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CO-CREATE

System maps: energy balance drivers
Deliverable 4.1

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Executive Summary

This report presents a qualitative study that is a core primary research component of the CO-CREATE project: Work Package 4 (Obesity System Mapping), led by The London School of Hygiene and Tropical Medicine. Described here are the results of 'systems mapping' workshops with a range of stakeholders, most importantly, groups of adolescents, in which they identified key factors perceived to be driving obesity in young people. During the workshops, participants were guided through the group model building process to produce causal loop diagrams; these represent the participants' views on the determinants of adolescent diets and physical activity, as they pertain to obesity. Included in this report are the outputs of system mapping workshops with adolescents in Poland, Portugal, The Netherlands, Norway, South Africa, and the United Kingdom; also included is a system map showing contributions from European-level policy-makers and academics. Taking a systems approach to the challenge of adolescent obesity prevalence allows consideration of the multitude of determinants, the ways they are inter-related and of other characteristics of complex systems such as feedback loops and emergence. The maps presented here will provide a basis for CO-CREATE Work Package 5 in which adolescents will form Alliances to develop policy responses that take a systems approach to the problem of adolescent obesity. The maps will also be further developed as an input to a systems dynamics model of potential policy responses to adolescent obesity, as part of CO-CREATE Work Package 7.

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List of acronyms / abbreviations

CLD	Causal loop diagram
EASO	European Association for the Study of Obesity
ECO	European Congress on Obesity
GMB	Group model building
STICKE	Systems thinking in community knowledge exchange [software]
UK	United Kingdom
WP	Work package

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Introduction

Deliverable description

In line with the European Commission Research Executive Agency/ Horizon 2020 Grant Agreement number 774210 — CO-CREATE, this report fulfils the requirement of Deliverable 4.1 from Work Package 4: "*A set of conceptual system maps is provided, outlining the drivers of energy balance related behaviours from the perspective of European youth, policymakers, and academic experts.*"

Objective of deliverable

The objective of the deliverable is to present the causal loop diagrams, also known as 'system maps', generated during workshops with adolescents in six countries and with adult obesity experts. The maps are in effect, data resulting from the workshops, representing the views of the participants, on the determinants of adolescent obesity. In this report, they will be contextualised within some background on the topic and on the theoretical framework, and the methodology used to conduct the mapping workshops. We will finish by situating the Work Package (WP) 4 maps within the overall CO-CREATE project.

Systems thinking in CO-CREATE

CO-CREATE is using complex systems thinking as a conceptual framework for the entire project. Complex systems thinking helps make sense of complex challenges: this mindset, and the tools and methods used to examine the system provide a framework for examining the factors and people in any given problem, the relationships between them and changes through time. The approach helps conceptualise and articulate the need to span a range of political, social, cultural, economic and academic domains within any given system. A system in this sense is more than the sum of its parts, it is the result of the interactions between them and the people involved. As such by taking a complex systems approach to obesity we conceptualise it as an outcome of many, interdependent factors within a connected whole (Rutter et al., 2017).

Given that, for complex challenges such as obesity, there are no simply definable causal relationships, systems thinking enables us to account for numerous spheres of interacting – and often uncertain – influences. Indeed, one of the defining features of complex systems is interconnectedness – of people and places, of physical, commercial, political and other environments, of increasing urbanisation and of shifts in working patterns and transport. A systems lens helps account for the interlinked, dynamic, somewhat chaotic relationships between such a range of factors (Finegood, 2011).

«Systems thinking is an iterative learning process in which we replace a reductionist, narrow, short-run, static view of the world with a holistic, broad, long-term, dynamic view, reinventing our policies and institutions accordingly."
(Sterman, 2006)

At the same time, the paradox of complex systems thinking is that it can help distil the interconnecting parts, to generate some manageable sense, in terms of identifying potential levers

for change. Complex systems theory embraces the reality of interaction and change: that it is not necessarily linear and because such changes take place in a system the effect is not likely to be straightforward (Hawe, Shiell, & Riley, 2009). The approach is useful not just for planning but also for auditing a given situation, identifying potential interventions and evaluating them. It can help set the scene, provide indicators for where to implement changes and anticipate long-term changes, including those to be avoided. A feature of a systems approach is seeing these different components of a public health issue not as discrete phases, but rather as part of an iterative, adaptive process.

As per the CO-CREATE grant agreement we are using complex systems theory as a "conceptual model that treats interventions as events within systems, considering the level of action within the system". Using a 'complex systems' framework signals acknowledgment that any interventions are likely to give rise to changes that are 'more than the sum of their parts'. They may well be multiplicative or exponential rather than additive, but the systems framework helps make sense of the complexity, the unpredictability, anticipate the unexpected and generate useful evidence. Additionally, some researchers propose that a complex systems approach is a way of representing a theory of change i.e. a conceptual model of how and why an intervention unfolds as it does (Penney et al., 2016; S. Rosas & Knight, 2018; S. R. Rosas, 2017). By even considering the potential of unexpected effects from an intervention, we ask different questions, which in turn leads to different decisions, projections and evaluations.

For the purpose of this project, a system is a set of variables, people, institutions, sectors contexts and other factors that, in some way, drives adolescent obesity. Therefore, under consideration is the obesity/energy balance system from perspectives predominantly of adolescents, as well as experts and policy-makers. Using systems thinking in CO-CREATE means considering how factors and actors associated with obesity interact at various levels; it means taking the view that obesity within an individual and in the population is the results of a synergy of such factors and actors (Rutter, 2012; Vandenbroeck, Goossens, & Clemens, 2007)

Systems mapping: a tool for systems thinking

Since the publication in 2007 of the UK Government Foresight report *Tackling Obesities: Future Choices* (Butland, 2007), obesity has commonly been characterised as a problem which emerges from multiple factors in a complex system. The 'map' of the "obesity system" in the Foresight report (see Figure 1) remains a touchstone for obesity policy to this day (Savona, Rutter, & Cummins, 2017).

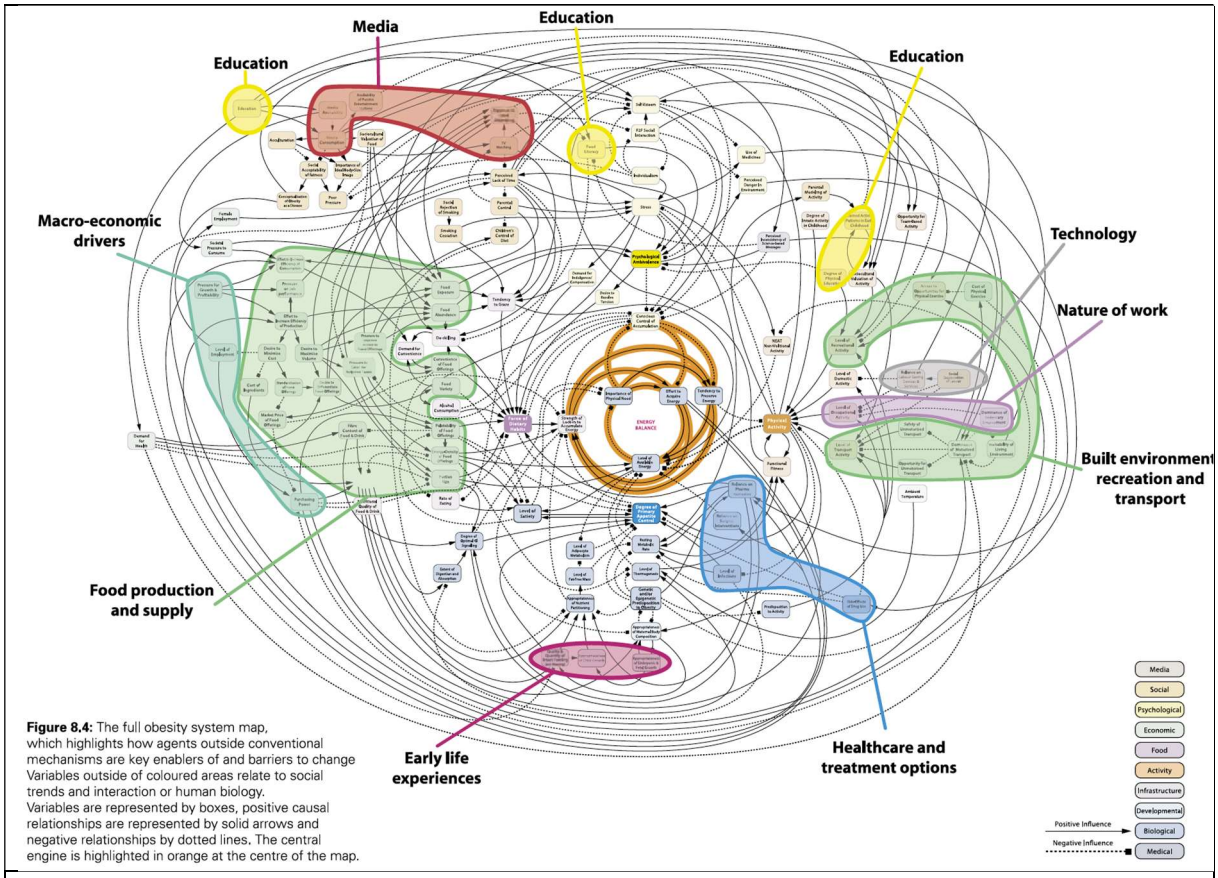

Figure 8.4: The full obesity system map, which highlights how agents outside conventional mechanisms are key enablers of and barriers to change Variables outside of coloured areas relate to social trends and interaction or human biology. Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

Figure 1: Foresight "The full obesity system map" (Butland, 2007)

Despite the recognition that a complex systems framework is a useful one for responding to obesity, many policies designed to reduce prevalence continue to take traditional, linear approaches. CO-CREATE as a whole, starting with WP 4 helps to address this potential shortcoming by taking a complex systems approach both theoretically and methodologically. A wide range of methods can be used to examine a public health challenge such as obesity through a complex systems lens. Two key tools for defining, representing and investigating a system are systems mapping and systems modelling.

This report presents a phase of CO-CREATE in which systems mapping was the main method: a structured technique whereby a group of select stakeholders in a given issue are guided through the process of creating a visual representation – a system map – of factors contributing to that issue, in the case of CO-CREATE, this is adolescent obesity. Of the various approaches to systems mapping the one used is 'group model building' (GMB). This is a well-tested process whereby stakeholders are guided through stages to generate the map, in the form of a causal loop diagram (CLD) (Hovmand, 2014). As this name suggests, it connects variables considered by the participants to be linked to obesity in a causal manner. As such, a systems map of adolescent obesity provides a conceptual model of the factors and processes that potentially drive or constrain the determinants of obesity, as perceived by the participants in the session. GMB is a form of mapping that sits within the 'systems

dynamics' tradition – as such, it is designed such that the maps can be developed further, to feed into systems dynamics simulation models (see below).

"CLDs provide a language for articulating our understanding of dynamic, interconnected situations."
(Williams & Hummelbrunner, 2011)

At its most simple, mapping provides a visual representation of a given system, showing the factors perceived to be involved and the connections between them. For CO-CREATE, we are using systems mapping in two different ways.

1) To create CLD with adolescents (and also topic experts and policy-makers), of their perceptions of the factors that contribute to or help avoid obesity (as presented in this report). CLD represent a range of variables that are perceived to influence obesity with connection arrows linking the nodes, demonstrating causal influence. Not only do the CLD demonstrate factors and connections worthy of interest and further investigation, but also they will be taken forward as a basis for developing policy ideas with adolescents as part of CO-CREATE Work Page 5, Youth Alliances.
2) To develop these conceptual maps further so that they may be used for computer methods to generate systems dynamics models (in WP7 by researchers at the University of Bergen). This involves obtaining a deeper understanding of the relationships between the variables using modelling to examine the direction of influence, how it increases or decreases the 'receiving' variable, and to illustrate balancing and reinforcing feedback loops. (WP4's Deliverable 4.5, due January 2020, will report on this process in more depth.)

Systems mapping is a useful tool for clarifying and helping to generate hypotheses about the connections between the various contributing factors, and thereby, to identify potential points in the system to intervene. It is therefore an ideal way of depicting adolescent obesity, with the complexities it entails.

Methods: systems mapping in CO-CREATE

The method used for generating the systems maps in CO-CREATE is group model building, a structured process designed to guide participants in a workshop through various stages to generate a causal loop diagram, which depicts the factors they believe contribute to adolescent obesity.

Group Model Building and STICKE software

The workshops were designed around the GMB methodology developed by Professor Steve Allender and his team at Deakin University in Australia who are partners in CO-CREATE (Allender et al., 2015). They based their method on work established by Professor Peter Hovmand (Brennan, Sabounchi, Kemner, & Hovmand, 2015; Hovmand, 2014).

GMB guides a stakeholder group through a series of participatory tasks to examine participants' mental models (cognitive representations of interdependent causes and effects) of a given challenge, to create a causal loop diagram (CLD) representing their views. The process means that the CLD represents a consensus about the system's components, relationships and boundaries.

Recruitment

Recruitment – schools/adolescents

The mapping workshops were held in The Netherlands, Norway, Poland, Portugal, South Africa and the United Kingdom. There was a common approach to recruitment across all countries, tailored to the specifics of local circumstances and context. Each participating country employed a recruitment process to identify relevant populations, feasibility and municipal administrative structures. The overarching aim common to each country, was to conduct four mapping sessions with 16-18 year olds, spanning a range of socio-economic characteristics. The box below describes a sample recruitment strategy, in the UK. Other country recruitment protocols are found in Appendix 2.

We started from the 326 existing local authorities (LAs, municipalities), which are each ranked by average Index of Multiple Deprivation (IMD) ranking, the official measure of relative deprivation for localities in England. The IMD relates to income deprivation, employment deprivation, health deprivation and disability, education skills and training deprivation, barriers to housing and services, living environment deprivation, and crime. Each local authority was then divided into quartiles based on IMD rankings, quartile 1 being the most deprived, and quartile 4, the least. We selected one LA in each quartile, selecting them in regions with the largest proportion of LAs in the quartile of interest. We then ranked all LAs of chosen region in each quartile. Within each LA, we identified all government -funded, mixed gender schools with 16-18 years olds. We then ranked the schools within each chosen LA by IMD decile (1 most deprived; 10 least deprived). We created a shortlist of four schools in each chosen local authority, purposively sampling lower decile schools in two authorities and higher decile schools in two authorities and sent invitations to those four schools. The schools we identified that fell within our sampling framework were then recruited through personal follow up as well as discussion with local government officials we were in contact with regarding potential Youth Alliance work (WP5).

Recruitment strategy example: England

Recruitment – policy-makers/academics

As per the Grant Agreement, the UK partners leading WP 4 (LSHTM) hosted an additional session with policy-makers and academics. This session was held at the European Congress on Obesity (http://www.eco2019.org/) on 29 April 2019 in Glasgow, Scotland.
Participants were recruited from those registered to attend the Congress, as well as by word of mouth through strong affiliation with the European Association for the Study of Obesity (EASO), the congress organisers. (NB Professor Harry Rutter, CO-CREATE PI, is Co-Chair of EASO's Prevention and Public Health Task Force.)

Conducting the mapping workshops

The mapping workshops were run in a standardised way across the countries, guided by a common script for the facilitators. A sample script used for one of the UK mapping sessions is shown in Appendix 1.

The production of the CLD is done via two key activities. The first is creating 'behaviour-over-time graphs' whereby – after a demonstration by the group facilitator – participants individually generate, then share graphs representing variables that they believe are linked to adolescent obesity, and how that variable has changed over time (see Figure 2). The participants, in small groups, prioritise these variables then share them with the whole group until there is data saturation.

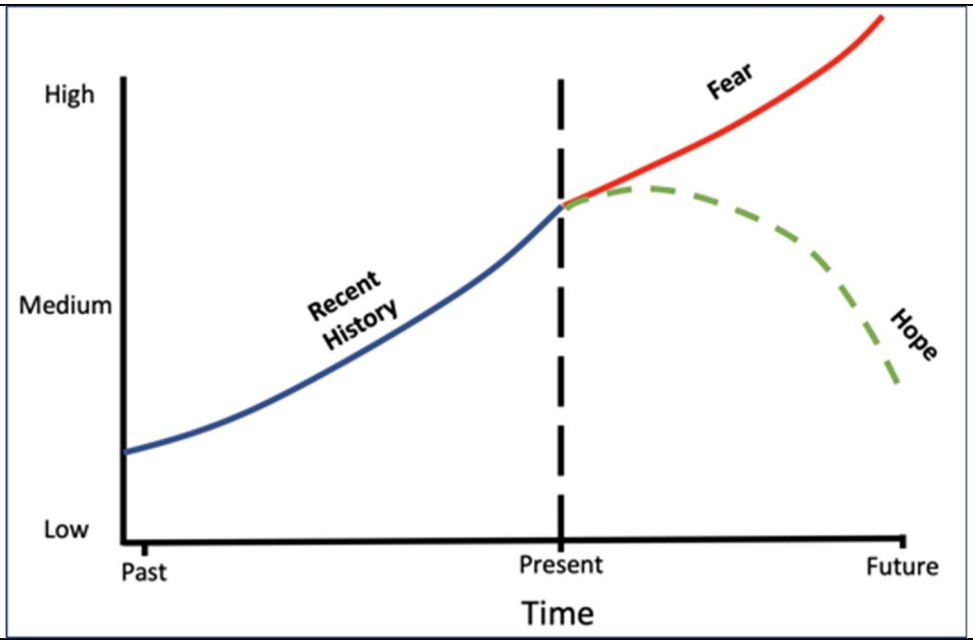

Figure 2: Sample 'behaviour-over-time' graph

As the variables are shared, they are entered into the STICKE software by the modeller member of the facilitation team, initially, in a circle, known as a 'connection circle' (see Figure 3). The image is projected onto a screen for the participants to see. The second phase of generating the CLD involves getting participants to identify causal relationships between the variables that are on the circle.

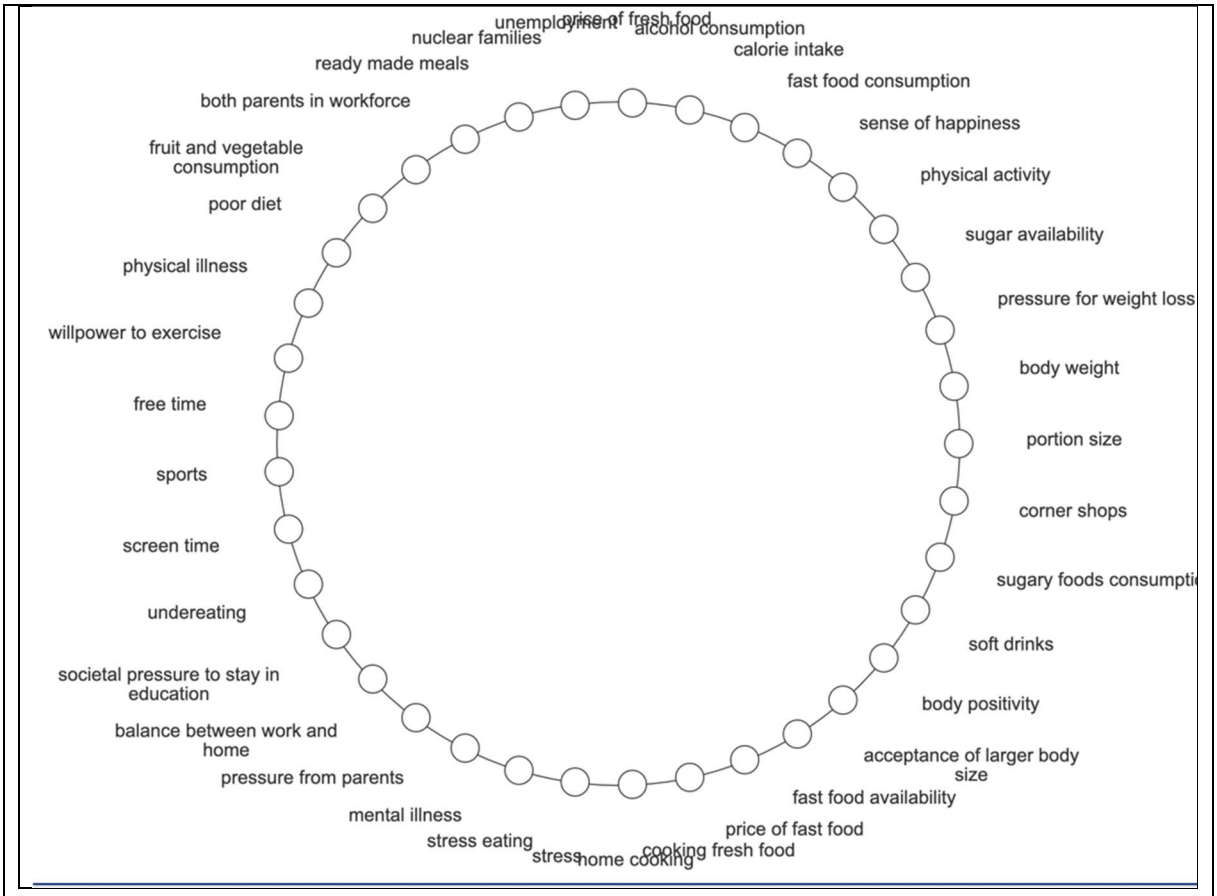

Figure 3: connection circle stage 1

As they are called out, these links are entered into the diagram by the modeller, with the facilitator eliciting whether the relationship between the two variables is positive or negative (see Figure 4). Once the group has run out of connection ideas, the modeller gets the STICKE software to transform the 'connection circle' into a system map. Throughout the session, the note-taker member of the facilitation team takes notes on what participants say, as close to *verbatim* as possible.

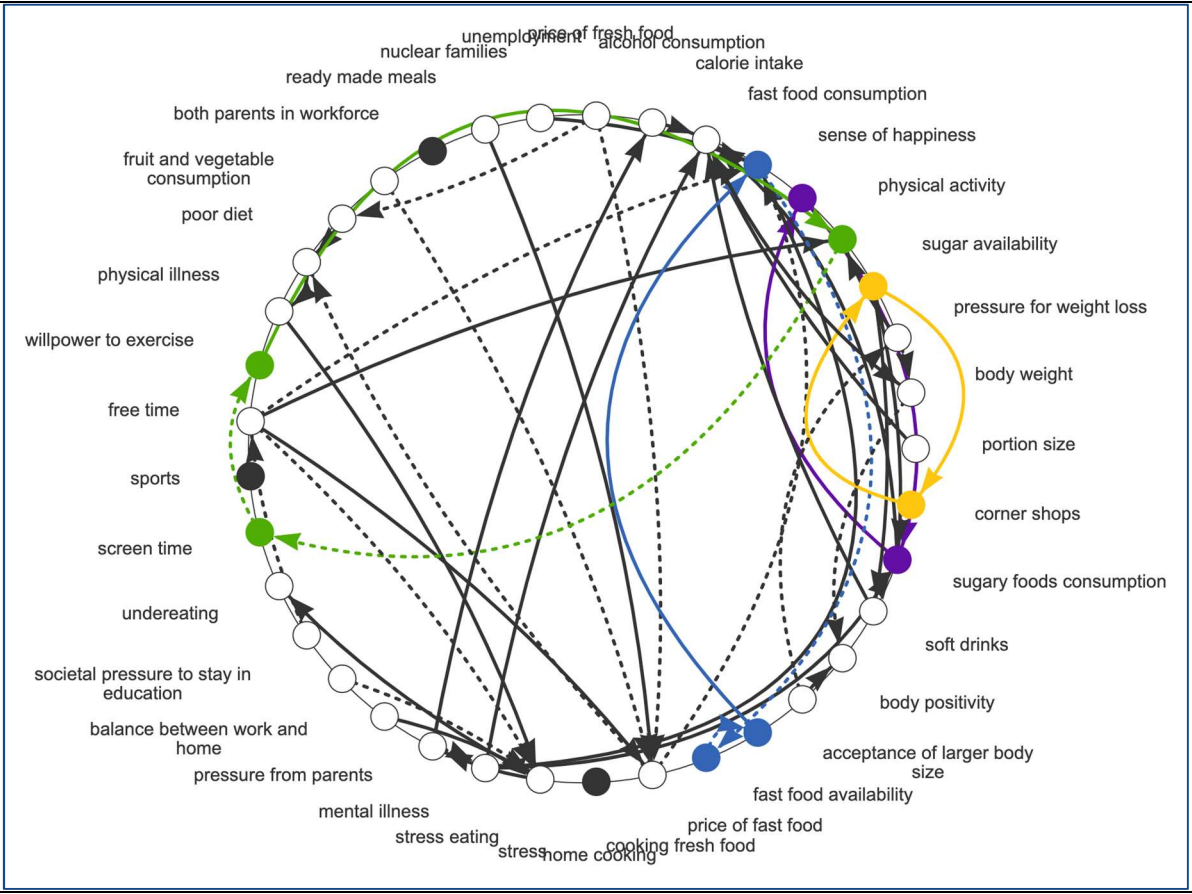

Figure 4: connection circle showing connections

After the session, the team members discuss the map. Using the notes taken, they 'clean up' the map i.e. move the variables around to make them more legible, to minimise crossing over of connection lines, to cluster themes if possible. They also – referring to the detailed notes – may add, amend or remove variables and connections, denoting such changes in a particular colour.

At a subsequent session, or after a break, the revised map is presented to the participants for verification. They are invited to agree or disagree with the changes made by the team and suggest changes to variables and connections. The maps presented in this report show these amended versions from each group.

Analysis

The final stage of the GMB session is designed to elicit from participants their ideas on potential "action ideas" i.e. places in the system where interventions may help reduce obesity prevalence. The results of this segment of the mapping workshops are presented in WP 4 Deliverable 4.3: *A report outlining a prioritised set of potentially important policy levers derived from the systems maps*

Merging maps

For the CO-CREATE Deliverable 4.6 (due M21, January 2020) a 'master map' will be produced. This will be a causal loop diagram synthesising the data from maps in all six countries and the topic experts.

Mapping obesity: the results

Here we present the core of Deliverable 4.1 for WP 4: "*A set of conceptual system maps is provided, outlining the drivers of energy balance related behaviours from the perspective of European youth, policymakers, and academic experts."* They are the results of the mapping sessions, as described above, conducted in each of the participating countries.

In Deliverable 4.4 we present, summarise and discuss the contents of the maps in detail.

Adolescent systems maps

Norway

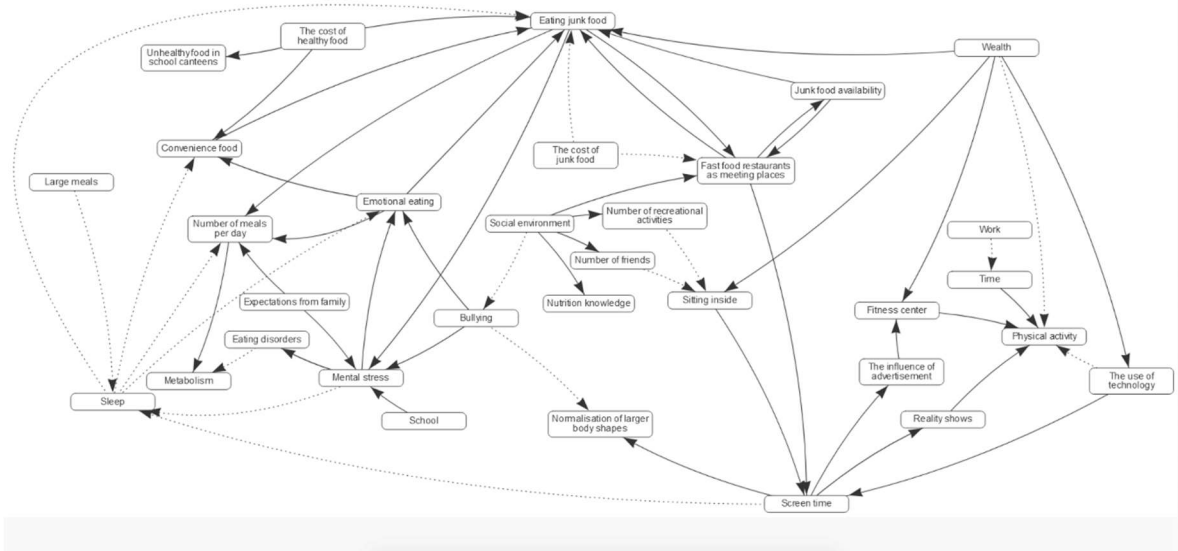

Figure 5: NORWAY School 1

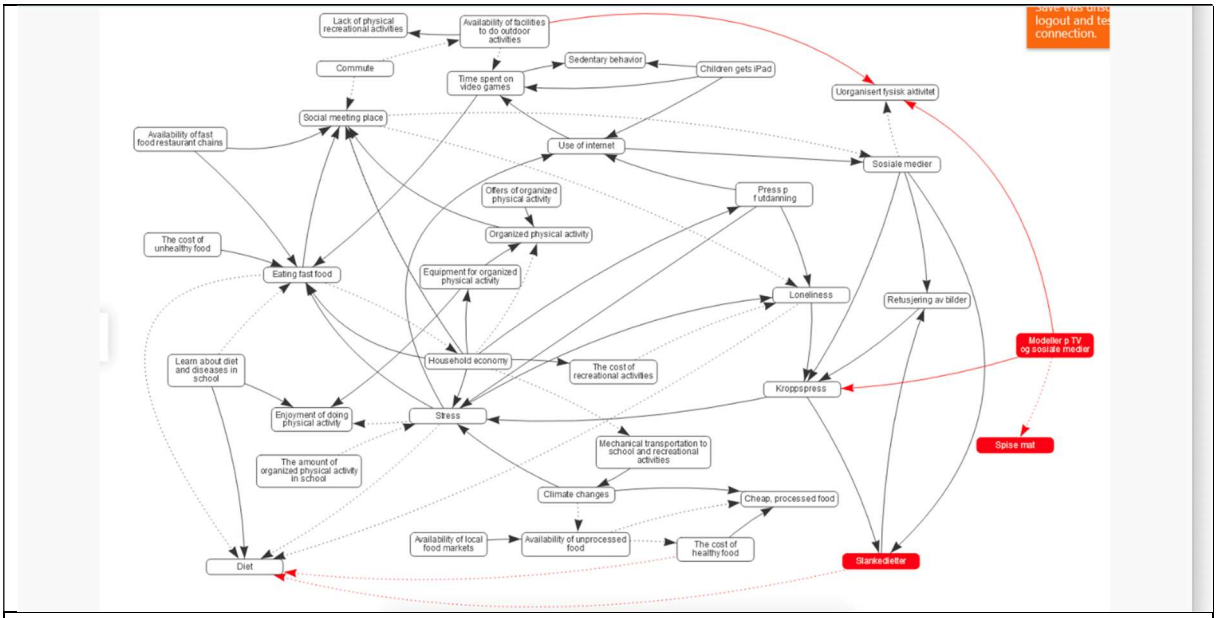

Figure 6: NORWAY School 2

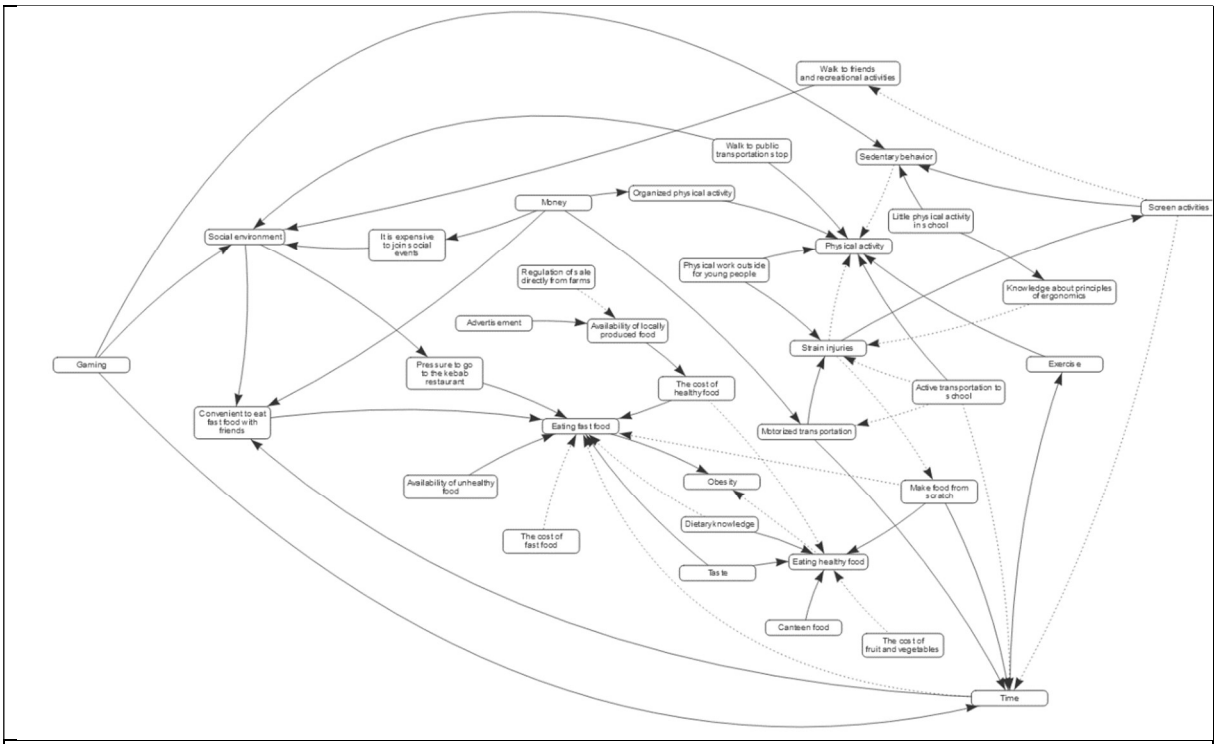

Figure 7: NORWAY School 3

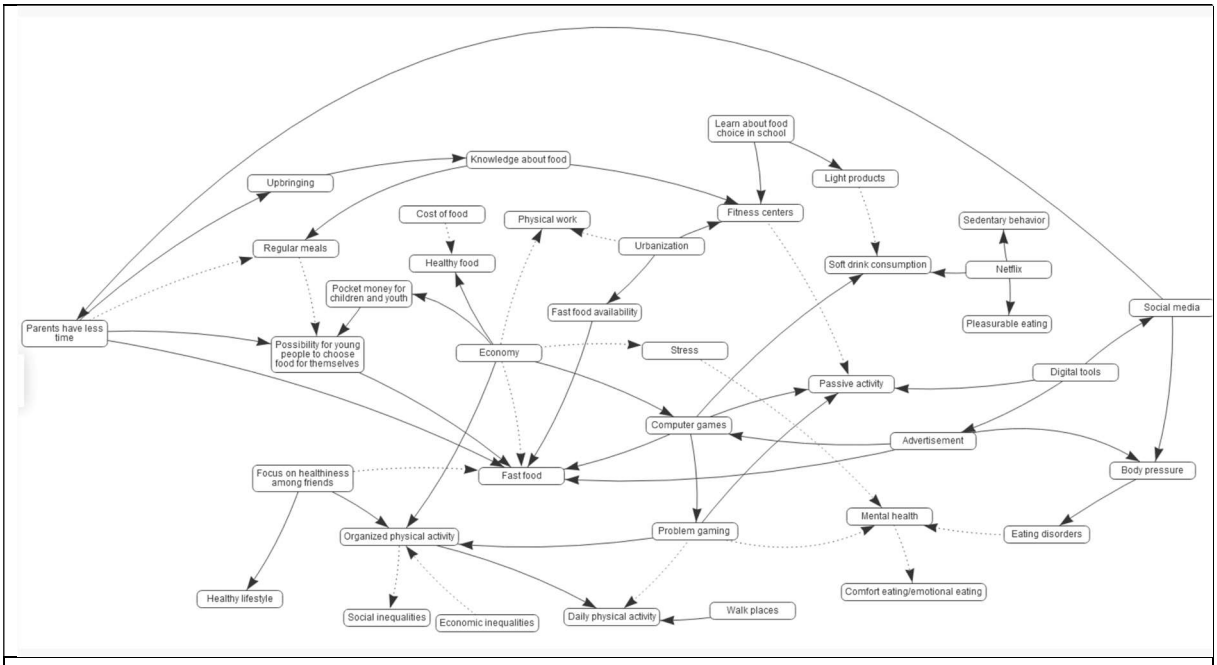

Figure 8: NORWAY School 4

Poland

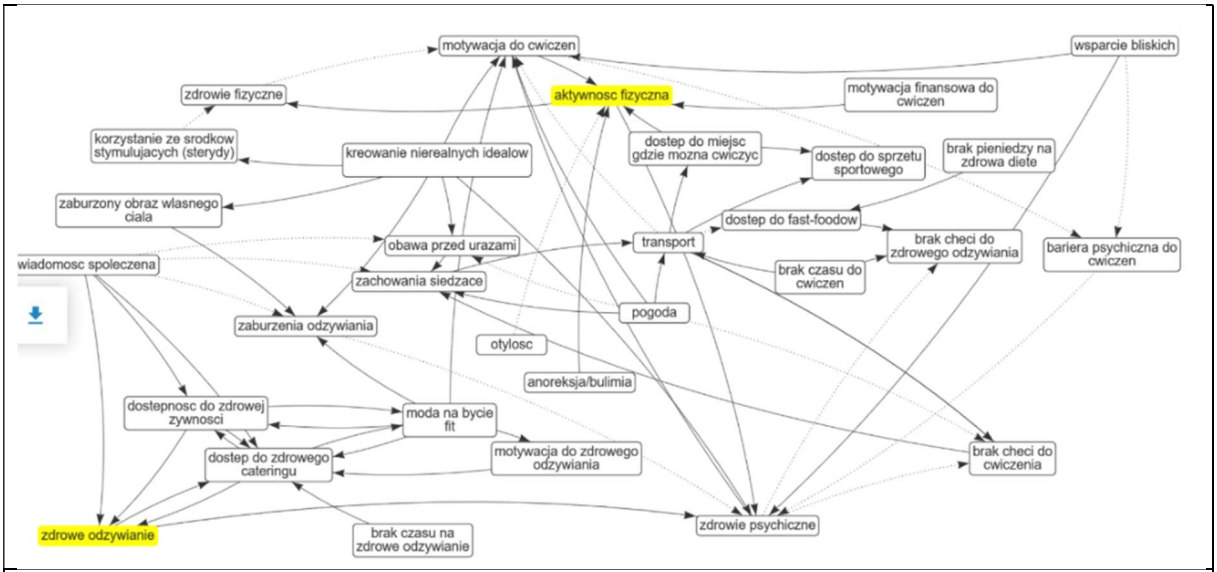

Figure 9: POLAND School 1

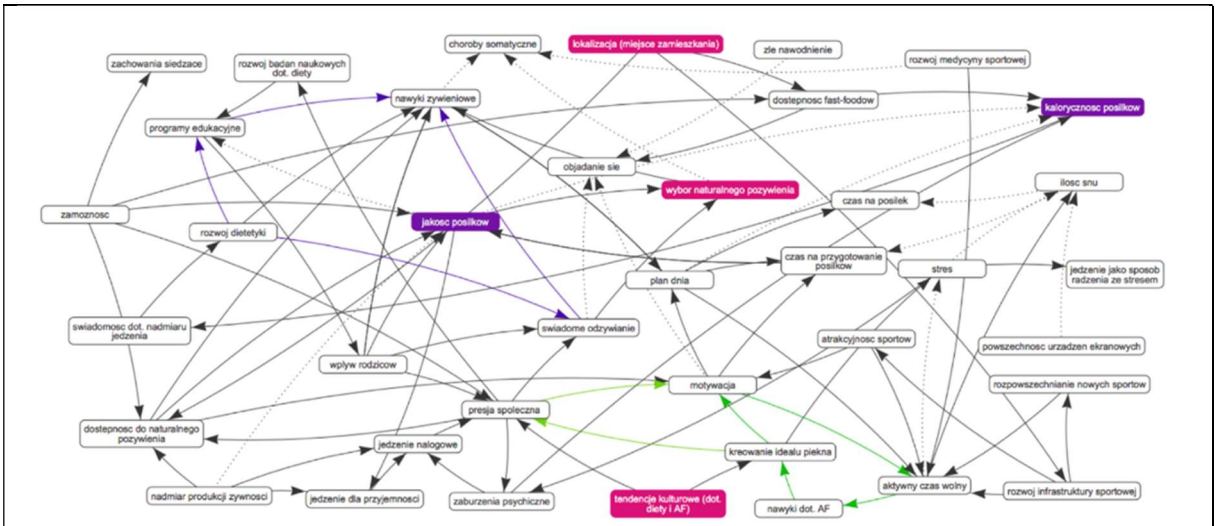

Figure 10: POLAND School 2

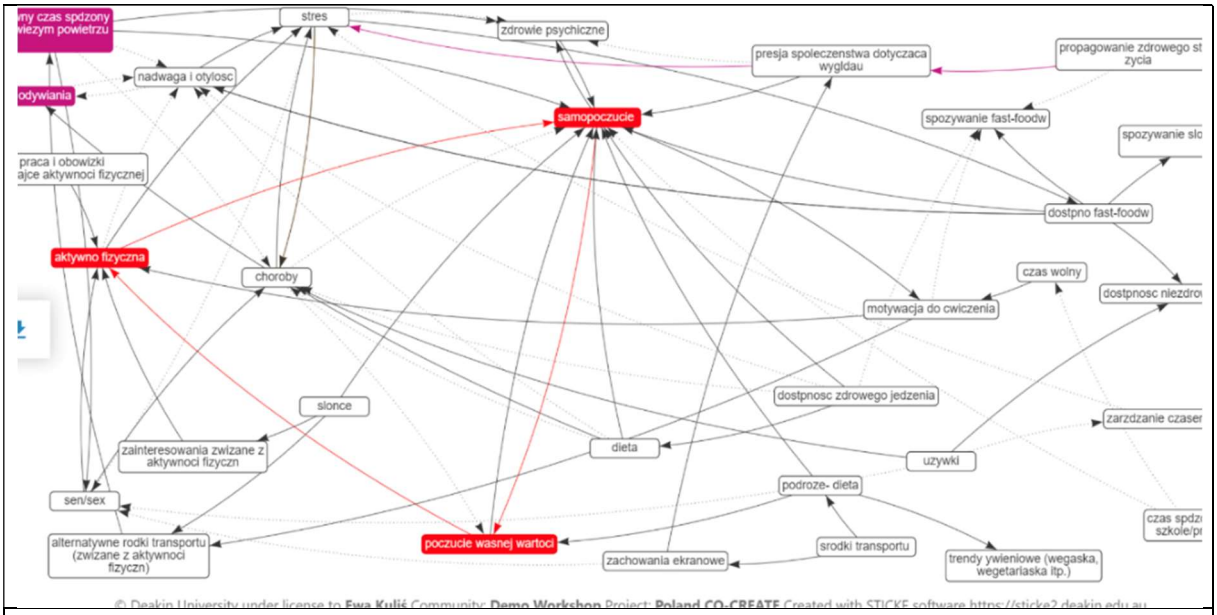

Figure 11 POLAND School 3

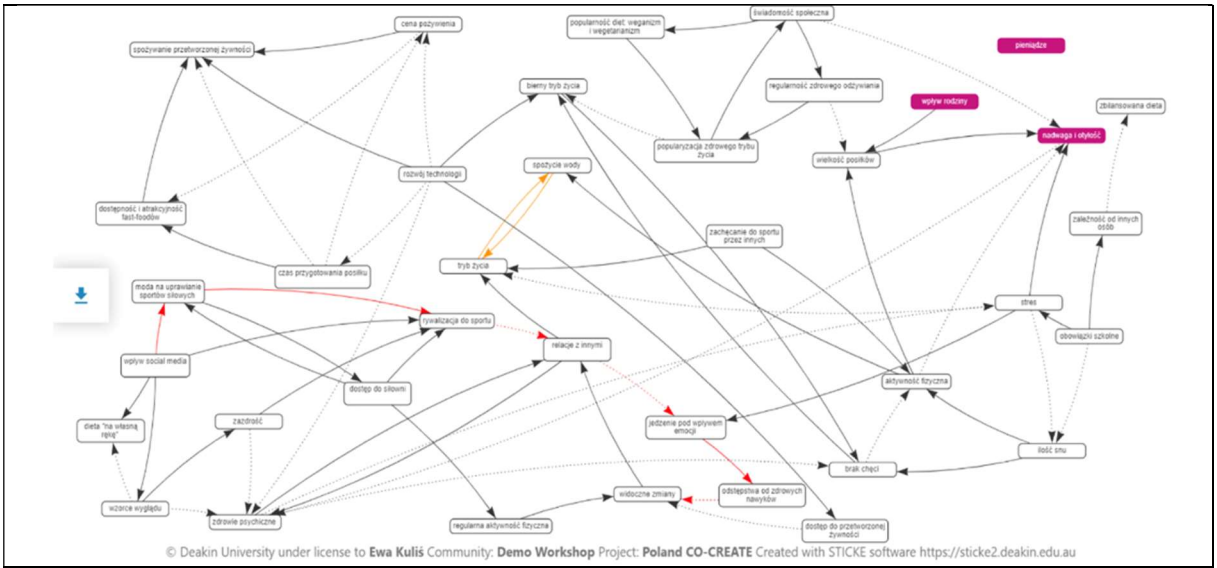

Figure 12: POLAND School 4

Portugal

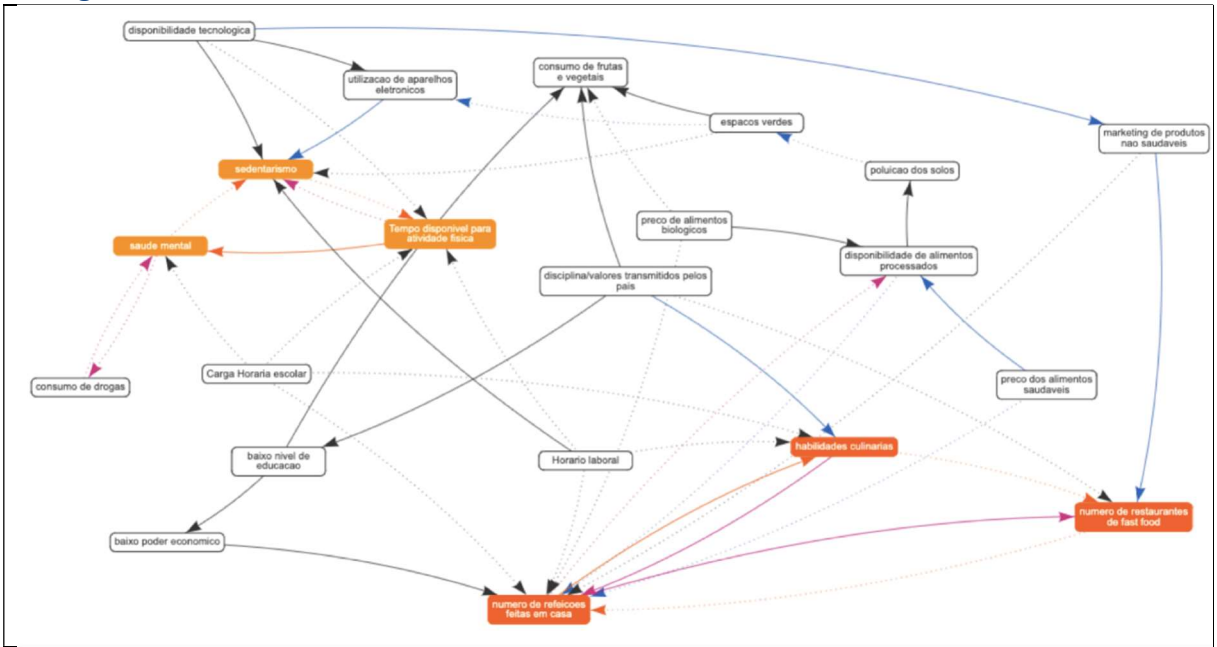

Figure 13: PORTUGAL School 1

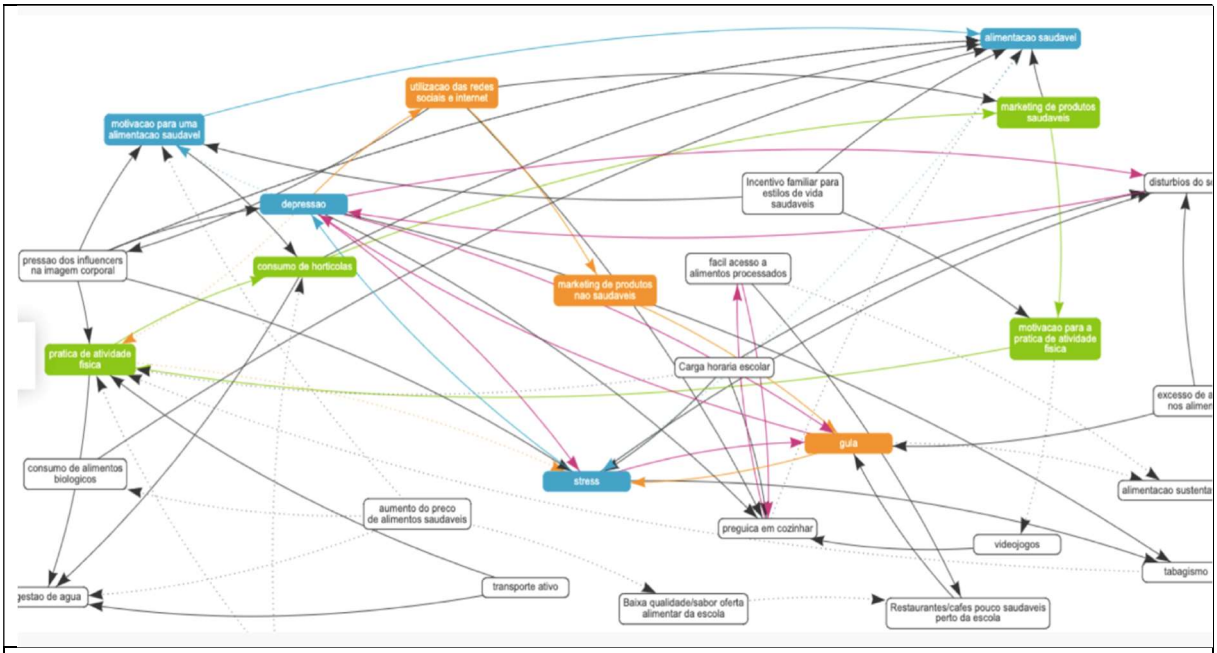

Figure 14: PORTUGAL School 2

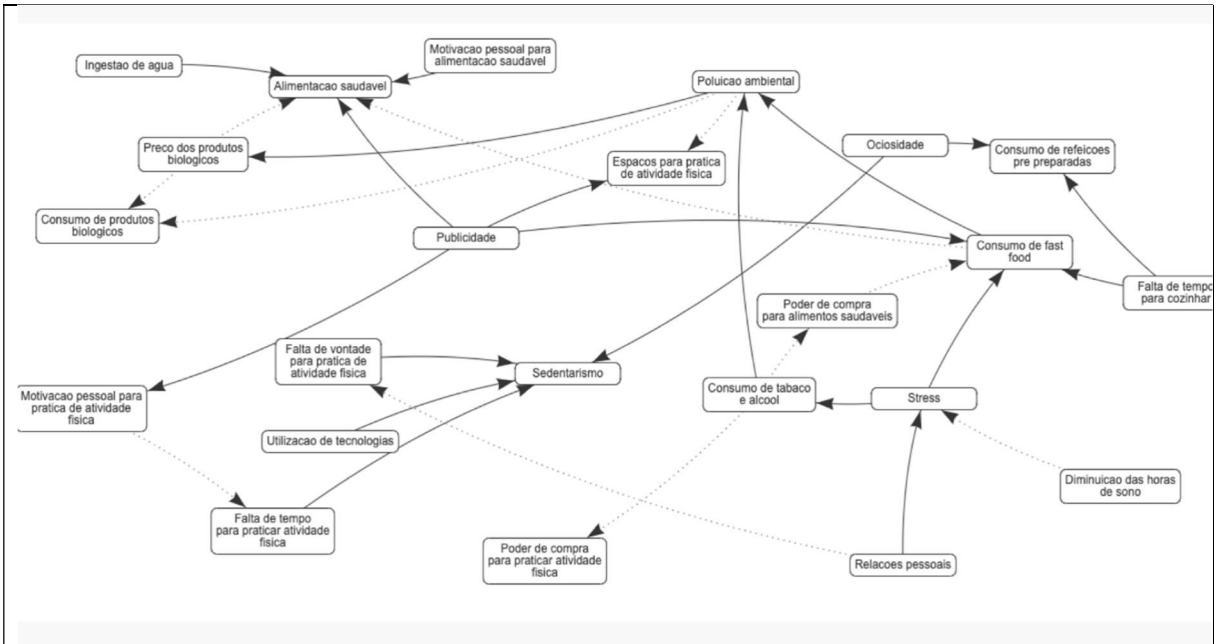

Figure 15: PORTUGAL School 3

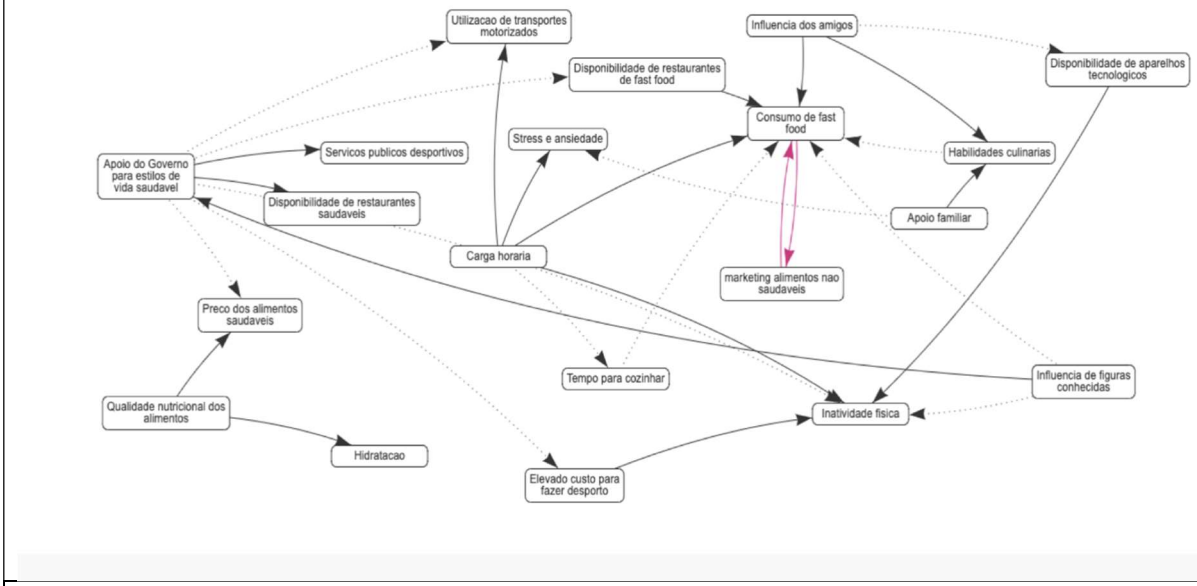

Figure 16: PORTUGAL School 4

United Kingdom

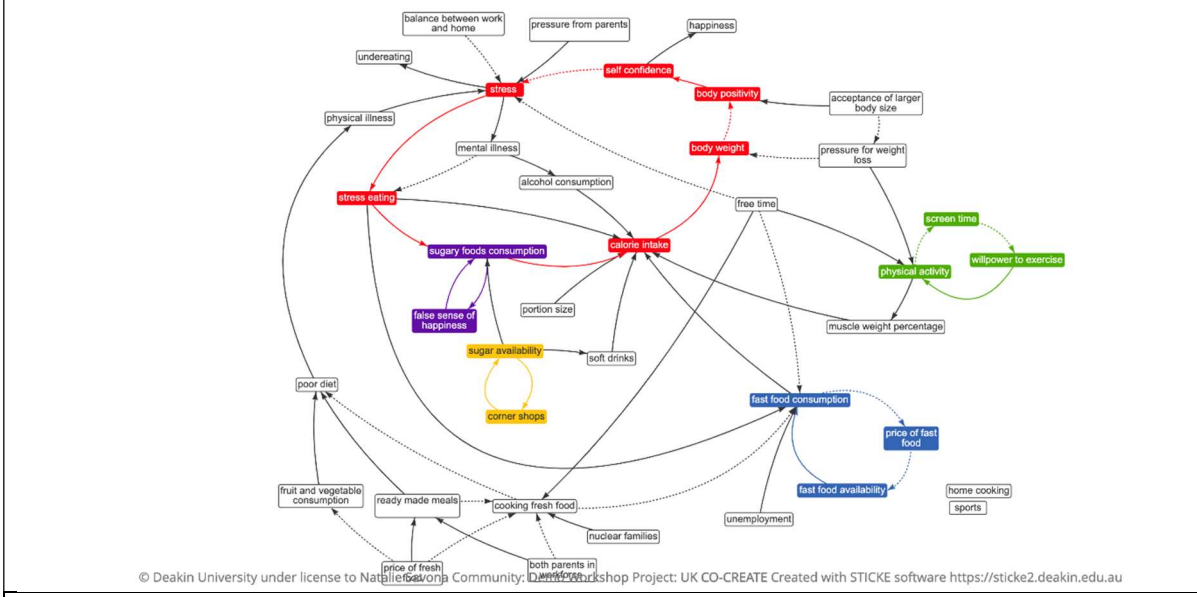

Figure 17: UK School 1

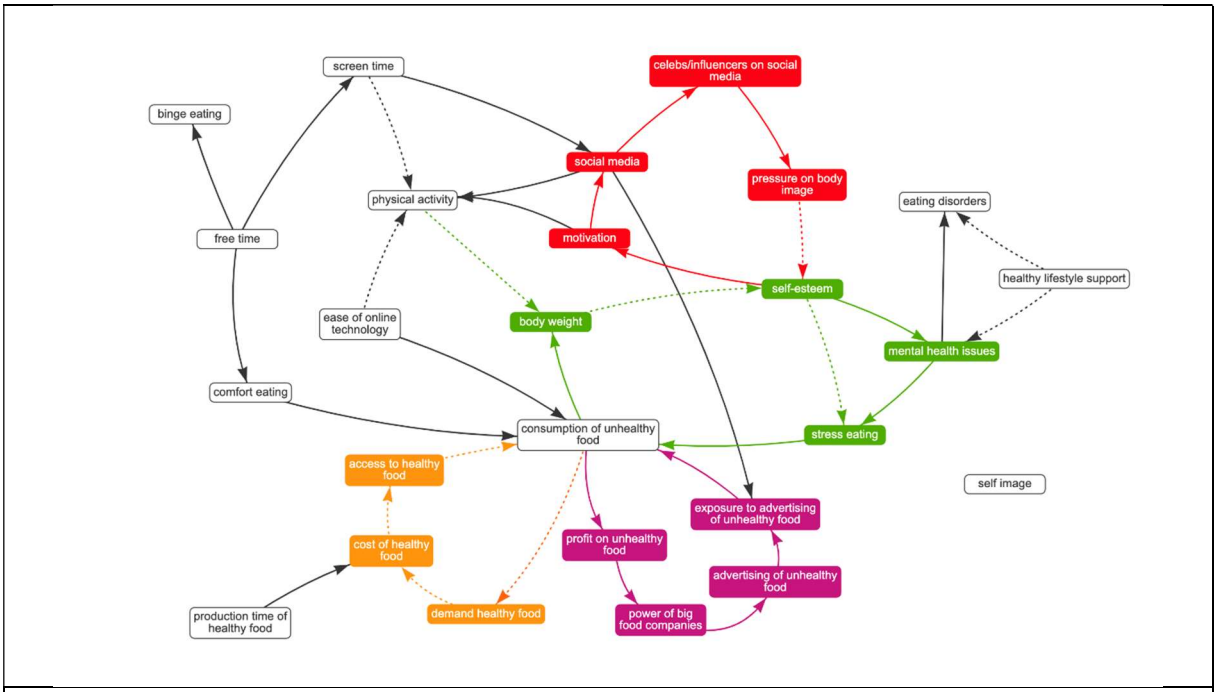

Figure 18: UK School 2

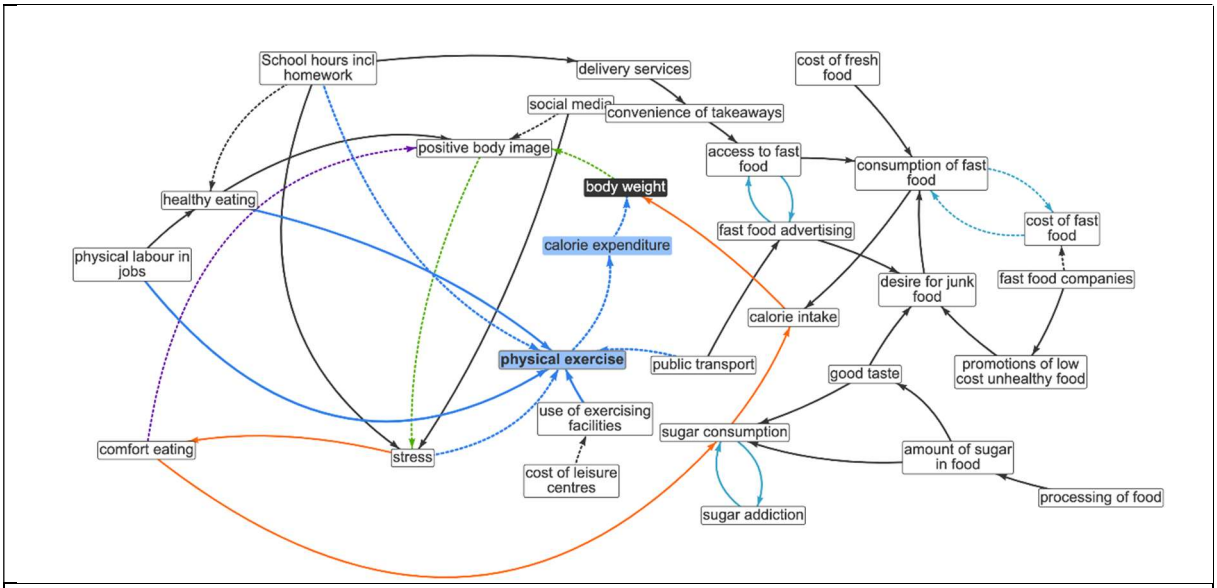

Figure 19: UK School 3

South Africa

Adolescents in public schools in South Africa write exams in May and no access is allowed to schools during this time; then they are on holiday in June. The third school term is from 9 July to 20 September 2019. Therefore, the following have been planned for mapping sessions:

22-25 July:	Session #1 at School 1
29 July-1 August:	Session #2 at School 1
	Session #1 at School 2
5-8 August:	Session #2 at School 2
12-15 August	Session #1 at School 3 and School 4
22-25 August	Session #2 at School 3 and School 4

Netherlands

At the time of reporting work was ongoing in the Netherlands to finalise recruitment of adolescents for the mapping sessions and to finalise workshop dates with them.

1. Almere; 10 participants; 19 and 20 June
2. Almere; church group currently in discussion about setting up a session
3. Amsterdam; group in high school; 24 June and1 July
4. Amsterdam; through contacts of a CO-CREATE staff member, a group is being set up.

Obesity experts' map

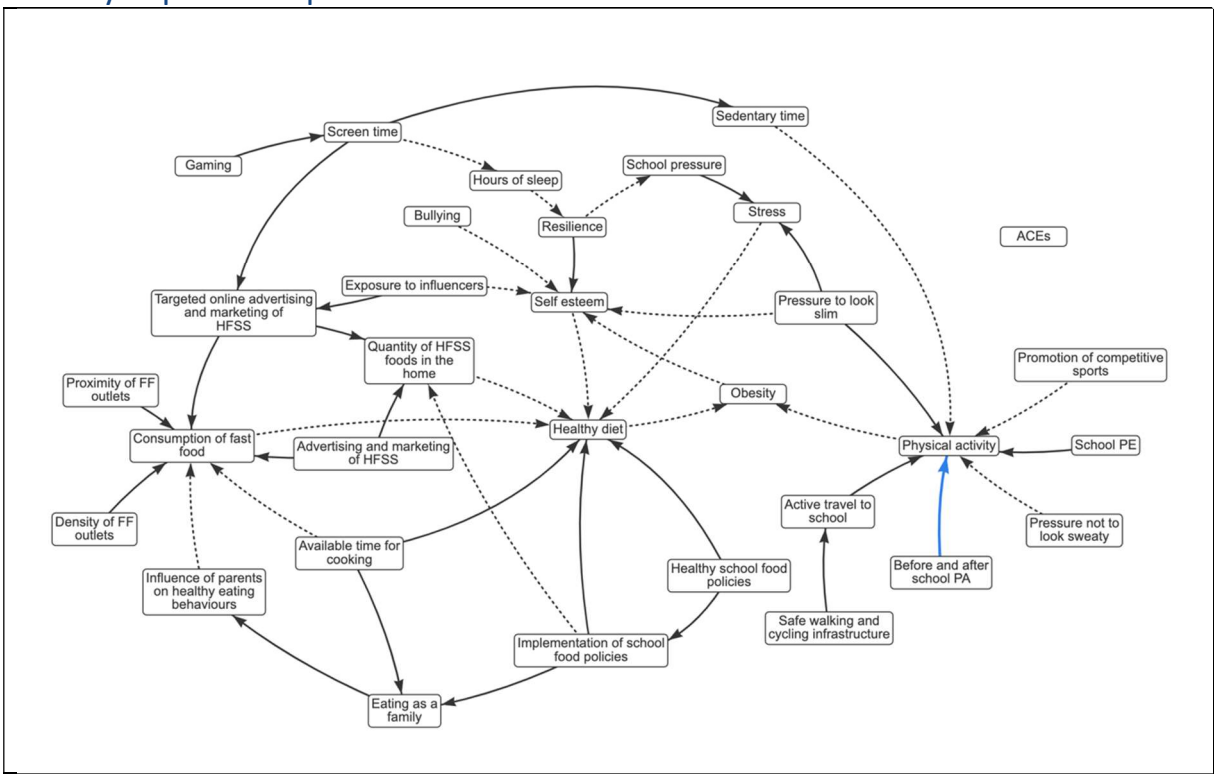

Figure 20: Obesity experts map

Conclusion

The purpose of employing system mapping in CO-CREATE is ultimately to identify policy amenable drivers of adolescent obesity, as perceived by adolescents, policy-makers and academic experts. The data generated in the maps presented in this report will be used in further segments of CO-CREATE. They will provide a basis for CO-CREATE WP 5 in which adolescents in each of the participating European countries will form Alliances to develop policy responses that take a systems approach to the problem of adolescent obesity. The maps will also be further developed, in WP7, to help generate a systems dynamics model showing the potential impact of the novel policy responses to adolescent obesity.

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Appendix 1 - Sample Group Model Building script

[XXXXX] SCHOOL
SCRIPT

Wednesday 27 March 2019:
8.45-10.45
20 minute break
1105-1205
[OR 0845-1015 BREAK 1035-1205]

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
08:45	INTRO	PP Title	*PRESENTATION* [15 min total]	Hello, my name is __Cecile_____ We're from the London School of Hygiene & Tropical Medicine, part of London University. Thanks very much for having us and for signing up to take part. As you know we're going to be creating a "systems map" today In a minute we'll all introduce ourselves so you know who we are and what our roles are here today, then I'll give you a brief overview of the project and how the system mapping that we'll be doing today fits in. Then we'll take you through the process to start creating the system map. If you have any questions or comments at any point, don't hesitate to interrupt.
		PP Agenda		I'm __Cecile_____ and I'm going to be leading you through the process. Making sure what everyone says is properly represented on the map. I'm __Natalie__ and I'm going to be listening to all of the factors you contribute and entering them into a software. This may be unclear now but will become clearer once we get started. I'm _Talia__and I'm going to be coordinating the session, making sure everyone has what they need, keeping to schedule etc. I'm _Anaely__ and I'm going to be keeping notes of what we do today because we're going to be chatting a lot and I want to make sure I properly capture all of the ideas that are shared.

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
				Ways of working together. *No phones & respect each other's views* One last administrative thing before we get on with the mapping. and that is to take you through the consent forms. Formality required for all university research projects. Not taking notes of who says what…your data won't be shared. Generally people really enjoy this process and find it stimulating and thought-provoking. Remember that if anything makes you feel uncomfortable or upset, you are free to leave at any time and you can talk to _____ >>>>*distribute consent form and take them through it* ANY QUESTIONS/COMMENTS?
		PP What is CO-CREATE		As you all may know, we are here as part of a large international project called COCREATE, 'Confronting Obesity: Co-creating Policy with Youth.' This is the official title which we realise is a bit clunky and is focussed on *obesity*, a term which we know is a bit negative and can take away from what we're really looking at. What we're really looking at is the question of healthy body weight and the factors contributing to that.
		PP System focus		In order to do this, we are taking a system approach What does that mean? We're not interested in what an individual does, we're interested in what's going on, what's changed over time around us, in our societies, and our environments (in other words, in the whole system)—that affects overweight in young people. And how it's all linked together. Over the next 3 hours we won't of course have the opportunity to talk about every single factor that affects overweight in young people but we should have enough time to hear what <u>you all</u> think is most important ANY QUESTIONS/COMMENTS?
		PP		As you probably know this is a problem that most countries are dealing with.

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
		Global challenge		
		PP Why do we need your views		*[see slide]* You're also the people who are going to be making decision, policies, raising children in the future. ANY QUESTIONS/COMMENTS?
09:00 *(00.15)*	GRAPHS OVER TIME EXPLAN-ATION	PP Activity 1	GROUP PRESENTATION [10 min total]	>>> One of the easiest ways to talk about healthy weight is to look at overweight and how it's changed over time. You saw that graph we showed you with rates of overweight and obesity going up over time in all those countries. So we'll be taking you through doing what we call "graphs over time" You've got sheets of paper like this on your tables.
		PP Overweight graph		So what you have up on the screen is what we're referring to as a 'graph over time'. *Explain overweight over time, hope and fear in the future etc. Explain what axes mean.*
		PP What factors affect overweight….?		What we want you to think of is what factors are contributing to changes in overweight over time? (and why?/what's causing those changes?) Shout out some examples. Now let's go through an example together. *[white board or flip chart]* [[[something student shouted out or fast food as an example]]]

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
				So you write "fast food" – what do you think we really mean? What has changed over time? Is it fast food shops? Fast food consumption? How do you think it relates to overweight? Do you think there the number of fast food outlets have increased over the past years or decreased? Or have they stayed the same? *[Draw dotted lines for what increase, decrease, and stay the same look like.]* *If participants ask when the past is referring to in the graph (i.e. how long ago, how far back) "maybe how old you all are, about 10-20 years)* So in terms of what happens in the future, what do you hope would happen to this factor and what do you fear might happen in terms of its impact on overweight. >>>GROUP ACTIVITY In the same way as we thought of fast food, choose a factor that you think is contributing to overweight and write it down on one of the papers on your desk. Has everyone written something down? On the left half of the graph illustrate how you think that factor has changed over time, using one of the four patterns we went over already (i.e. if you think it has increased, then make your line go up) Now draw two lines showing how - in terms of how it influences overweight – how we would HOPE this factor might change in the future and how you FEAR this factor might change in the future.
09:10 (*00.25)*	GRAPHS OVER	PP What factors	INDIVIDUAL ACTIVITY	You've got a few minutes now to get down as many factors as you can think of. So you use a new sheet of paper for each, separate factor. Put each factor on a new graph, a new sheet of paper.

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
	TIME INDIV	affect overweight….?	*SMALL GROUP ACTIVITY* [10 min total]	ANY QUESTIONS? Everyone get in groups of 3-4 and prioritise your variables, which do you think are the most pressing things that need to be addressed to improve diet and physical activity.
09:20 *(00.35)*	FACTORS>CIRCLE	STICKE CIRCLE	[15 min]	*>>>WHOLE GROUP ACTIVITY* Go around and share most important variables. ***Arnfinn method: mine one area for rich data* If someone has already said it, just go to the next one. Tell us: How has it changed over time and why is it important or relevant? So now you'll start to see our system mapping software in action. STICKE *(Systems Thinking in Community Knowledge Exchange)* _____ will be typing the factors that you come up with into the software…… *[Facilitator confirms variables with participants. Helps slow things down for modeller and note taker]* "What are the factors that affect X?" Remember we're always ultimately coming back to overweight as the issue. *[Mine each variable for further, connected factors…]* >what else is linked to XX factor? >Does anyone else have anything to say about XX factor? >deeper cause >why?

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
				Anything else that's not up here that you would like to add, anything that popped into your head after seeing these ones? *Ask WHY questions about factors already in circle, may help to generate more factors to add.*
09:35 *(00.50)*	CONNEC-TION CIRCLE	STICKE connection circle	[30 minutes for connections]	Software helps us show connections in the circle Identify factors that are connected, where one has an effect on another How something might make something else go up or down Dotted line vs solid line, change in opposite direction, change in same direction *Can also ask why questions when making connections…may lead to adding more variables/factors*
1015 *(01.30)*	*???BREAK*		[20 mins OR 5 mins]	*for team to tidy map layout, discuss themes…* Check notes
10:35	MODEL REVIEW	STICKE Map	*WHOLE GROUP DISCUSSION* [20 minutes]	[MODELER TO UPDATE MAP LIVE] Explain that now we are going to 'tidy up', refine, check, confirm the map So… Stories in there that can be expanded? What works, what's good, what is interesting, what needs improvement? Cross things out. Add things in – factors or links. Change things… Themes/domains Names of variables

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
				Explore particular areas – mine for rich data/more variables Seek changes/added variables/ connections we're going to make the changes you suggest live as you share them [MODELER TO UPDATE MAP LIVE]
10:55	MODEL REVIEW	STICKE live map	SMALL GROUP ACTIVITY [5 min]	Spend 5 mins Looking at the map… Any other reflections on the map now? For example, we felt that there was more you said on XXXXX that could be represented on the map. We'll give you a few minutes to do this. ANY QUESTIONS/COMMENTS?
1100am	MODEL REVIEW contd	STICKE live map	WHOLE GROUP DISCUSSION [15 min]	Feedback on maps… unpack stories, variables Share what you have discussed What else needs to be added/changed/removed from the map? ANY QUESTIONS/COMMENTS?
1115am	ACTION IDEAS intro	STICKE map	WHOLE GROUP PRESENTATION	What we are now going to focus on is: where do you think action is needed to improve the problem we're thinking about – overweight and obesity in adolescents. What we call 'action ideas'. Look at loops/traps/cycles [describe one – show it becomes a 'trap']

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
			SMALL GROUP ACTIVITY [10 min]	Work in your small groups to look again at the map, think about 3 factors that you think are the most important places where we could act to improve the problem. Often the 'trap' areas are the loops
1125am	ACTION IDEAS – demonstrate template		WHOLE GROUP PRESENTATION [5 min]	So…those areas you've thought about. We're now going to use what we called the 'action idea' template. Who'd like to share an action idea… *[GO THROUGH USING TEMPLATE WRITING AN EXAMPLE ON WHITEBOARD, DRAWING RELEVANT LOOP]* Make clear which part of the map, which factor you're trying to affect.
1130am	ACTION IDEAS – using template		INDIVIDUAL ACTIVITY [10 min]	Now Have another look at the map. On the template, draw a part of the map, or a trap, one of the stories that you find particularly interesting, and write ideas down that you have to improve it. How can we break one of these cycles? Name and describe your action idea. If you find it clearer, you don't need to draw your idea and the loop/trap – you can just describe it. ANY QUESTIONS? Has everyone written something down?

TIME *(elapsed)*	ACTIVITY	AV SCREEN	GROUP/INDIV [time allocated]	SCRIPT
1140am	SHARING ACTION IDEAS		WHOLE GROUP ACTIVITY [20 min]	Each small group – share their favourite idea or the one they think could make most difference. [Discuss ideas, explore further…]
1200	Summing up THANK YOU		[5 min]	Thank you [Share Metro article link] https://metro.co.uk/2019/03/20/young-people-are-asking-the-questions-politicians-are-afraid-of-and-its-time-we-listened-8952662/ [NO Questionnaire – but keep here to remind us to add for next time] >>>VOUCHERS
…1205 ENDS…				

Appendix 2 - Country recruitment protocols

Norway: sampling of schools for system mapping workshops

In Norway we will aim to recruit two upper secondary schools from Oslo (representing urban area) and two upper secondary schools from municipalities surrounding Oslo.

In Norway there is a general divide between vocational schools and schools with specialization in general studies. By recruiting one of each type of school in each of these two settings, we aim to have maximized diversity.

There is no commonly used SES indicator available for schools in Norway. At the municipality level there are several indicators and we plan to use a combination of a poverty rate (OECD-50/EU-60) and percent with higher education (completed 4 years or more) to prioritize the relevant municipalities outside Oslo aiming for a higher poverty rate and a below average level of higher education. The poverty rate is the ratio of the number of people whose income falls below the poverty line, set to 50 percent (OECD-50) or 60 percent (EU-60) of the median household income of the total population (1). It is a relative income-level indicator that is based on defining poverty as a social phenomenon and relates the household's income and living conditions to the general standard in the country (2). The two indicators differ in the equivalent on how to compare household incomes to households with different composition and size.

Within Oslo, we will sort the schools in the two types and use the last year grade point average to enter the school combined with its location to prioritize the order in which they are contacted. There is also a broader indicator of school quality which we will look into. Oslo is a highly divided city with lower SES and higher rates of ethnic minorities in the Eastern parts, but the upper secondary schools serve the whole city so we would also need to find out which schools primarily recruit from their local surroundings.

Poland: sampling of schools for system mapping workshops

Poland will use a national-level, widely available index measuring SES by geographical area and by school (a hybrid index). The index allows to identify schools intrinsically within a particular SES category which are also mapped geographically to identify schools in particular areas that fall into the different categories.
In particular, Poland will use G index values calculated by the Ministry of Finance of Poland (2018). G index refers to taxable income per capita in a commune (pol: gmina, the lowest level of administrative district with an influence on local food and PA policies).
G index is used to determine which schools in Poland are in the lowest SES areas and thus require social and educational subsidies (both individual and school level; National Bill on Supporting Education, Parliament of Poland, 2017). Schools in areas with G index below 75% (National Bill on Supporting Education, Parliament of Poland, 2017) represent the lowest SES.
Schools will be purposefully sampled from 2 communes representing the lowest SES (G index below 75%) and 2 communes representing the highest SES (G index above 125%).

Contacting Schools

We will approach the headmasters of a purposefully selected public high schools in respective communes (by phone, followed by an individual appointment). Study objectives and the protocol will be discussed, followed by obtaining the consent from the headmaster (in case of a lack of consent, the next high school in the commune will be approached). The headmaster will be asked to indicate at least 3 grades (with students aged 16-18) to be visited by the facilitating team.
Next, grades with students aged 16, 17 and 18 will be approached by the facilitating team. The team will visit during the school classes; the study objectives and protocol will be presented. Students who are interested will be invited to join after the presentation. All students willing to participate will be asked signing an informed consent; students younger than 18 years old will be asked to deliver informed consent signed by a parent/legal guardian. Students will be informed that we can accommodate up to 15 persons per workshop and that the selection among those who agreed to participate will be random, stratified for age and gender. Up to 18 participants will be invited, assuming 20% of no-shows.
In general, self-nomination among adolescents will be the primary way of recruitment.

Arranging Workshops
Workshops will take place in the afternoon during a weekday. Date, time and a suitable classroom will be agreed between the facilitators and the headmaster. Catering will be provided during the workshop. A total of 3 persons from the CO-CREATE team will take part in the workshop, with 2 active facilitators and 1 taking notes.

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Portugal: sampling of schools for system mapping workshops

1. Number of participants

- The four selected schools will host one mapping workshop each (4 workshops in total). Ideally there will be between 10 and 15 adolescents per workshop;
- Sample will be selected according to the total of adolescents in Grade 10, 11, 12.

2. Inclusion criteria

Included adolescents should be:

- At least 16 years old 15th March 2019;
- 18 years old and under 19 years old on 30 September 2019;
- Registered in school in Portugal;
- The adolescents must be considered able or competent to give their consent to participate;
- If the adolescent is under 18 years' old, they need to get their parents consent;

3. Exclusion criteria

- Not between 16 and 18 at the time of recruitment;

2. **Schools**

1. Identification of the Municipalities

- We will select 2 municipalities;
- We will contact the municipalities and present the Project;
- Establish a protocol with the municipalities;
- Once this is done, they will provide a list of all secondary schools public and private with the social support categorization: "None", "SAS B", "SAS A"
    - In Portugal, the municipalities are able to categorize each school according to the social support ("none", "SAS B", "SAS A"). In that way it is easier to approach the schools that higher number of each category;

2. Identification of Schools

- Four secondary schools will be purposively selected. We will identify 2 outside capital areas (two among the most deprived municipalities and two among the least);
- After the municipalities give us the list and the contacts of the schools we will select a set of 4 schools (assuming some non-response). Once a school is identified its contact details and website

information will be entered on a spreadsheet collating information about the school's recruitment;

- Then we will send to the schools a INFO about the Project;
- Through the study and small questionnaire (which can be done online) with an invitation for the adolescent to participate and considering the questions which are important for us (SES, GENDER; AGE, ETHNICITY). In this we will let the family know that there will be several levels or recruitment and they might be considering on a later stage or not;
- Once we receive the replies and consents we will have, probably an over sample. Then we would divide the adolescents into groups of gender, ethnicity, SES and age and we proceed with withdrawing a convenient sample.

3. Contacting schools

Schools will be contacted regularly by phone and email until a response regarding participation in the project is achieved. This may take several weeks, given the schedule of teachers' timetables and their availability for dealing with phone/email requests.

4. What information will the schools receive?

After an initial discussion about the project on the phone, an information sheet about the project will be sent to the Head Teacher and/or other relevant school personnel. Schools will also be given a consent form for information in this first stage. Finally, we will also share all relevant research ethics approval documents in order to discuss and ensure the children's safeguarding.

Head teachers (or other appropriate personnel) will be provided communication materials to inform the students about the opportunity to participate in this research. These include notices/flyers/posters and internet posting, and will be shared during existing opportunities at the school such as morning assemblies, and classroom sessions. We will take the lead from each school as to whether they would like to post the information on their online or other digital channels such as school information apps.

Information sheets will cover: the nature of the involvement of the school, what we are asking of the school in terms of help with recruitment, providing a room for the mapping session, what the sessions would involve, how long they will take etc. Information will also be provided on the CO-CREATE project more generally, how our work fits into it and describing its aims.

The school will be asked to provide a room for the mapping session (for which we can pay a fee, if required) and we will encourage that a member of staff is present.
Once the school has agreed to participate, they will be asked to sign and return the consent form to confirm their participation in the project, which may be returned via fax/email/post or in person during the sessions. (The recruited school details will be transferred to the "Confirmed Schools" spreadsheet.)

5. Gaining consent from parents/carers

Information will also be given to the schools to pass on to parents. This will be the same information provided to the adolescents themselves but written as addressed to the parents/carers. We will take advice from the interested schools on a case-by-case basis about whether any further materials or otherwise would be useful/necessary. We will take the lead from each school as to whether they would like to post the information on their online or other digital channels or use paper copies.

NOTE: Maybe it would be interesting to add some questions to the parent's consent, such as occupation/education and income. Once we have the informed consent signed we will have this information, after that we can then withdraw a representative sample.

6. Gaining consent from adolescents

Adolescents will receive materials provided to the schools setting out information about the project, the nature of the involvement, what the sessions would involve, and what their contribution is. The consent/assent process will be conducted with adolescents signing a paper form.

The Netherlands: sampling of schools for system mapping workshops

In the Netherlands, the following strategy will be applied to purposively select schools for WP4 (while making sure that the selection criteria are also in line for the purpose of WP5) to particularly aim for diversity in terms of the socioeconomic positions of the schools' populations.

1. Two political units/municipalities are selected, one of them being the capital and the other one being a municipality outside of the capital.

As the Dutch capital, *Amsterdam* is selected as our first municipality with 821.000 inhabitants and 67 secondary schools. The second municipality is *Almere*, a smaller city with 197.000 inhabitants and 13 secondary schools, 30 kilometers outside of Amsterdam. Amsterdam and Almere are interesting to compare because Amsterdam has a high level of spatial segregation between people of different social and economic status as well as those coming from different ethnic and cultural backgrounds (Scheffer 2006; Broekhuizen et al. 2008) while Almere has a lower level of spatial segregation and a larger portion of lower middle-class citizens (Huygen 2017; Metaal & Reijndorp 2013; see also Emmelot et al. 2010, when compared to Broekhuizen et al. 2008).

2. A total of four schools are selected. In each of the municipalities, one school on a higher tier of Dutch stratified educational system is recruited and the other one is a school on a lower tier.

In the Netherlands, adolescents' socioeconomic positions and their parents' educational levels, as a proxy of their socioeconomic positions, are related to tier of secondary school these young people are enrolled in (Kloosterman 2010; Fukkink et al. 2016; Van Daalen 2010). On the lower tier, vocational high schools, *'VMBO's'*, have higher portions of students whose parents have lower educational levels and disadvantaged social backgrounds while on the upper tier, high schools for university preparation, '*VWO's'*, have higher portions of students whose parents have higher educational levels and are relatively more affluent (Cohen 2018; Kloosterman 2010). We will thus recruit one VMBO school and one VWO school in Amsterdam as well as in Almere.

3. We will reach out to VMBO and VWO schools in Amsterdam and Almere which most clearly fit our diversity criteria.

We will decide which VMBO and VWO schools to recruit for our study based on 1) whether the school offers only VMBO or VWO or a mix of several tier of educations, 2) the distribution of parents' educational levels for schools in a particular area, and 3) whether or not students in those schools mostly come from the neighborhood where that school is located. We will use this information to prioritize the order in which the schools suitable for our study are contacted, thereby maximizing our chances to recruit socioeconomic diversity in school populations for Amsterdam and Almere. We bear in mind that students whose parents have lower educational levels often choose either categorial schools offering only VMBO or mixed schools whereas students whose parents have higher educational levels more often than not choose categorial schools that solely offer VWO (Fukkink et al. 2016). We will therefore initially aim to recruit categorial VMBO and VWO schools and otherwise select these education types in mixed schools. The policy report of the municipalities describe the percentages of parents with higher/lower educational levels per neighborhood (see Fukkink et al. 2016; Kets et al. 2018) as well as whether students go to school in

their own neighborhood or travel to other neighborhoods in the same municipality (for Amsterdam: Fukkink et al. 2016).

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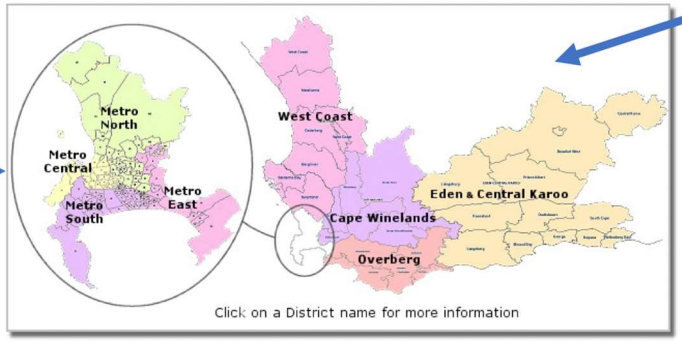
South Africa: sampling of schools for system mapping workshops

1) Geographical diversity

- South Africa divided in 9 provinces with 86 Education Districts.
- We will conduct the workshops in schools in the Western Cape province.
- The Western Cape province has 8 Education districts (map below)

The 2 urban schools will be selected from 2 of the 4 Education Districts in the Cape Town metropole



Select 2 rural/non-capital schools from the West Coast & Eden/ Central Karoo Education districts.

2) SES diversity

- All public schools are categorized into 5 quantiles
  - Based on weighted household data on income dependency ratio (or unemployment rate), and the level of education of the community (or literacy rate) from national census data.
- Quintile one (Q1) = schools in the poorest communities; they are not allowed to charge school fee; Q1 to Q3 are no-fees schools
  - Lower SES schools.
- Quintile five (Q5) = schools in the wealthiest communities; Q4 and Q5 charge school fees.
  - Higher SES schools
- List of all schools in the Western Cape Education districts and their quantile classification are available online.
- Mix gender schools

Recruitment strategy

1. Approval from UCT ethics committee (6-8 weeks)
2. Approval from the Western Cape Department of Education (takes 1-2 weeks)
   - Online process, ethical approval and protocol must be attached.
   - We must list the schools we would like to include.
   - Thus, we will select more schools within each of the 4 categories; so that if a school declines invite we can approach the next school on the list etc..
3. Request meeting with headmaster per school to explain study, provide project info sheets, school level consent form, ethics info.
4. Learners will volunteer by placing forms in box at secretary or arranged place at school (no online process due to limited/no internet or technology in lower SES schools/ rural areas).

Other considerations

- Language barriers: Home language and language taught at school may either be Afrikaans only, Xhosa only or English. We will ensure language diversity in the research team.
- Compensation/Incentives:
    - For learners from lowest SES schools:
        - Pair of school shoes (about 10 Euros) and stationary
        - Airtime for Cell phone?
    - For learners from highest SES
        - Airtime for cell phones
        - Book voucher?

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