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Advancing the evidence base for public policies impacting on dietary behaviour, physical activity and sedentary behaviour in Europe: The Policy Evaluation Network promoting a multidisciplinary approach

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ABSTRACT

Non-communicable diseases (NCDs) are the leading cause of global mortality. As the social and economic costs of NCDs have escalated, action is needed to tackle important causes of many NCD's: low physical activity levels and unhealthy dietary behaviours. As these behaviours are driven by upstream factors, successful policy interventions are required that encourage healthy dietary behaviours, improve physical activity levels and reduce sedentary behaviours of entire populations. However, to date, no systematic research on the implementation and evaluation of policy interventions related to these health behaviours has been conducted across Europe.

Abbreviations: CDC, Centers for Disease Control and Prevention; CFIR, Consolidated Framework for Implementation Research; COSI, Childhood Obesity Surveillance Initiative; DEDIPAC, Determinants of diet and physical activity; EHIS, European Health Interview Survey; EPI, Environment Policy Index; EtDs, Evidence to Decision frameworks; EU, European Union; HDHL, A healthy diet for a healthy life; HE^2, Healthy and Equitable Eating; HEPA PAT, Health-Enhancing Physical Activity Policy Audit Tool; INFORMAS, International Network for Food and Obesity/ Non-communicable Diseases Research, Monitoring and Action Support; JPI, Joint Programming Initiative; KH, Knowledge Hub; NCD, Non-communicable disease; PA, Physical Activity; PEN, Policy Evaluation Network; PEIP, Pathways to Evidence Informed Policy; RE-AIM, Reach, Effectiveness, Adoption, Implementation, Maintenance; SUMP, Sustainable Urban Mobility Plan; WHO, World Health Organisation

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Consequently, no information on the merit, gaps, worth or utility of cross-European policy interventions is available, and no guidance or recommendations on how to enhance this knowledge across European countries exists. As part of the Joint Programming Initiative "A Healthy Diet for a Healthy Life" (JPI HDHL), 28 research institutes from seven European countries and New Zealand have combined their expertise to form the Policy Evaluation Network (PEN). PEN's aim is to advance tools to identify, evaluate, implement and benchmark policies designed to directly or indirectly target dietary behaviours, physical activity, and sedentary behaviour in Europe, as well as to understand how these policies increase or decrease health inequalities. Using well-defined evaluation principles and methods, PEN will examine the content, implementation and impact of policies addressing dietary behaviour, physical activity levels and sedentary behaviour across Europe. It will realise the first steps in a bespoke health policy monitoring and surveillance system for Europe, and refine our knowledge of appropriate research designs and methods for the quantification of policy impact. It will contribute to our understanding of how to achieve successful transnational policy implementation and monitoring of these policies in different cultural, demographic or socioeconomic settings. PEN will consider equity and diversity aspects to ensure that policy actions are inclusive and culturally sensitive. Finally, based on three policy cases, PEN will illustrate how best to evaluate the implementation and impact of such policies in order to yield healthy diets and activity patterns that result in healthier lives for all European citizens.

1. Introduction

As the social and economic costs of non-communicable diseases (NCDs) have escalated and are requiring an intensification of population approaches, measures targeting unhealthy lifestyles have (or should) become a priority in the policy agenda in Europe and elsewhere. NCDs are currently the leading cause of global mortality, responsible for 40.5 million deaths in 2016, equating to 71% of all deaths (WHO, 2016). In 2010, obesity specifically contributed to 3.5 million deaths and it has been estimated that 10% of global disability adjusted life years are ascribed to dietary risk factors and physical inactivity (Lim et al., 2012). Thus, successful policy actions that encourage healthy dietary behaviours and reduce physical inactivity have the potential to influence the health and well-being of an entire population (Woods and Mutrie, 2012).

The last two decades have witnessed an exponential growth in policy research and interventions targeting upstream determinants of health behaviours to reduce the burden of lifestyle-related diseases. A recent search on the Nourishing data-base has identified 109 policies aimed at promoting healthier diets in the European Union, mostly implemented at the member state level (WCRF, 2019). Similarly, policy research in physical activity and sedentary behaviour has developed significantly in recent times, with over two hundred publications in Europe alone since 2017 (Klepac-Pogrmilovic et al., 2018).

Here, policies are defined as 'decisions, plans and actions that are enforced by national or regional governments which may directly or indirectly achieve specific health goals within a society'. The role of policies is to change systems instead of individuals, and in doing so, to create supportive contexts in which programmes, infrastructure and environments collectively can reduce NCDs, including obesity. If successful, policies should result in supporting individuals to adopt and maintain health behaviours, in this instance healthy diets, physical activity and less sedentary behaviour. Policies can give support, coherence, and visibility at the political level, and make it possible for national government sectors, regional or local authorities, stakeholders, and the private sector, to be logical and consistent in their actions to achieve a shared goal (WHO Europe, 2010). Consequently, understanding how to facilitate sustainable change across multiple sectors and at multiple levels is paramount. In addition, an understanding of the evidence behind the policy and in particular evidence of effectiveness is also needed. To this end, PEN will undertake a detailed examination of three case study policies to assess their level of evidence informed decision making and any evidence of effect. The case study policies are described below.

A case study is the implementation of a sugar sweetened beverages (SSB) tax. The consumption of SSB has been associated with weight gain in both children and adults (Malik et al., 2013). Studies have shown that SSB sales and intake are price responsive, i.e. an increase in price would lead to a decrease in demand (Powell et al., 2013). The WHO therefore advocates taxation on SSB (WHO, 2017). Several European countries have implemented such a tax or are discussing it, for example Portugal (Graca et al., 2018) or the UK (Thomas-Meyer et al., 2017), whereas other countries have not introduced or even abolished an SSB tax, as Denmark did in 2014 (Jensen and Smed, 2018).

A second example are Sustainable Urban Mobility Plans (SUMPs), which are used as policy instruments to guide the development of transport (supporting active transport) in urban areas. The EU has developed SUMPs as a practical tool that supports policymakers and planners in creating a vision of urban mobility as well as to identify the effective measures that make local transport systems more sustainable. National guidelines for urban mobility planning provide orientation to local authorities. In France, for example, urban mobility plans have become an obligatory requirement for receiving national government funds for local transport projects (Böhler-Baedeker et al., 2014).

A third example are school policies that are implemented on national and regional levels to improve diet, to increase physical activity levels and/or to reduce sedentary time of children and adolescents. Such policies prescribe what procedure could be followed (Storcksdieck et al., 2014; Rütten and Pfeifer, 2016; Dreyhaupt et al., 2012). A systematic review conducted in 2018 by Micha and colleagues (Micha et al., 2018) quantified the impact of school food environment policies on dietary habits of children age 2–18, in preschool, primary and secondary school. Based on the 91 studies included, the review found that direct provision policies increase fruit intake by 0.27 servings per day, and increase vegetable intake by 0.04 servings per day. (Micha et al., 2018).

To date, no systematic research on the implementation or evaluation of policy interventions across Europe has been conducted. Consequently, gaps in our knowledge exist, as we have no information on the impact nor on implementation of policy interventions across Europe and no guidance or recommendations on how to develop our knowledge with appropriate research designs, methods and tools.

The Policy Evaluation Network (PEN) is a cross-country, multidisciplinary collaborative project combining expertise in diet, physical activity and sedentary behaviour with policy- and implementation science to deliver a comprehensive approach to address this gap. PEN will build on knowledge, experience and outputs of the Determinants of Diet and Physical Activity Knowledge Hub (DEDIPAC KH) (Brug et al., 2017; Lakerveld et al., 2014) and other existing approaches from international networks, e.g. the NOURISHING framework (Hawkes et al., 2013) and INFORMAS which provide frameworks for benchmarking policies against international best practice (Swinburn et al., 2013).

Sustainably improving healthy lifestyles of populations requires changes of the physical, social, cultural, economic, and political environments that shape health behaviours. Our aim is to guide the development, implementation and evaluation of policies that improve

food choice, enhance physical activity and reduce sedentary behaviour effectively, for the ultimate purpose of improving health behaviour of European citizens.

The key objectives of PEN are to advance our knowledge on the effective implementation of policies and their impact in terms of improving health behaviours. More specifically PEN aims to:

- Adapt and implement a Food Environment Policy Index (Food EPI) and develop a Physical Activity Environment Policy Index (PA EPI) to provide benchmarks of best practice from which policy practice can be rated;
- Map health-related indicators needed to assess the impact of policy interventions and to further develop surveillance systems to monitor these indicators;
- Review, critically assess and refine quantitative methods to evaluate the impact of public policies;
- Identify key factors, barriers and facilitators of implementation of policy interventions and identify tools to assess their successful implementation;
- Summarise the requirements for policy interventions to reach vulnerable groups, including lower socio-economic groups and ethnic minority populations;
- Provide an in-depth assessment of existing exemplary policies: SSB taxation, active transport policies, and school policies on nutrition and physical activity.
- In this paper we describe the rationale and specific goals of our ambitious project and the innovations, which it will bring to our knowledge on policy impact.

2. State of the art: Policies and their evaluation

2.1. Upstream entry points for change

The impact of many 'downstream' interventions directly targeting individual health behaviours without considering their 'upstream' drivers and barriers have had limited impact. Thus, an effective and sustainable adoption of healthy lifestyles on the population level requires changes of the food and physical activity systems as well as the physical, social, cultural, economic and political environments that shape our health behaviours. The example of the global obesity epidemic indicates that interventions targeting upstream drivers will have larger effects than health promotion programmes or medical treatments, although their political implementation seems to be more difficult (Swinburn et al., 2011). To sustainably improve the lifestyles of European citizens we need to create an evidence-base guiding the development and implementation of 'upstream' policies that improve food choice, enhance physical activity and reduce sedentary behaviour effectively.

This 'upstream' policy-based approach to the promotion of healthy lifestyles has been endorsed by several United Nations General Assemblies, including a specific reference to the need for strengthening the science-policy interface to provide strong evidence-based instruments to support policy makers in promoting sustainable development (United Nations General Assembly, 2015). More specifically, the WHO *Global Activity Plan for the Prevention and Control of NCDs 2013–2020* (WHO, 2013), the *Physical Activity Strategy for the WHO Europe Region 2016–2025* (WHO, 2016), the new *WHO Global Action Plan on Physical Activity 2018–2030* (WHO, 2018)) as well as the *European Food and Nutrition Action Plan 2015-2020* (WHO, 2015) and the *EU Action Plan on Childhood Obesity 2014-2020* (European Commission, 2014) as well as the *Report of the Commission on Ending Childhood Obesity* (WHO, 2016) call for action through a *Whole-of-Government*, *Health-in-All-Policies* approach. Consequently, this requires action on all policy levels and collaboration among policy makers from several different sectors, each tackling the physical activity, sedentary behaviour and nutrition goals with the same outcome spread across multiple agendas. This implies a complex implementation to change the socio-political, economic, cultural and environmental drivers in a favourable direction while ensuring that the benefits of a healthy diet and an active life are accessible for all citizens. Policy makers have argued the case for policy interventions, the research gap to be addressed is how best to determine the impact of these policies and what implementation strategies would be most effective to achieve a real and sustainable change.

Although progress has been made in our understanding of the potential for policy actions to improve population health, an examination of the literature reveals an important research gap. Despite the call for evidence-based policy-making and the increasing amount of resources invested in evaluation, there remains uncertainty in relation to the impact of different policy measures, and their real potential to reduce the burden of disease (Brambila-Macias et al., 2011; Varela et al., 2018). Furthermore, quantitative evaluations have often been limited to capture the effects of policies on the primary outcome, overlooking the implementation elements that might help a better targeting of future policies (Capacci et al., 2012). The intensification of research on this knowledge gap was driven by a variety of disciplines, ranging from nutrition studies and medicine to exercise science, epidemiology, political sciences, economics, and public health. However, despite a growing body of evidence, research aimed at understanding the population impact of policies remains very fragmented with sometimes controversial results. Thus, a multi-disciplinary coordination effort is highly desirable and very timely. To address this incoherence, governments from seven European countries have funded the "Policy Evaluation Network (PEN)".

Policy measures often involve multilevel, multisectoral, and multicomponent actions and therefore the evaluation of the impact is by no means trivial. Evaluation approaches employing standard epidemiological methods are hardly suitable as they require randomisation to ensure similar risk profiles of intervention and control groups. As suitable control groups are usually lacking when policies target larger populations, other methodological approaches are needed.

Population-based surveillance data covering indicators that are targeted by certain health policies are essential to evaluate their impact. Not only because there are huge gaps regarding the availability, coverage and comparability of surveillance data, more comprehensive approaches addressing, both, the complexity of the implementation of public policy interventions as well as their complex effects on health-related behaviours are clearly required. This is even more the case as actual policy implementation is expected to be a major driving factor in achieving (or failing to achieve) equitable population-level improvements in dietary intake and physical activity behaviours.

The development of a framework guiding the evaluation of such policies, and the translation of this framework into a series of logic models that outline potential mediating approaches and processes, requires a trans-disciplinary approach. Epidemiology and Implementation Science can contribute to the public health evidence by monitoring health behaviours and health outcomes on the population level, evaluating the implementation and impact of intervention measures.

2.2. Theoretical frameworks for policy evaluation

It is essential to account for the complexity of direct and indirect effects of policies. These effects are characterised by the interplay of various policy domains, feedback loops that may induce or impede further change and responses that may counteract the intended effects. Achieving this requires an approach which accounts for the multitude of inter-dependent elements and uses a multitude of methods to understand the complex systems driving our health behaviours and impacting public health (Swinburn et al., 2011; Rutter et al., 2017).

To understand the process of public policy and how to evaluate its impact and implementation, PEN will be guided by the application of policy frameworks. In the first instance PEN was guided by a "point-of-departure theoretical framework" that has been adapted from the CDC

(Centers for Disease Control and Prevention, 2013a; 2013b; Brownson et al., 2009). This framework recognizes the steps from identifying the problem relating to current policies towards implementation of policies that can be summarized as content evaluation, implementation evaluation and impact evaluation (Fig. 1).

Evaluating policy content refers to how a policy articulates its goals, its implementation strategies and its underlying logic as to how and why the policy should produce the intended change. Additionally, evaluating the development of a policy helps us to understand the context from which the content emerged and any resultant implementation successes or challenges. Evaluating policy implementation may focus on assessing fidelity i.e. if the policy in question was implemented as intended. It can provide important information about the barriers to and facilitators of implementation and a comparison between different components or intensities of implementation. Evaluating policy impact examines if a policy produced its intended outcomes or impact. Documenting the changes in key indicators that have occurred since the implementation of a policy and the extent to which changes can be attributed to the policy are important. This requires the use of both quantitative and qualitative research methods, and an evaluation of short-term and intermediate outcomes.

To operationalise this conceptualisation and to provide an overarching trans-disciplinary framework for work across the various disciplines covered by the PEN consortium, we will follow a logic modelling approach. Logic models represent a tool to facilitate (i) that existing knowledge and assumptions about how a given policy works are made explicit; (ii) that those aspects likely to influence the impact of this policy as well as its generalisability are assessed in detail; and (iii) that findings obtained through different methodological approaches and across multiple disciplines are integrated (Rehfuess et al., 2018). It will thus maximize insights gained across European countries in the PEN consortium.

PEN recognises that the CDC model has several strengths for example its application to health policy and its clarity in describing the policy evaluation roadmap. However, its linear design is limited in its understanding of the complexities of policy evaluation and as such one of the first tasks of PEN is to generate a specific, overarching framework that will be used to guide the work of PEN. Several frameworks exist, but since they are designed for different purposes they are not directly suitable for PEN. However, they may offer valuable elements for the development of an overarching framework for PEN.

From an implementation perspective PEN will consider the *Pathways to Evidence Informed Policy* (PEIP; Bowen and Zwi, 2005); and the *Consolidated Framework for Implementation Research* (CFIR; Damschroeder et al., 2009). From a policy process and agenda setting perspective, Kingdon's (2011) *Multiple Streams Framework* will be reviewed. It consists of three streams, (1) the problem stream e.g. the perception that obesity is an issue that needs attention from governments, (2) the policy stream, where professional analysis of the problem informs solutions proposed by bureaucracy and (3) the political stream, where the ebb and flow of political power matches the problem with possible palatable policy options. Further frameworks, for example the *RE-AIM Framework* (Reach, Effectiveness, Adoption, Implementation and Maintenance; Glasgow et al., 1999) and others (Eccles and Mittman, 2006; Rabin and Brownson, 2012; Tabak et al, 2012) have been proposed on knowledge translation, policy implementation, improvement science and implementation science. Frameworks used to guide policy analysis in physical activity and sedentary behaviour were highlighted in a recent scoping review, and will be considered by PEN (Klepac-Pogrmilovic et al., 2018). These include the *Elite Theory* (Tan, 2015), multilevel models of physical activity promotion (Ruetten et al., 2013), *Figurational Sociology* (Stuij and Stokvis, 2015), *Institutional Change Theory* (González et al., 2016), the *Theoretical Domains Framework* (Michie, 2005) and the *Behaviour Change Techniques Taxonomy* (Michie, 2013). For qualitative interviews with stakeholders, the *Theory of Chance Framework* will be used (de Silva et al., 2014).

3. The PEN approach

As explained, the gap in our knowledge on policy interventions is the impact that existing European or national policy interventions may have on dietary behaviours, physical activity, and sedentary behaviours, and how these interventions potentially contribute to increasing existing health inequities. Equally, evidence of effective implementation is needed. As no systematic research on implementation and impact with a focus on different relevant policy interventions currently exists across Europe, PEN will address this need. The PEN approach aims to identify best practice in policy impact and implementation and will allow comparisons of different policies implemented on a national or local level. Eventually, PEN will identify actions and prioritise policy areas.

3.1. The focus of PEN

PEN will establish a multi-disciplinary research network with 28 research centres from seven European countries and New Zealand to evaluate policy interventions at population level regarding dietary behaviours, physical activity, and sedentary behaviours. Our New Zealand partners will provide the expertise and guidance on describing the policy environment and the collaboration allows sharing of international food policy best practice benchmarks against which European policies can be compared. PEN will consider different cultural, demographic or socio-economic environments; how they may require different approaches; or how they may modify the impact of policies. PEN will create an evidence-base to improve those health behaviours with regard to content, implementation and impact of policy interventions and it will give recommendations for their improvement. The project will focus on five interconnected research areas:

(1) Benchmark the current situation in European public policies affecting the food and physical activity policy environments using validated policy analysis tools such as the INFORMAS *Food Environment Policy Index*.
(2) Develop and prioritise a set of indicators for dietary behaviours, physical activity, and sedentary behaviours, measured using harmonised instruments that ideally can be used by existing monitoring and surveillance systems.
(3) Review, refine and develop methods for the quantitative evaluation of the impact of policies, considering experimental settings and observational data, and aspects related to the classification of

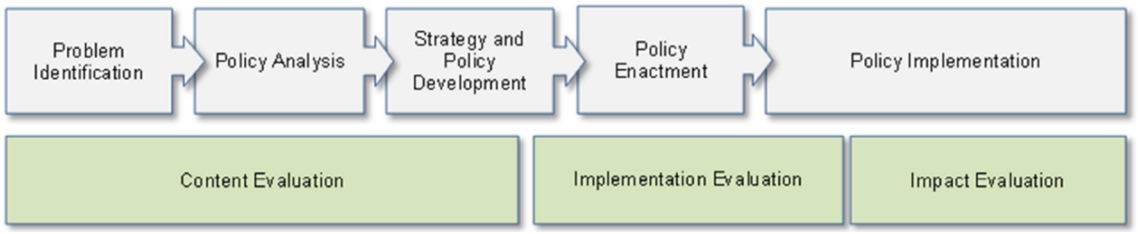


Fig. 1. CDC logical model used by PEN as a point-of-departure framework*, * Reproduced according to CDC (Centers for Disease Control and Prevention, 2013).

quantitative evidence while including elements of economic evaluation.
(4) Improve knowledge on the implementation dimension of policies, more specifically: (i) the process of implementation, (ii) facilitators and barriers for implementation and (iii) the evaluation of the implementation process.
(5) Explore the equity dimension of policies, through a better understanding of the impact of policies on lower socio-economic and ethnic minority groups in a crosstalk with research areas 1–4.

These research areas will be integrated and elaborated on through three cross-cutting case studies specifically to reflect the policy priority action areas in Europe: (a) evaluation of a SSB tax; (b) evaluation of policies related to urban mobility/active transport (*Sustainable Urban Mobility Plans*), and (c) evaluation of policies addressing nutrition, physical activity and sedentary behaviour in schools, as indicated in Fig. 2. More details on the structure of the work, the objectives for each research area and partners involved can be found on the dedicated project website: https://www.jpi-pen.eu/.

3.2. Food and physical activity environment policy index

To date the European food and physical activity policy environment has not been described. PEN will adapt the INFORMAS-led *Food Environment Policy Index* (Food-EPI) tool and will develop a *Physical Activity Environment Policy Index* (PA-EPI). This approach will facilitate the identification of existing policies and describe the current food and physical activity policy environment. It will then rate these policies against international best practice. PEN will provide an overview of public policies with direct/ indirect potential influence on food and physical activity policy environments. It will build on existing tools including the Food-EPI (INFORMAS, 2017) and the *Health-Enhancing Physical Activity Policy Audit Tool* (HEPA PAT; WHO Europe, 2017) as well as the DEDIPAC-toolbox (Brug et al., 2017). The INFORMAS Food-EPI is a comprehensive tool aimed to assess the level of implementation of government policies and to identify priorities and actions to improve the healthiness of food systems/environments that are benchmarked against international best practice. The Food-EPI consists of two components (policies and infrastructure support), across 14 domains (e.g. food composition, leadership) and consists of 47 good practice indicators, against which the evidence is benchmarked. The Food-EPI has been validated and implemented in 14 countries globally including New Zealand, Australia, Canada and the UK. A similar approach will be taken in Europe, where the Food-EPI will be adapted and validated for use in the European context taking relevant EU-level indicators into account. The European policy environment, in particular the food policy environment, is unique with some policies under EU jurisdiction, guided and enforced at the EU level and some policies developed and enforced at the national level. The PEN Food-EPI will be adapted to, both, the European level and the national level in five PEN countries (Ireland, The Netherlands, Germany, Norway and Poland), thus producing a European Food EPI and five national Food EPIs. The Food EPI approach involves identifying current policy practice. A key output will be food policy evidence papers, one at the European level and five individual national papers. The evidence papers will be validated for accuracy by policy makers. Policy implementation will be rated against international best practice by a panel of identified experts. This process will be conducted in each of the five PEN countries individually and then be adapted to provide a European approach. Subsequently policy gaps and action areas and priority actions will be identified (European and national). The approach taken at national and EU levels will potentially allow us to identify policy areas where 'double gaps' exist i.e., policy gaps at national and European level.

A PA-EPI will be developed based on methodology similar to the Food-EPI stemming from the WHO HEPA PAT (WHO Europe, 2017) which is a standardised tool designed to help researchers and policy makers collect information on what policies exist across different sectors that directly or indirectly impact on physical activity (and sedentary behaviour). This will provide baseline data from which to develop and complete the PA-EPI. Both are tools to benchmark government (local, regional and national) implementation of policy actions to effect change. These tools will be made available for the research and practice communities and have the potential to contribute to the global database for cross country/ continent comparisons.

3.3. Health-related indicators and their surveillance

The general shift towards evidenced-based policy making in the EU requires the development and application of universal indicators that can measure policy effectiveness. At present, there is no clear consensus on the indicators which should be used to evaluate the outcomes and implementation of diet and physical activity related policies. Indicators provide necessary baseline information for a particular policy area. They are also used to monitor progress in the implementation of a policy and, ultimately, indicators are critical in measuring the effectiveness of a policy in achieving its objectives. Still, comparability of the prevalence of unhealthy behaviours and health outcomes across countries is limited as we lack indicators that are measured according to the same standardized protocols with objective methods whenever feasible. As long as a comprehensive and harmonised European surveillance system is not in place, the evaluation of the effectiveness of policy measures across EU countries is seriously hampered. First steps in this direction where taken by existing surveillance systems, such as the *WHO Childhood Obesity Surveillance Initiative* (WHO-COSI; Wijnhoven et al., 2014), the *European Health Interview Survey* (EHIS; Lange et al., 2017), *EU Menu* (European Food Safety Authority, 2014) or the *Nordic Monitoring System* (Matthiessen et al., 2016). However, there is no consensus on a suite of common indicators which could allow for comparable data across countries and age groups that would facilitate the alignment of policies, action plans and recommendations to combat unhealthy lifestyles and NCDs in the European region.

PEN will continue the work on a roadmap towards a harmonised pan-European surveillance system that was begun as part of the DEDIPAC KH (Brug et al., 2017). PEN will foster a consolidated approach to policy evaluation across Europe by developing and prioritising an agreed set of indicators for dietary behaviours, physical activity, and sedentary behaviours as well as for upstream drivers, measured by harmonised instruments that ideally can be adopted easily by existing monitoring and surveillance systems. First, indicators for

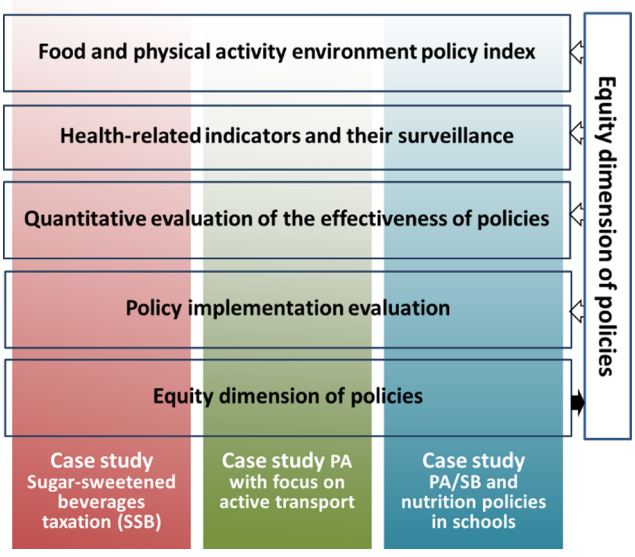


Fig. 2. Overview of PEN research areas and case studies.

"policy and action" and for "behaviour and determinants" will be identified for diet, physical activity and sedentary behaviour. Then, indicators for health policy and action will be assigned to related indicators of determinants and behaviour in order to allow for evaluating the effect of upstream factors on behaviour directly. These indicators will then be mapped against available data considering important dimensions most relevant for policy evaluation. Besides the established *European Core Health Indicators*, selection of dietary indicators will consider observational dimensions for each of the proposed *Food-EPI* (Swinburn et al., 2017), the *NOURISHING* and the *Healthy and Equitable Eating* (HE^2) frameworks (Hawkes et al., 2013; Pescud et al., 2018), the *DONE* framework (Stok et al., 2017), the *German Adiposity Monitoring Framework* (AdiMon, Robert Koch-Institute, 2018) and related DEDIPAC studies (Bel-Serrat et al., 2017; Osei-Kwasi et al., 2016). Comparably, physical activity- and sedentary behaviour indicators will consider dimensions from the *Global Action Plan on Physical Activity* (WHO, 2018), the *WHO HEPA PAT* (WHO Europe, 2017) domains, or those described in Sawyer et al, 2017 and Pettee et al., 2012. PEN will consider indicators that are relevant for future evaluation of effective policy implementation, such as facilitators and barriers of implementation of dietary or physical activity-related policies, and that are relevant for PEN's exemplary case studies targeting diet and physical activity. Identification of key indicators of equity and diversity dimensions will allow the prospective evaluation of policy impact on vulnerable groups. Subsequently, prioritization of key indicators will facilitate the identification of suitable instruments, to measure variables that describe relevant key policy indicators. In addition, the information will be synthesised to produce a searchable catalogue for researchers, policy makers and other interested stakeholders to facilitate the development and evaluation of their policy-related work.

Following the prioritization of an agreed set of indicators and instruments, it will be possible to develop a protocol for harmonised pan-European surveillance of young and adult populations and a monitoring system for more distal indicators that provide comparable data needed for policy outcome and impact evaluation. The further development of existing surveillance systems will be guided by the DEDIPAC KH conceptual framework that proposes a stepwise approach towards a cross-country harmonisation of health policy indicators (Hebestreit et al., 2019). By harmonisation of surveillance data on key indicators and their determinants at individual, setting and population level, and by identification and sharing of existing intersectoral health and consumer data, this research line will improve the assessment of the impact of policy interventions.

3.4. Quantitative evaluation of the impact of policies

PEN aims to review, critically assess and refine quantitative methods for the evaluation of the impact of public policies targeting dietary behaviours, physical activity, and sedentary behaviours across Europe. A specific PEN research line provides methodological support for the case studies. Experimental and quasi-experimental methods will be used to estimate policy impacts. As part of this task, a scoping review on the applicability of the *Cochrane GRADE* system (Guyatt et al., 2011) and *Evidence to Decision* frameworks (EtDs) to policy evaluation will assist in developing a framework for assessing the quality/certainty of the outcome evaluations and on the process for developing recommendations, both for experimental designs and methods based on observational data. The economic dimension will be analysed under simultaneous consideration of direct effects on health and indirect effects in other sectors. The direct economic dimension includes potential long-term changes in (quality adjusted) life expectancy and long-term health care costs that result from policies and resulting changes in risk levels and distributions. Model and simulation frameworks will be applied for quantifying those long-term effects (Squires et al., 2016; Weatherly et al., 2009). Indirect effects consider the relationship of policies with the broader economic environment (co-existing policies and regulations) and the distribution of the policy impact with regard to the economic welfare distribution (effects on employment and reformulation costs for industry). Publicly available observational data will be used to model and simulate the epidemiological impact (effectiveness/ efficacy) of policies at the population level, conditional on contextual factors and the five dimensions reach, efficacy, adoption, implementation, and maintenance (RE-AIM).

3.5. Policy implementation evaluation

The evidence for key characteristics of implementation processes, facilitators and barriers is accumulating (Howlett et al., 2009), but there is a lack of an overarching synthesis which may guide an effective implementation of policies aiming at healthy diets and a physically active lifestyle. To date, developments in frameworks and research on the evaluation of policy implementation (Bowen and Zwi, 2005; Proctor et al., 2011) were not translated into practice-ready checklists of tools or frameworks which may be used to evaluate policy implementation. To achieve these goals, PEN will build on DEDIPAC (e.g. Horodyska et al., 2015) to elicit major characteristics of policy implementation including (a) the process of implementation, (b) facilitators and barriers for implementation and (c) the evaluation of the implementation process (Nilsen, 2015).

Two theoretical frameworks addressing implementation, namely Pathways to *Evidence Informed Policy* (Bowen and Zwi, 2005) and *Consolidated Framework for Implementation Research* (Damschroeder et al., 2009), will be used as starting points for this PEN research line. PEN will make use of the DEDIPAC database of examples of good practice in terms of public policies and multicomponent interventions. The database contains information on intervention characteristics, monitoring and evaluation efforts as well as implementation, sustainability, and transferability conditions.

Regarding implementation processes, we will aim at identifying key aspects of processes such as policy penetration or enforcement, implementation styles and logics. The PEN overarching framework will be further refined based on e.g., *Pathways to Evidence Informed Policy* (PEIP; Bowen and Zwi, 2005); the *Consolidated Framework for Implementation Research* (CFIR; Damschroeder et al., 2009) and Kingdon's (2011) *Multiple Streams Framework*. Through a systematic review, theoretical frameworks focusing specifically on processes of policy implementation will be identified and evaluated with respect to their comprehensiveness and usefulness in practical applications. For this, evidence about barriers and facilitators for policy implementation at the individual level (characteristics of target group, implementers, and leaders), the institutional level, and the social, political, system and environmental contexts (Tabak et al., 2012) is required, and PEN will set out to critically summarize this evidence base. Facilitators and barriers will be grouped according to the respective policy field (e.g., nutrition, physical activity) and domain/setting (e.g., school, general population, transport) and level within the implementation process (European, national/ regional/ local). In stakeholder studies and using a backward mapping methodology (Elmore, 1979) crucial conditions for successful implementation will be identified using the *Theory of change* (De Silva et al., 2014) approach which allows also analyse normative and ambiguities conflicts involved in policies when they are implemented (Matland, 1995). Finally, we will investigate the existing tools for evaluation of policy implementations and propose a new checklist for assessing policy implementation (Bowen and Zwi 2005; Damschroeder et al., 2009; Nilsen, 2015). The overall synthesis of findings will give practice-oriented guidance about the evaluation of policy implementation processes to policy makers and various stakeholders from different sectors (Kingdon 2011; Howlett et al, 2009; 2016). As more and more regional and national governments as well as supra-international bodies establish specific health and prevention-related policies, such guidance and knowledge on pivotal aspects of implementation processes is becoming increasingly relevant.

3.6. Equity dimension of policies

Across Europe, the prevalence of obesity is higher in lower socio-economic groups (Roskam et al., 2010), among residents of deprived neighbourhoods (van Lenthe and Mackenbach, 2002; Lakerveld et al., 2015) and among members of ethnic minorities (Agyemang et al., 2016). A recent study even suggested a widening of absolute inequalities in obesity in many European countries (Hoffmann et al., 2017). Inverse associations have also been found between indicators of socio-economic position (SEP) and leisure time, not occupation-related physical activity (Beenackers et al., 2012). Whether sedentary behaviour is more prevalent among lower socio-economic groups is yet inconclusive (Loyen et al., 2016). Major diet-related food choices, such as food and vegetable intake (Roos et al., 2001) or the consumption of snacks are also known to vary by SEP to the disadvantage of lower socio-economic groups. Reviews on determinants of dietary behaviours, physical activity and sedentary behaviours in ethnic minority groups have indicated that culturally dependent knowledge, notion and ideas of food habits, physical activity and health are important factors for these groups (Osei-Kwasi et al., 2016, Langøien et al., 2017). If we are serious to make progress in tackling the obesity epidemic and to improve lifestyles for that purpose, a clear focus needs to be on those groups in society where prevalence proportions are above average. Policies are generally seen as a promising approach to change population health and to tackle inequalities (Backholer et al., 2014). Interventions to promote healthy eating have been recognised to have differential socioeconomic impacts (McGill et al., 2015), but there is a lack of studies of socioeconomic impacts of policy interventions.

This research line aims to advance the understanding of the impact of policies on lower socio-economic and ethnic minority groups, and will deliver a set of recommendations for an equity and diversity perspective in all stages of developing, benchmarking, implementing, monitoring, evaluating and disseminating policies directly or indirectly targeting dietary behaviours, physical activity, and sedentary behaviours across Europe. The work builds on two DEDIPAC state-of-the-art reviews on inequalities in these lifestyle behaviours and their determinants that indicated that culturally dependent knowledge, notion and ideas of food habits, physical activity and health were the most important factors (Osei-Kwasi et al., 2016, Langøien et al., 2017). The current research line will further a systems perspective to understand the differential impacts of policies for disadvantaged population groups and will guide the other research areas and their methods to incorporate an equity and diversity perspective.

3.7. Exemplary case studies

Three case studies will be carried out to showcase how specific policies can be evaluated regarding implementation and impact, using methods/procedures as identified by PEN. We generate a comprehensive in-depth understanding of the content, implementation and impact of these policies and to give guidance for future development of the most effective measures. In addition, recommendations regarding future implementation of the selected policies will be formulated based on the outcomes of the case studies.

Case studies were selected in such a way that they cover policies affecting (1) diet- and physical activity -related outcomes, (2) policies that are of pan-European relevance and currently under debate or implemented, (3) policies affecting adults and children, (4) policies on national and local levels, and (5) controversial versus more widely accepted policies. The final selection was also based on the expertise of the researchers involved in PEN. Finally, three case studies were selected: (a) evaluation of a SSB tax; (b) evaluation of policies related to urban mobility/active transport (SUMPs), and (c) evaluation of physical activity and nutrition policies in kindergarten/school settings. For each case study, a similar series of sub-studies will be carried out, including an overview of the existing evidence regarding impact and/or acceptability of this type of policies, one or more impact evaluations (within the general population, and within lower socio-economic or migrant groups), one or more implementation evaluations, and recommendations regarding the policy evaluated. Relevant stakeholders will be consulted. Based on the various bodies of evidence identified and generated, recommendations will be developed regarding physical activity and nutrition policies, and summarised in a fact sheet.

4. Expected outputs

PEN allows a comprehensive assessment of the food and physical activity policy environment in five European countries and at the EU level. It will produce a Food-Environment Policy Index (EPI) in five partner countries which will describe food policy gaps and action areas, benchmark these policies against international best practice, and identify priority action areas. We will also describe for the first time the food policy environment at the EU level and produce evidence documents to support our findings. PEN will produce the first prototype of a PA EPI describing the physical activity policy environment in the PEN participating countries.

Health-related indicators and their surveillance: Following the published roadmap (Hebestreit et al., 2019), the activities will aid the establishment of a stepwise harmonisation process building on existing surveillance systems in order to increase comparability of data across surveys, age groups and countries. Provision of a searchable catalogue of key indicators to allow for comparable data across countries for researchers, policy makers and other interested stakeholders will facilitate the development and evaluation of policy outcome and impact. Existing surveillance systems may undertake a joint effort to establish a sustainable methodological competence platform for supporting and coordinating the necessary methodological developments and continue the harmonisation process beyond the funding period of PEN.

The focus on equity and diversity in policies will result in new understanding of how and why policies have differential impact on lower socio-economic groups and ethnic minority groups. The main outcome will be recommendations ensuring that the needs of disadvantaged and vulnerable groups are adequately considered in policies aiming at improving dietary, physical activity and sedentary behaviours across Europe.

Factsheets will be delivered with evidence-based recommendations for implementation and effect evaluations of a SSB-tax, SUMPs and physical-activity and nutrition policies in school settings in Europe. Scientific evidence on barriers and facilitators of implementation of SSB-tax schemes, SUMPs and physical-activity and nutrition policies in school settings in Europe will be synthesized. Also, the impact of these policies will be reported, as well as (potential) differential effects among socio-economic groups.

The research line on implementation of policies will provide new insights on key aspects of policy implementation processes, with a focus on barriers and facilitators for policy implementation. Novel tools will be developed for the evaluation of policy implementation, using major public health policy topics as case studies.

As PEN does generally not involve study subjects, ethical issues applying to observational or interventional studies with individual-level personal data are mostly not relevant for PEN. However, ethical implications of recommendations that may be delivered by PEN as well as the policy interventions themselves require consideration of ethical principles, particularly the aspects of justice that will be dealt with in the work on equity and diversity of policies, where the need to avoid any harm will form a cornerstone of all recommendations. In order to ensure this, PEN has involved an ethics expert in its scientific advisory board.

5. Conclusions

The evidence base for the impact of regional, national or European

policies designed to significantly change dietary behaviours, physical activity, and/or sedentary behaviours in a sustainable way across Europe is currently scant. Consequently, we hardly know if, or how, policy interventions impact on citizens' health and lifestyle behaviours, or how this potential impact is mediated by cultural, demographic or socio-economic differences.

PEN will bring together more than 60 researchers from seven European countries and New Zealand with the purpose of learning how best to evaluate implementation of policy interventions and to guide policy makers at regional, national and transnational levels. PEN members contribute expertise in policy, evaluation, epidemiology, public health, physical activity, sedentary behaviour, nutrition, economic analysis, sociology, psychology, consumer science and transportation. In addition, PEN has planned to significantly interact with and actively involve national, European and global experts in policy development, implementation and evaluation. In addition, it will join forces with STOP and CO-CREATE, two ongoing European research projects addressing policy measures to tackle the childhood obesity epidemic, both funded by the *EU Framework Programme HORIZON 2020*. The aim is that this multidisciplinary group will collaborate nationally and transnationally to expand the network beyond the PEN consortium and to build capacity and develop Europe's first systematic and robust approach to policy evaluation in dietary behaviours, physical activity, and sedentary behaviours.

However, PEN will be limited by the extent and quality of evidence on policy relating to dietary, physical activity and sedentary behaviours. Within nutrition, the peer-reviewed literature is somewhat developed as evidence already exists for food policies such as SSB taxation and food labelling. In physical activity, while peer-reviewed literature on policy exists, this is mainly descriptive with little empirical data on impact. For sedentary behaviour the level of development is minimal. Much of the information on policy relating to the lifestyle behaviours under study exists in the grey literature, and PEN's ability to synthesize this information is limited to the PEN countries only. However, PEN will combine peer-reviewed and grey literature to fully understand policy impact and implementation. PEN brings a unique opportunity for collaboration across Europe, with the diversity of political structures within the PEN countries and while this will inform our understanding of policy, it will also add to the complexity of the work programme, providing significant challenge to ensure the findings are relevant to policy makers across countries and within countries at national, sub-national and local levels.

This pan-European collaboration will increase our insight regarding the various policies that are being implemented or should be implemented, allow better transnational comparison, and facilitate unified approaches to advance European research in this field. PEN will be one of the largest collaborative efforts of European experts in dietary behaviours, physical activity, and sedentary behaviours and related health policies. It facilitates knowledge exchange, capacity building, and the development of a clear pan-European strategic approach to advancing the policy agenda for nutrition, physical activity and sedentary behaviour.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2020.101873.

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