibration and improvement of existing instruments before their progressive replacement by more comparable measurement tools (AP6). The establishment of a competence platform is envisaged for guiding the harmonization process (AP7).

Conclusions This approach builds on existing systems, provides comparable key health indicators across European regions, helps to assess temporal trends and—once in place—will facilitate health reporting and monitoring of national and international health targets.

Keywords Surveillance · Policy evaluation · Health · Diet · Physical activity · Sedentary behaviour

Abbreviations

AP	Action points
ASA24	Automated Self-Administered 24-h Recall
DEDIPAC	Determinants of Diet and Physical Activity
ECHI	European Core Health Indicators
EGHI	Expert Group on Health Information
EFSA	European Food Safety Authority
EHIS	European Health Interview Survey
FFQ	Food Frequency Questionnaire
HBSC	Health Behaviour in School-aged Children
HEPA PAT	Health-Enhancing Physical Activity Policy Audit Tool
INFORMAS	International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support
KiGGS	German Health Interview and Examination Survey for Children and Adolescents
NHANES	National Health and Nutrition Examination Survey
OECD	Organisation for Economic Co-operation and Development
SB	Sedentary behaviour
WHO	World Health Organization

✉ Antje Hebestreit
hebestr@leibniz-bips.de

[1] Leibniz Institute for Prevention Research and Epidemiology – BIPS, Achterstr. 30, 28359 Bremen, Germany

[2] University of Education Heidelberg, Heidelberg, Germany

[3] International Agency for Research On Cancer, Lyon, France

[4] University of St Andrews, St Andrews, UK

[5] Robert Koch Institute, Berlin, Germany

[6] University of Oslo, Oslo, Norway

[7] VU University Medical Center, Amsterdam, The Netherlands

[8] University of Bremen, Bremen, Germany

WHO-COSI	WHO European Childhood Obesity Surveillance Initiative
24HDR	24-h dietary recall
PA	Physical activity

Introduction

The Vienna Declaration on Nutrition and Non-communicable Diseases and the European child and adolescent health strategy 2015–2020 (World Health Organization 2014; World Health Organization Europe 2013) acknowledged the disease burden caused by unhealthy lifestyle patterns and its major health, societal and economic impacts in Europe. To address these challenges, a series of actions were adopted and member states from the World Health Organization (WHO) European region committed themselves to support nutrition and health-related actions and surveillance systems across the life course (World Health Organization 2016). European member states have already recognized the need for harmonized public health surveillance systems to obtain comparable data across countries and to align their policies, action plans and recommendations to combat unhealthy diets, physical inactivity and overweight within the European region (World Health Organization - Europe 2014). However, one major obstacle to comparing the prevalence of unhealthy behaviours and health outcomes, such as overweight and obesity, across countries is the lack of harmonized data based on objective methods and standardized protocols.

Within the Determinants of Diet and Physical Activity (DEDIPAC) Knowledge Hub (Brug et al. 2017), we conducted an inventory of existing (pan-) European surveillance systems (Bel-Serrat et al. 2017) including initiatives based on the following criteria: (1) national, regional (e.g. Nordic Monitoring System) and international initiatives (e.g. WHO European Childhood Obesity Surveillance Initiative (WHO-COSI)) collecting data on dietary, physical activity (PA), sedentary behaviour (SB) and their determinants; and (2) surveillance systems currently ongoing, or with at least one recently completed wave, carried out on a periodic basis. Most importantly, the inventory reported that only a few surveillance systems involve young populations. Internationally harmonized and comparable data on school-aged children and adolescents are currently provided by two international surveillance systems, the WHO-COSI and the Health Behaviour in School-aged Children: WHO Collaborative Cross-National survey (HBSC). Together, they cover the age groups 6–9 years (WHO-COSI) and 11, 13 and 15 years (HBSC), but the comparability between these systems is limited. In addition, health data of younger children (< 6 years) are not captured by current international surveillance systems despite that this developmental period is considered critical for later health outcomes.

We propose a road map towards a harmonized pan-European surveillance system for monitoring of lifestyle behaviours and their main determinants in children and adolescents. The end goal is to maximize coverage and comparability of data and provide a robust evidence base to inform policy and related actions to improve young people's health across the European region.

Methods

Identification of existing surveillance systems covering children and adolescents

Based on the results of the DEDIPAC inventory (Bel-Serrat et al. 2017), we identified existing European surveillance systems that involve young populations and that either provide state-of-the-art instruments or have already created a pan-European infrastructure potentially serving as a structural basis to successively develop a harmonized surveillance system. Harmonization in this respect refers to the process of minimizing differences in comparability of measures, variables and methods, so that outcomes are comparable. Further, standardization refers to the process of developing and implementing methodological or technical standards based on the consensus of all relevant parties to maximize comparability, interoperability, repeatability or quality.

Structured workshop

Five international surveillance systems were selected as suitable: WHO-COSI, HBSC, EU Menu, the European Health Interview Survey (EHIS) and the Nordic Monitoring of Diet, Physical Activity and Overweight (Table 1). Additionally, the GloboDiet initiative was selected as an initiative that provides a standardized instrument suitable for assessing harmonized dietary data. According to the DEDIPAC inventory (Bel-Serrat et al. 2017), objectively measured PA and biomarkers were not analysed in international surveillance systems; however, PA data and sampling collection were conducted in several national monitoring surveys, such as the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), and so KiGGS was selected to serve as a model for the implementation of objective measurement methods and the collection of biosamples in population-based surveys (Kamtsiuris et al. 2007). Representatives of these surveillance systems contributed to the road map through a structured workshop in April 2016.

Table 1 Main pan-EU surveillance systems (adapted from Bel-Serrat et al. 2017)

Survey system	Year of first wave	No. of completed waves	No. of countries first wave	No. of countries last/current wave	Target population	Sample size (year of wave)
Nordic Monitoring System	2011	2	5	5	7–12 years and 18–65 years	2479 children; 9153 adults (2011)
Health Behaviour in School-aged Children	1983/1984	9	5	47	11, 13, 15 years	219,460 (2013/14)
WHO European Childhood Obesity Surveillance Initiative	2007/2008	4	13	36	6–9 years	256,157 (2012/13)
European Health Interview Survey	2006–2009	2	17	30	> 15 years	210,000 (2014)
EU Menu	2011	6	2	16	3 months–74 years	≥ 130 valid subjects per sex and age class

Results

Conceptual framework

The proposed conceptual framework for this road map focuses on children's and adolescents' health and shall guide the future development and implementation by a series of process-oriented action points (AP) (Fig. 1).

First, we aim to develop and prioritize an agreed set of indicators at the individual and setting levels according to the different areas of interest: dietary intake, dietary behaviour, PA, SB, health status (AP1) and their determinants (AP2). Out of those, key indicators with a high priority for measuring policy impact will be selected (e.g. consumption of soft drinks (Expert Group on Health Information (EGHI))). A set of core variables (or proxies) to assess the selected key indicators will be developed (e.g. consumption frequency of soft drinks) (AP3). Then, state-of-the-art methods/instruments to measure those variables (e.g. Food Frequency Questionnaire, 'how often do you drink soft drinks per day?') will be identified and compiled in short screening instruments (screeners) which should be incorporated into existing surveillance systems (in the full sample) (AP4). This screening tool is a set of simple standard instruments/questions measuring variables that are needed to describe the most relevant indicators in the full surveillance sample. In parallel, a set of supplementary objective measurement methods (such as activity trackers and mHealth technology) may be implemented among subsamples in these systems (AP5).

Before integration of new harmonized measurement instruments into existing surveillance systems can take place, their feasibility needs to be assessed in pilot studies. Subsequent methodological studies will allow calibration of existing instruments across surveys. Eventually, the gradual replacement of some of the current non-harmonized questions and measurements by new measurement modules would result in harmonization across existing systems (AP6). A methodological competence platform would be essential for coordinating and guiding the methodological studies that need to accompany the development, implementation and calibration of existing instruments in the long run (AP7). From early on, the proposed approach will provide a core set of harmonized data for health reporting, benchmarking and monitoring of national and international health targets.

Discussion

Identification and prioritization of key indicators (AP1 and AP2)

Key indicators of health behaviours (AP1)

Surveillance systems need to assess indicators that are related to health targets to inform progress and performance of health policies. In 2012, a joint action of the European Commission and the member states resulted in a shortlist of 88 European Core Health Indicators (ECHI), classified by policy area, such as health determinants (National Institute for Public Health and the Environment 2012). Several criteria had to be met by the ECHI shortlist indicators (Expert Group on Health Information (EGHI)); for example, indicators should support potential policy action (at the EU and Member State levels); should build on existing indicator systems (e.g. OECD Health Data); should already be in use as widely as possible; and should focus on major public health problems (including health inequalities) and on the best potentials for effective policy action, both at the EU and at Member State levels.

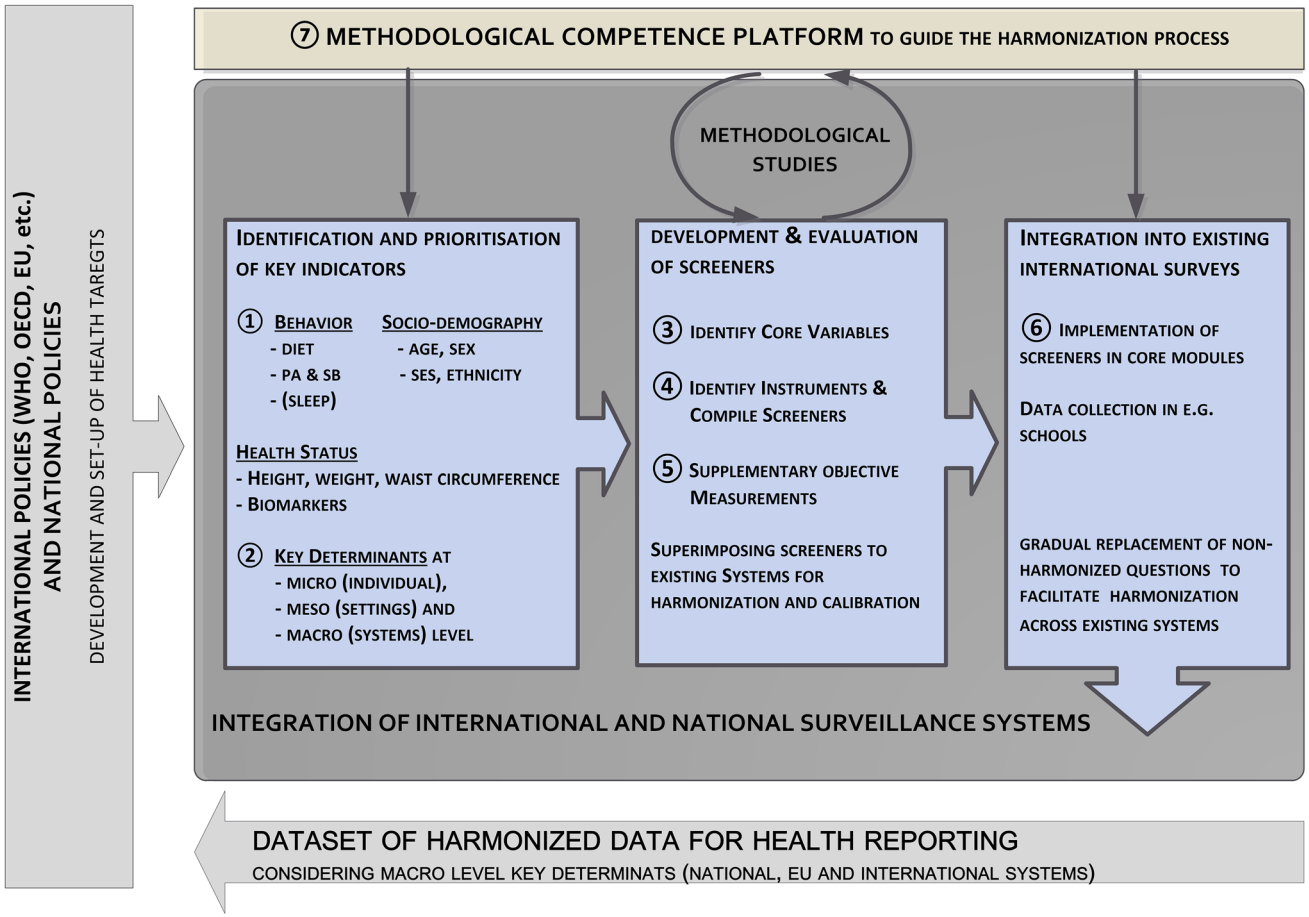

Fig. 1 Conceptual framework for the road map towards the establishment of a standardized children's and adolescents' health surveillance system

As an example, indicators of dietary patterns like consumption frequency of sugar-sweetened beverages (Malik et al. 2013), fast food (Rosenheck 2008) or fruits and vegetables (Wang et al. 2014) meet these requirements. These food items affect the quality of the diet and are associated with public health outcomes, such as overweight and obesity (Fernandez-Alvira et al. 2017). Further, eating patterns dominated by high energy-dense foods (Hebestreit et al. 2014) or breakfast consumption (Pearson et al. 2009) are often used for public health monitoring in children and adolescents (Currie et al. 2000).

In relation to PA, frequency, duration and intensity are typically measured across different domains (e.g. transport, leisure time or organized PA) as well as assessment of overall PA level expressed in relation to meeting the current PA recommendations (Poitras et al. 2016). Objective assessment of PA and SB has higher validity and should preferably be used in parallel to supplement self-report assessments. However, the most existing population-based surveillance systems are still solely dependent on self-report due to cost and practical considerations. PA and SB have been reported to be associated with overweight/obesity, metabolic disorders and cardiovascular disease in children and adolescents (de Moraes et al. 2015). Screen time is often used as a proxy for total SB (McVeigh et al. 2016) but is only a partial indicator of time spent sitting and presents a number of methodological challenges (Atkin et al. 2012). Moreover, screen time involves exposure to marketing of unhealthy foods that may in itself be related to the same health outcomes as SB, mediated through food choice (Olafsdottir et al. 2014). Hence, objective assessment of SB (together with PA) would make an important addition to surveillance systems.

For the proposed road map, priority will be given to established indicators used by European member states and pan-European public health initiatives. For the selection of key indicators, clear criteria will be applied, such as (1) evidence of association with health or health-related behaviours; (2) importance for health status; (3) usefulness for analysing policy impact; and (4) usefulness for analysing implementation facilitators and barriers, taking ECHI criteria also into account (see under AP1). The selection process itself will be accomplished in multiple steps. First, indicators will be identified after a literature

review and will then be prioritized by experts during a workshop and a subsequent Delphi expert survey. Second, a preliminary set of indicators will then be mapped against available monitoring and surveillance data provided, for example, by the WHO STEPwise approach or the EHIS initiative. This work will be accomplished within the Policy Evaluation Network (www.jpi-pen.eu), which runs until 2020.

Key indicators of determinants (AP2)

The ECHI shortlist includes 14 indicators of health determinants, including socio-economic, health status and intervention indicators (Table 2). During the last decades, it became evident that individual-level determinants of dietary behaviour are often overridden by environmental-level (upstream) determinants in youth (Sleddens et al. 2015) (Table 3). Therefore, relevant determinants at the environmental level of schools (e.g. availability and accessibility of un-/healthy foods/drinks in schools and other settings (Buck et al. 2013)), and family (e.g. number of family meals (Hebestreit et al. 2017)) should both be considered in order to assess the impact of the policies at both levels and to assess their interactions.

With regard to PA, self-efficacy and perceived social support at the individual level (Bauman et al. 2012) combined with indicators of well-implemented physical education and PA programmes at the school level and with indicators of land use in the neighbourhood/community may be useful to assess policy impact (Heath et al. 2012).

Knowledge on SB and its determinants in children and adolescents is currently increasing: apart from age—older adolescents are more sedentary—gender, socio-economic status of the family, weight status and environmental determinants are known to be correlated to time spent in SB (Stierlin et al. 2015). As ECHI provides predominantly screen use as an indicator for SB, more evidence is required and determinants need to be identified for surveillance purposes.

Additionally, we will consider indicators used by the International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support (INFORMAS) that facilitates evaluating the current situation in European public policies affecting the food policy environments. The INFORMAS approach comprises indicators such as food provision, prices, promotion, labelling, retail and trade, leadership and governance. We will further include indicators of the WHO Health-Enhancing physical Activity (HEPA) Policy Audit Tool (PAT) which is a standardized tool designed to help researchers and policy makers collect information on what policies exist across different sectors (e.g. organized sport, school, transport, recreation) that directly or indirectly impact on PA (and sedentary behaviour).

Table 2 Health determinant indicators (and related ECHI numeration) of the European Core Health Indicators (Expert Group on Health Information (EGHI))

Health determinant indicators of the European Core Health Indicators	
Proximal health determinants	Distal health determinants
42. Body mass index	47. Hazardous alcohol consumption
43. Blood pressure	48. Use of illicit drugs
49. Consumption of fruit	53. Work-related health risks
50. Consumption of vegetables	54. Social support
52. Physical activity	55. Particulate matter exposure
46. Total alcohol consumption	
44. Regular smokers	
45. Pregnant women smoking	

Table 3 Priority list of indicators of the European Core Health Indicators (Expert Group on Health Information (EGHI))

Indicators of dietary intake	Indicators of physical activity	Indicators of sedentary behaviour
Consumption of vegetables	Physical activity frequency, duration and intensity	Media use
Consumption of fruits	Organized physical activity	Screen time
Consumption of soft drinks	Leisure-time physical activity	Computer use
Alcohol intake	Transport physical activity	Television time

Development and evaluation of screeners and supplementary modules (AP3, AP4 and AP5)

Selection of a set of core variables (AP3)

Based on the selected and prioritized key indicators, a set of core variables (or proxies) will be identified that can be measured with a few screening questions (screeners). To give an example, assessing fruits and vegetables intake can be measured as daily intake (piece/day) or as adherence to the 5-a-day recommendation (in %). Therefore, the screener may include respective instruments to measure fruits and vegetables intake, e.g. a FFQ (as provided by EHIS), a 24HDR (GloboDiet), 'How often do you eat fruit?' (HBSC survey 2013/2014) or 'How often do you eat fruits and vegetables during a day, a week or a month?' (Nordic Monitoring System). Accordingly, the screeners will capture the most relevant aspects of health-related topics and allow ideally quantitative assessments; they should be self-sufficient for inclusion in different survey instruments, and they should capture central components of key indicators; the selection of screeners for specific topics should be based on validity, reliability and the evidence regarding impact on health and health behaviour. A few studies such as HBSC already provide suitable screening tools for the collection of behaviour- and health-related data that may be considered for the harmonization process (Brooks et al. 2015).

Selection of instruments to assess key indicators (AP4)

Accepted and validated methodologies and definitions exist for a number of indicators, but the corresponding variables are not always comparable between systems. Dietary intake is mainly assessed using Food Frequency Questionnaires (FFQ; without estimation of portion size), 24-h dietary recall (24HDR; ideally repeated recalls) (De Keyzer et al. 2015) or food diary/records (ideally repeated days recorded) (DIET@NET partnership 2017).

Multiple 24HDRs (or dietary records of children) are considered as the least-biased way to monitor food, nutrient and contaminant intake in populations. The traditional interviewer- or self-administered 24HDR method is still the standardized assessment method used in large-scale surveys, such as ASA24 (Automated Self-Administered 24-h Recall; http://epi.grants.cancer.gov/asa24/). In Europe, the interviewer-administered GloboDiet 24HDR software is used as a standardized system to assess dietary data in some European countries. Also, 24-h urine voids are used to monitor certain components/nutrients such as sodium and iodine intake (biomonitoring surveys) (Brussaard et al. 2002).

Dietary behaviour questionnaires have been validated less frequently compared to dietary intake questionnaires, although questions are less complex. Dietary behaviour (e.g. breakfast consumption) may be measured using questionnaires or FFQs. Several short FFQs focusing on a smaller number of key indicators have been developed for use in cross-country studies such as WHO-COSI and HBSC. Validity of these FFQs was tested in both HBSC and the Nordic Monitoring of Diet, Physical Activity and Overweight, while reproducibility was only tested in HBSC (Bel-Serrat et al. 2017).

As FFQs create less respondent burden and are less resource intensive compared to dietary records, 24HDR or biomarker use, FFQs have so far been a preferred method for population-based surveys.

Official reports about PA levels in European children use data obtained through questionnaires (Janssen et al. 2005). As questionnaires are imprecise in the assessment of PA in children and adolescents and given the advances made in this area over the last decades, objective methods should be favoured in large-scale studies or for surveillance purposes (Basterfield et al. 2008). In contrast, various PA questionnaires have been used to assess PA, but their validity is known to be limited (Helmerhorst et al. 2012). For example, PA screeners used in HBSC have been shown to have acceptable psychometric properties and validity (Health Behaviour in School-aged Children Study 2014). SB is most often assessed via questionnaires that mainly collect information on reading or screen-based behaviours, with some studies showing that these measures are reliable and valid (Bobakova et al. 2015). However, there is a lack of validated measures for total sitting time in children and adolescents.

Activity monitors and other new technological devices are promising objective methods for measuring PA and SB in surveillance surveys as they will facilitate the harmonization and integration of high-quality measurements (Van Hecke et al. 2016; Verloigne et al. 2016). A major limitation that prevents the widespread use of activity monitors is the relatively high cost of the measurement devices as well as the laborious data management (Pedisic and Bauman 2015). Furthermore, for the comparability of accelerometer data standardized proceedings in data collection and processing are essential (Pedisic and Bauman 2015). However, data management may become simpler and faster as the technology progresses and costs will presumably drop in future as these devices are becoming the standard in current research. Additionally, suitable instruments (a) have to be valid and reliable for use in a cross-cultural context; (b) should overlap as much as possible with methods and instruments already used by current systems; (c) have to be easily applicable to provide robust estimates; and (d) should be affordable.

Selection of a set of supplementary modules (AP5)

The feasibility of replacing self-reports by objective measurements (e.g. activity monitors) and mHealth technology (World Health Organization 2011) should be evaluated for selected core variables. In parallel with the incorporation of screeners into existing surveillance systems (full sample), a set of supplementary objective measurement methods may be implemented (among sub-samples) in these systems, where feasible; this will enhance data quality and completeness. This may initially be accomplished in supplementary modules for smaller subgroups, while core variables may be used to assess temporal trends in the full study population. Supplementary modules may provide quantitative data and could be used to validate self-reports or calibrate survey instruments. For dietary assessment, the European Food Safety Authority (EFSA) recommends dietary records for children aged 3–9 years and 24-h dietary recall interviews for children aged over 10 years, adolescents and adults for an application in subgroups (European Food Safety Authority 2014).

Objective measurements provide information on patterns and intensities, at least in subgroups; in combination with a PA diary, activity monitors allow the assessment of PA intensities and duration by domain (school-related, transport, leisure time). To our knowledge, no pan-European surveillance initiative has used activity monitors so far, but examples exist in national surveys such as KiGGS. In the second examination wave, KiGGS and the supplementary module Motorik-Modul (MoMo) used a physical activity questionnaire in addition to accelerometers (Actigraph GT3X +/wGT3X-BT) in a sub-sample. Accelerometer data sets for 6720 respondents (11 to 29 years) have been collected. In the long run, KiGGS and MoMo will be able to investigate temporal trends across the total sample (Woll et al. 2017).

Implementation of screeners accompanied by methodological studies (AP6)

A set of screeners will be integrated into existing surveillance systems to provide comparable data between these systems for a limited number of variables only. Due to the strong selection criteria (validity, reliability and robustness of estimates in a cross-cultural context), the implementation of screeners facilitates quality assurance across the systems and over time. Screeners will be used to calibrate existing instruments with which they overlap across different surveillance systems. This calibration approach could be integrated in pilot studies (comparing data collected using new screening instruments with data from established instruments) and validation studies (comparing data collected using new screening instruments with data from established 'gold standard' methods, such as activity monitors for PA and SB). Since the screeners may be implemented by surveillance systems without discarding existing instruments, the system's internal integrity is secured and their ability to assess temporal trends is retained.

Then, in subsequent steps, more screeners or supplementary modules may be added and enable the gradual transition of existing surveillance systems towards harmonized and higher-quality measures. Eventually, some of the original non-harmonized instruments may be replaced by new harmonized measurements without the loss of information on temporal trends if the calibration was successful.

Sustainable harmonization through a methodological competence platform (AP7)

The success of the harmonization of current surveillance systems will depend on the willingness of existing systems to work together for the common aim of a pan-European system. Support may be greater if existing systems retain a certain degree of flexibility to provide data serving regional or national interests. Sustained support is needed for the selection, development, pretesting and validation of novel tools that are affordable, that are easy to use in different settings and that provide robust estimates. Existing surveillance systems may undertake a joint effort to establish a sustainable methodological competence platform for supporting and coordinating the necessary methodological developments. This most certainly will comprise information and communication technology, technical features and qualified personnel; the involvement or linkage with national and international surveillance systems will be desirable. Such a platform ought to offer instruments based on a modular system and enable the user to decide which tools they want to apply in their (national) surveillance system, e.g. from a basic questionnaire up to physical or even biochemical measurements. Such a methodological platform may facilitate: (a) the development and validation of novel instruments and measurement modules; (b) the gradual replacement of the original measures with valid harmonized measurements; (c) the promotion of common standards for data management, data pooling, data access, ethics, training and quality management; and (d) the collaboration of surveillance systems.

In conclusion, the authors do not recommend the development of a novel pan-European surveillance system as several well-established systems are operational. Instead, we propose a stepwise harmonization process building on these existing surveillance systems in order to facilitate increased comparability of data across surveys, age groups and countries. This approach would of course

require additional resources to integrate these new measures into the existing surveillance systems, which might prove challenging as these systems are often financially stretched already.

The modular approach would allow to build a bridge between health reporting and research systems. This idea is already inherent in the proposed validation studies that would be conducted in sub-samples. As already done in several surveillance systems such as National Health and Nutrition Examination Survey (NHANES) and KiGGS, longitudinal sub-samples could become a fully integrated component to assess the causal relationship between behaviours, determinants and health outcomes and could further constitute a powerful pan-European cohort. Close concatenation with research may be a means to improve the quality and usefulness of the surveillance data and to optimize data use for the impact evaluation of health-promoting policies.

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Compliance with Ethical Standards

Human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest The authors declare that they have no competing interests.

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