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1 **Obesity prevention in the early years: a mapping study of national policies in England from a**  
2 **behavioural science perspective**

3

4 **Short title**

5 National policies in England for obesity in the early years

6

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21

22 Authors' contributions- RMV and CH conceived the study. HC designed the study methods with input  
23 from SR, CH, HB, SM, RMV. HC, SR, AG, AB undertook the data coding, mapping and interpretation.

24 HC wrote the first draft of the manuscript. All authors provided input into the draft and read and  
25 approved the final draft

26

27 **Abstract**

28 Background

29 Evidence indicates that early life is critical for determining future obesity risk. A sharper policy focus  
30 on pregnancy and early childhood could help improve obesity prevention efforts. This study aimed  
31 to systematically identify and categorise policy levers used in England with potential to influence  
32 early lifecourse (pregnancy, 0-5 years) and identify how these interface with energy balance  
33 behaviours. The objective is to identify gaps and where further policy actions could most effectively  
34 focus.

35

36 Methods

37 A behavioural science approach was taken using the Capability-Opportunity-Motivation-Behaviour  
38 (COM-B) model and Behaviour Change Wheel (BCW) framework. The key determinants of energy  
39 balance in the early years were identified from the Foresight Systems Map. Policy actions were  
40 scoped systematically from available literature, including any health or non-health policies which  
41 could impact on energy balance behaviours. Foresight variables and policy actions were considered  
42 in terms of COM-B and the BCW to determine approaches likely to be effective for obesity  
43 prevention and treatment. Existing policies were overlaid across the map of key risk factors to  
44 identify gaps in obesity prevention and treatment provision.

45

46 Results

47 A wide range of policy actions were identified (n=115) to address obesity-relevant risk factors. These  
48 were most commonly educational or guidelines relating to environmental restructuring (i.e.  
49 changing the physical or social context). Scope for strengthening policies relating to the food system  
50 (e.g. the market price of food) and psychological factors contributing to obesity were identified.  
51 Policies acted via all aspects of the COM-B model, but there was scope for improving policies to  
52 increase capability through skills acquisition and both reflective and automatic motivation.

53

54 Conclusions

55 There is substantial policy activity to address early years obesity but much is focused on education.

56 Scope exists to strengthen actions relating to upstream policies which act on food systems and those  
57 targeting psychological factors contributing to obesity risk.

58

59

60

61

## 62 **Introduction**

63 Rates of overweight and obesity in children have increased worldwide since the 1980s, and despite a  
64 slowing recently, it remains an important public health issue with serious consequences for health  
65 (1, 2). In the UK, approximately 10% of children aged 4-5 years and 20% of those aged 10-11 years  
66 were living with obesity in 2018/19 (3). Children in the UK are also developing obesity at a younger  
67 age and therefore are likely to accumulate greater levels of overweight across their lifetimes (4).  
68 Behaviour-changing interventions to treat children with overweight and obesity can reduce body  
69 mass index (BMI) but effects tend to be small (5) and effective prevention programmes have  
70 generally proved elusive (6). There is growing evidence for the importance of pregnancy and  
71 maternal factors, including maternal weight, general health and the environment, for programming  
72 weight gain in offspring across the life-course (7, 8). Pre and postnatal growth, and their interaction,  
73 are important for establishing risk factors for obesity (7). Children from disadvantaged backgrounds  
74 have higher rates of obesity and, in England, these inequalities have increased over the past decade  
75 (9). Early life is likely to be critical; a recent systematic review showed consistent associations  
76 between rapid growth in the first two years of life and later obesity, with the strongest effects in  
77 children of lower socioeconomic status (SES) and ethnic minority groups (10). Evidence also suggests  
78 that children of lower SES have greater exposure to several early life risk factors for obesity,  
79 including pre-pregnancy maternal obesity and diabetes, low birth weight and poorer early life  
80 nutrition (11). This suggests that a sharper policy focus on pregnancy and early childhood could be  
81 useful for improving the effectiveness of obesity prevention efforts and for addressing health  
82 inequalities.

83

84 The complex nature of obesity, with its numerous interacting contributing factors, requires a  
85 comprehensive, coordinated and sustained policy response (12). Policy levers have been described  
86 as “instruments that can be adjusted by governments to achieve system-wide change” (13).

87 Adjusting or applying a policy lever should significantly impact on the system, and in this case

88 influence behaviours or determinants of behaviour related to child obesity (14). Policy actions are  
89 available through the 'layers of influence on health', from the individual, through family, social and  
90 community networks ('downstream' influences), to wider socioeconomic and environmental  
91 conditions and up to national level ('upstream influences') (15). Therefore, there are a range of  
92 periods and settings where policy levers may potentially be applied during the early lifecourse.  
93 National obesity policy has tended to focus on individual responsibility and locally-led actions (16)  
94 (17) (18) (19). However, a comprehensive mapping of existing policies in England to intervene during  
95 the critical early years part of the lifecourse, and whether they target appropriate behaviours or  
96 behavioural influences has not been conducted to the authors' knowledge. An improved  
97 understanding of the current policy landscape and whether actions are appropriately targeted has  
98 potential to provide insight on whether resources are being appropriately allocated. The aim of this  
99 study was to use a behavioural science approach to identify and categorise the policy levers being  
100 used in England that have potential to influence obesity across the early lifecourse (here considered  
101 to be pregnancy and 0-5 years), identify how these interface with energy balance behaviours  
102 (behaviours related to energy intake or expenditure), and identify areas where further policy actions  
103 could focus.

104

## 105 **Methods**

106 The objectives were to: 1) identify and describe the key factors relevant to obesity prevention in the  
107 early years; 2) identify and describe relevant English national policy; 3) systematically map the  
108 identified policies onto the key factors relevant to obesity prevention; and 4) identify gaps and  
109 where further policy actions could be most effectively focused.

110 A behavioural science approach was taken using the Capability-Opportunity-Motivation-Behaviour  
111 (COM-B) model and Behaviour Change Wheel (BCW) framework; see Fig 1 and Table 1 (20, 21). The  
112 COM-B model identifies the factors required to bring about behaviour change and the BCW  
113 highlights the approaches likely to be effective. For a behaviour to occur, there must be sufficient

114 Capability (physical and psychological); Opportunity (physical and social); and Motivation (reflective  
 115 and automatic). COM-B and the BCW allowed us to theoretically describe obesity risk factors and  
 116 existing policies, and then to create a map of how policies interface with risk factors. The methods  
 117 used to address each aim are described below. Data extraction templates and detailed step-by-step  
 118 coding guidelines were developed (provided in S1 Supporting Information File).

119

120 **Fig 1- Behaviour Change Wheel**

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122

123 **Table 1- COM-B and Behaviour Change Wheel (BCW) components**

| <b>COM-B components</b>                          |  |
|--|--|
| Physical capability                              | Physical skill, strength, or stamina   |
| Psychological capability                         | Knowledge or psychological skills, strength or stamina to engage in the necessary mental processes   |
| Physical opportunity                             | Opportunity afforded by environment involving time, resources, location, cues, physical 'affordance'   |
| Social opportunity                               | Opportunity afforded by interpersonal influences, social cues and cultural norms that influence the way we think about things, e.g. the words and concepts that make up our language |
| Automatic motivation                             | Automatic processes involving emotional reactions, desires (wants and needs), impulses, inhibitions, drive states and reflex responses   |
| Reflective motivation                            | Reflective processes involving plans (self-conscious intentions) and evaluations (beliefs about what is good and bad)  |
| <b>Behaviour Change Wheel intervention types</b> |  |
| Education  | Increasing knowledge or understanding  |
| Persuasion                                       | Using communication to induce positive or negative feelings or stimulate action  |
| Incentivisation                                  | Creating an expectation of reward  |
| Coercion   | Creating an expectation of punishment or cost  |
| Training   | Imparting skills   |
| Restriction                                      | Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)          |
| Environmental restructuring                      | Changing the physical or social context  |
| Modelling  | Providing an example for people to aspire to or imitate  |

|            |   |
|------------|---|
| Enablement | Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring) |
|------------|---|

**Behaviour Change Wheel policy categories**

|                         |   |
|-------------------------|---|
| Communication/marketing | Using print, electronic, telephonic or broadcast media  |
| Guidelines              | Creating documents that recommend or mandate practice. This includes all changes to service provision |
| Fiscal measures         | Using the tax system to reduce or increase the financial cost   |
| Regulation              | Establishing rules or principles of behaviour or practice   |
| Legislation             | Making or changing laws   |
| Environmental/social    | Designing and/or controlling the physical or social environment                                       |
| Service provision       | Delivering a service  |

124 (Taken from Michie et al, 2014)

125

126 ***To address objective 1 (identify and describe the key factors relevant to obesity prevention in the***

127 ***early years)***, the Foresight Systems map was used to identify key mechanisms influencing energy

128 balance (22). This map provides insight into the complex relationships between the many

129 determinants of obesity, with factors organised into broad groups including those relating to an

130 individual’s physiology, physical activity, biology, diet, and psychology, the physical activity

131 environment, and the food production system. The variables most strongly connected to ‘energy

132 balance’ in the centre of the model were the focus of this study. These include ‘key variables’ and

133 ‘first tier variables’, which are considered leverage points for obesity policy having strong

134 connections with the wider system (23). Only variables relevant to children were used, identified

135 using the relevant Foresight map (“Segmented Map: Children”)(22), including those occurring via

136 parent actions; this resulted in 23 variables. Each variable was coded, by considering how it could

137 influence energy balance behaviours using COM-B; one or more components of capability,

138 opportunity or motivation were assigned. For example, the variable ‘food exposure’ was coded as

139 ‘physical opportunity’ and the variable ‘level of recreational activity’ was coded as ‘physical

140 capability’, ‘physical opportunity’, ‘social opportunity’, and ‘reflective motivation’. Variables were

141 independently coded by two researchers (HC and SR), the rate of agreement was recorded and

142 discrepancies discussed to reach consensus.



143

144 **To address objective 2 (identify and describe relevant national policy)**, a systematic online search of  
145 current relevant national government policies was undertaken (see S1 Supporting Information File  
146 for search strategy). This included policy documents relating to obesity, child health (pregnancy and  
147 maternity care, child care settings, primary schools, leisure facilities), and other areas (dental; social  
148 e.g. travel, housing). Policy actions have been defined as ‘the specific actions put into place by any  
149 level of government and associated agencies to achieve the public health objective’ (24). Therefore,  
150 we included interventions as well as policies providing they were judged to be ‘concrete and  
151 actionable’ (i.e. not aspirational or vague). Interventions and policies were systematically coded  
152 using the BCW. We considered how each intervention or policy could change behaviour, by one or  
153 more of the following intervention types: education, persuasion, incentivisation, coercion, training,  
154 restriction, environmental restructuring, modelling, or enablement. We then considered which  
155 policy category or categories from the BCW (communication/ marketing, guidelines, fiscal measures,  
156 regulation, legislation, environmental/ social planning, service provision) best reflected the mode of  
157 action of each policy. Each policy was independently coded by two researchers (HC and AB), the rate  
158 of agreement recorded and any discrepancies discussed to reach consensus.

159 The searches were undertaken in May 2018. The Childhood Obesity Plan: a call for action, Chapter 2  
160 (COP2) was published in June 2018 and coded by HC and AG as a consensus exercise at a later date  
161 (25). Policies were also coded according to the mode of influence; direct action on the child (e.g.  
162 change in food provided to the child in a child care setting), direct action via parent (e.g. policy  
163 resulting in parent changing food provided to child), indirect action via parent (e.g. policy resulting in  
164 parent changing own behaviour resulting in modelling of healthier behaviours), or a combination.

165

166 **To address objective 3 (systematically map the identified policies onto the key factors related to**  
167 **obesity prevention)**, the matrix developed by Michie et al (2014) was used, see Table 2 (21). This  
168 indicates the intervention types most likely to be useful for bringing about change in each COM-B

169 construct. The coding generated for objectives 1 and 2 was used. We examined the Foresight  
 170 variables sequentially; we used the two sets of coding (COM-B and BCW) to create a grid which we  
 171 used to cross-reference the policies and intervention types. This enabled us to identify the specific  
 172 policy actions available to address each Foresight variable. This was done by two researchers (HC  
 173 and AB) as a consensus exercise; mapping of COP2 was additionally undertaken by HC and AG. The  
 174 results from the mapping work were summarised into a HEAT map; green indicating the presence of  
 175 at least one policy action to target a particular Foresight variable (with results presented for each  
 176 relevant intervention type for each Foresight variable) and red indicating no identified policy actions.  
 177

178 **Table 2- Matrix of links between COM-B and intervention types**

179

| COM-B components         | Intervention types |            |                 |          |          |             |                             |           |            |
|--------------------------|--------------------|------------|-----------------|----------|----------|-------------|-----------------------------|-----------|------------|
|                          | Education          | Persuasion | Incentivisation | Coercion | Training | Restriction | Environmental restructuring | Modelling | Enablement |
| Physical capability      |                    |            |                 |          | X        |             |                             |           | X          |
| Psychological capability | X                  |            |                 |          | X        |             |                             |           | X          |
| Physical opportunity     |                    |            |                 |          | X        | X           | X                           |           | X          |
| Social opportunity       |                    |            |                 |          |          | X           | X                           | X         | X          |
| Automatic motivation     |                    | X          | X               | X        | X        |             | X                           | X         | X          |
| Reflective motivation    | X                  | X          | X               | X        |          |             |                             |           |            |

180 (Taken from Michie et al, 14)  
 181 *X indicates the intervention types most applicable for bringing about change in each COM-B*  
 182 *construct*

183  
 184

185 ***To address objective 4 (identify potential gaps and opportunities for policy actions to be developed***  
 186 ***or implemented),*** the mapping work generated for objective 3 was used. Coherence between the

187 key influences of energy balance and current policies was examined (i.e. presence of policies to  
188 address key factors influencing energy balance). We also examined whether there were  
189 opportunities for developing or implementing policy. This is where there are factors known to  
190 influence obesity but for which we were unable to identify any policies to address, or where the  
191 policies were not targeted in the most effective way according to the BCW.

192

## 193 **Results**

194 The coding of the Foresight variables using the COM-B model resulted in an agreement between  
195 coders of 71%, considered moderate, and agreement for the coding of policies using the BCW was  
196 90%, considered very high (26). The full coding is provided in S1 Supporting Information File.

197

### 198 ***Objective 1: Identify and describe the key factors relevant to obesity prevention in the early years***

199 The codes relating to COM-B assigned to the Foresight variables varied widely, so that there was a  
200 good spread of potential influences on children's energy balance; summarised in Fig 2.

201

#### 202 **Fig 2 HEAT Map showing Foresight variables with mapped policy action**

203 *Intervention types:* Tr-training; En-enablement; Ed-education; Re-restriction; Env-environmental  
204 restructuring; Mo-modelling; Per-persuasion; Inc-incentivisation; Co-coercion; *Mapping:* Grey- not  
205 applicable (COM-B construct not relevant for that variable); Green- policy actions identified; Red- no  
206 policy actions identified, Orange -uncertain

207

### 208 ***Objective 2: identify and describe national policy in the early years for obesity prevention***

209 A total of 106 specific policy actions were identified in the initial search, this included specific policy  
210 initiatives (e.g. the 'National Child Measurement Programme' and 'Change for Life') and national  
211 clinical and public health guidelines produced by the National Institute for Health and Care  
212 Excellence (NICE). Four additional policy actions were identified but not included as they either fed

213 into other policies (update of Nutrient Profile Model), were planned for the future (Healthy Rating  
 214 Scheme for primary schools; suite of digital applications for healthy eating) or were not a specific  
 215 policy action (healthy marketing strategy). Some of the policies had more than one specific policy  
 216 action (e.g. measurement and feedback elements of the ‘National Child Measurement Programme’  
 217 and a wide range of actions at different time points in the ‘Healthy Child Programme’); the number  
 218 of unique policies was 79. An additional nine policy actions were identified in COP2. In total, 115  
 219 specific policy actions were identified and 88 unique policies. The remainder of the results relate to  
 220 these 115 policy actions. Examples of how these relate to the intervention types in the BCW, as well  
 221 as the mode of action, is provided in Table 3. The most common intervention type was education,  
 222 with environmental restructuring and modelling approaches also commonly used. Coercion,  
 223 restriction and incentivisation approaches were rarely used. As well as policies impacting directly on  
 224 the child, many were via adult-focused initiatives which provide educational opportunities for  
 225 parents and modelling opportunities for children (via parent behaviour change). The number of  
 226 policy actions assigned to each intervention type and policy category is shown in Fig 3 and 4  
 227 respectively.

228  
 229 **Table 3- Examples of how identified policy actions relate to BCW intervention types**

| BCW intervention type                                     | Examples of policy actions relating to each intervention type  |  |   |
|---|--|--|---|
|   | Direct action on child   | Direct action via parent   | Indirect action via parent                    |
| Education<br><i>Increasing knowledge or understanding</i> | Food teaching in primary schools framework; School Food Plan; NICE guidance- obesity prevention- schools; resources to support NCMP in schools; Cycling and walking investment strategy (walk to school project) | Healthy Start Scheme; Healthy Child Programme; National Child Measurement Programme feedback; Change4Life resources; 5aday logos | Healthy Child Programme; One You NHS campaign |
| Persuasion  | None identified  | Promotion of breastfeeding   | One You campaign online                       |

|   |  |   |  |
|---|--|---|--|
| <i>Using communication to induce positive or negative feelings or stimulate action</i>  |  | within Healthy Child Programme; Clearer food labelling; consistent calorie labelling; Change4Life resources; NICE physical activity guidelines  | resources; physical activity infographic   |
| Incentivisation<br><i>Creating an expectation of reward</i>   | Cycling and walking investment strategy (walk to school project- children’s challenge);  | Change4Life vouchers for healthy food   | None identified  |
| Coercion<br><i>Creating an expectation of punishment or cost</i>  | None identified  | None identified   | None identified  |
| Training<br><i>Imparting skills</i>   | Funding for bikeability training; Cooking in the national curriculum; Sports skills within national curriculum   | NICE guidelines including imparting skills regarding breastfeeding, cooking, positive parenting   | NICE guideline on obesity prevention (NHS interventions for adults)                          |
| Restriction<br><i>Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)</i> | Advertising restrictions in children’s media   | Ban on sales of energy drinks to children; proposed ban of promotion of unhealthy foods and drinks  | None identified  |
| Environmental restructuring<br><i>Changing the physical or social context</i>   | Sugar drinks levy; Sugar and Calorie Reduction Programmes; provision of opportunities to be active at school (breaktimes and PE); Primary PE and Sports Premium; provision of healthier foods in school; Food in Early Years Settings; lowered maximum protein content of formula milk; Nursery Milk Scheme; universal free school | Sporting Future (improved local leisure facilities); local transport plans to encourage active travel; NICE guidance on postnatal care and maternal and child nutrition; consistent calorie labelling | NICE obesity prevention guidelines; NICE physical activity guidelines on walking and cycling |

|  |  |   |   |
|--|--|---|---|
|  | meals for KS1; Daily mile  |   |   |
| Modelling<br><i>Providing an example for people to aspire to or imitate</i>  | Creation of healthy food environments in public sector settings (including leisure centres); staff modelling recommended in Food in Early Years Settings; School Fruit and Vegetable Scheme; | Healthy Child Programme (peer support for breastfeeding); positive images within Change4Life; Baby Friendly accreditation               | One You Campaign, NHS weight loss plan, various NICE guidelines                               |
| Enablement<br><i>Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)</i> | Universal free school meals for KS1; What works in schools and colleges to increase physical activity?   | Vouchers within Healthy Start Scheme; behavioural elements and vouchers with Change4Life; prompts for behaviour change with Start4Life; | Support for behaviour change and access to resources in NICE guidelines; NHS weight loss plan |

230

231

**Fig 3- Policy actions coded by 'intervention type'**

232

**Fig 4- Policy actions coded by 'policy category'**

233

234 ***Objective 3: Systematically map the identified policies onto the key factors related to obesity***

235 ***prevention in early life***

236 The results of the mapping work as a whole are shown in the HEAT map (Fig 2), which indicates

237 where policy actions were identified for Foresight variable as per the BCW. Of a possible 287

238 opportunities for policy, over half had at least one policy action (n=157; 54.7%), but we were unable

239 to identify any actions for the remainder (n=128; 44.6%) or there were uncertainties over the coding

240 (n=2; 0.7%). A summary of how well the identified policies mapped onto the COM-B theoretical

241 model and the intervention types from the BCW is shown in Table 4. For the COM-B constructs,

242 'physical capability' was the best covered and 'physical opportunity' and 'social opportunity' were

243 reasonably well covered. The constructs with the least identified policy actions were 'psychological

244 capability', 'automatic motivation' and 'reflective motivation'. For the intervention types from the  
 245 BCW, there was wide variation in coverage. There were many policy actions based on education and  
 246 environmental restructuring, with more than 80% of the opportunities for these approaches having  
 247 policies in place. There were a reasonable number of policy actions in place to address modelling  
 248 and enablement (with over 60% of opportunities having policies in place), fewer for training,  
 249 restriction, persuasion and incentivisation (less than 60% of opportunities) and no policy actions  
 250 based on coercion.

251

252 **Table 4- Policy actions in place by COM-B constructs and intervention types (across all Foresight**  
 253 **variables)**

| <b>COM-B construct</b>  | <b>Number with any mapped policies</b> | <b>%</b> |
|---|--|----------|
| Physical capability<br><i>Physical skill, strength, strength or stamina</i>   | 13/14                                  | 93%      |
| Social opportunity<br><i>Opportunity afforded by interpersonal influences, social cues and cultural norms that influence the way we think about things, e.g. the words and concepts that make up our language</i> | 42/60                                  | 70%      |
| Physical opportunity<br><i>Opportunity afforded by environment involving time, resources, location, cues, physical 'affordance'</i>   | 38/60                                  | 63%      |
| Psychological capability<br><i>Knowledge or psychological skills, strength or stamina to engage in the necessary mental processes</i>   | 13/24*                                 | 54%      |
| Reflective motivation<br><i>Reflective processes involving plans (self-conscious intentions) and evaluations (beliefs about what is good and bad)</i>   | 22/52                                  | 42%      |
| Automatic motivation<br><i>Automatic processes involving emotional reactions, desires (wants and needs), impulses, inhibitions, drive states and reflex responses</i>   | 29/77*                                 | 38%      |
| <b>BCW intervention type</b>  |  |          |
| Environmental restructuring<br><i>Changing the physical or social context</i>   | 37/41                                  | 90%      |

|   |         |     |
|---|---------|-----|
| Education<br><i>Increasing knowledge or understanding</i>   | 17/21   | 81% |
| Modelling<br><i>Providing an example for people to aspire to or imitate</i>   | 18/26   | 69% |
| Enablement<br><i>Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)</i>                                | 36/56   | 64% |
| Persuasion<br><i>Using communication to induce positive or negative feelings or stimulate action</i>  | 13/24   | 54% |
| Restriction<br><i>Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)</i> | 13/30   | 43% |
| Training<br><i>Imparting skills</i>   | 17/41** | 41% |
| Incentivisation<br><i>Creating an expectation of reward</i>   | 6/24    | 25% |
| Coercion<br><i>Creating an expectation of punishment or cost</i>  | 0/24    | 0%  |

254 \*There was uncertainty regarding the coding for one of the policy actions within each of these  
255 categories, these were therefore not coded as a mapped policy action

256 \*\* There was uncertainty regarding the coding for two of the policy actions within each this  
257 category, these were therefore not coded as mapped policy actions  
258

259 The HEAT map (Fig 2) can also be used to examine the policy actions available for individual  
260 Foresight variables. The nutrition-related variables with the most policy actions in place were food  
261 literacy, food abundance, food exposure, palatability of food, breastfeeding and weaning, energy  
262 density (at least 60% of opportunities had identified policies). For example, actions for food literacy  
263 included policies for clearer food labelling and education within the Healthy Child Programme. There  
264 were a reasonable number of policies (40-60% of opportunities had identified policies) to address  
265 de-skilling, convenience of food, portion size, purchasing power, perceived inconsistency of science  
266 messages, and tendency to graze. For example, nutrient-based standards in food outlets to target  
267 food convenience. There is much overlap with many of the policy actions; for example, healthier  
268 foods in schools could help to address food abundance, food exposure, palatability of food offerings,



269 and energy density. For physical activity, the variables with the most policy actions (at least 60%)  
270 were degree of physical education, innate activity in childhood, recreational activity, transport  
271 activity, functional fitness, with a reasonable number (40-60%) present for de-skilling. For example,  
272 guidance for schools to target physical education and NICE guidance re public open spaces and  
273 schools to target recreational activity. The variables with limited identified policy actions were  
274 stress, food advertising, self-esteem, side-effects of drugs, demand for indulgence, and market price  
275 of food (less than 30% of the opportunities for policies had identified policy actions). There were  
276 however some efforts to target these variables with marketing restrictions identified as key actions  
277 in the COP2.

278

279 ***Objective 4: Identify potential gaps and opportunities for policy actions to be developed or***  
280 ***implemented***

281 As identified from the above mapping work, the COM-B constructs with the least identified policy  
282 actions were 'psychological capability', 'automatic motivation' and 'reflective motivation'. The HEAT  
283 map (Fig 2) indicates which intervention types specifically were lacking for these. In relation to  
284 increasing psychological capability, there were opportunities to strengthen policies through training  
285 and enablement. The Foresight variables that had gaps for these included stress, food literacy,  
286 inconsistent messaging, 'demand for indulgence', and de-skilling. In relation to increasing automatic  
287 motivation, there were, in particular, opportunities to strengthen policies based on persuasion,  
288 incentivisation, coercion, training, and enablement. In relation to reflective motivation, there were  
289 opportunities to particularly strengthen policies based on incentivisation and coercion. A number of  
290 Foresight variables had particular gaps relating to motivation, including stress, food advertising, self-  
291 esteem, 'demand for indulgence', tendency to graze, and market price of food. The Foresight  
292 variable 'market price of food' was notable in that no policies were identified which targeted it.

293

294 **Discussion**

295 This scoping and mapping exercise identified where there were policies in place in England to target  
296 risk factors for obesity, and whether the methods employed were appropriate according to a  
297 behavioural science perspective, and where there was scope for additional actions. A substantial  
298 amount of policy activity was identified aiming to address childhood obesity and strong coverage of  
299 policies to target many of the energy balance-related risk factors from the Foresight systems map. A  
300 total of 115 relevant policy actions were identified and over half of the potential opportunities for  
301 addressing these risk factors had appropriate actions in place. This indicates that Government has  
302 implemented many actions in England to address early years obesity.

303

304 The mapping work in the current study was able to provide specific information about whether the  
305 policy action in place to target the Foresight variables used appropriate approaches, as identified by  
306 COM-B and the BCW. There were policy actions targeting all of aspects of the model but we also  
307 identified gaps. The COM-B model identifies two types of capability- physical and psychological.  
308 Physical capability refers to physical skill, strength or stamina and is best acted upon with training or  
309 enablement, whilst psychological capability refers to knowledge and psychological skills and is best  
310 acted upon with education, training and enablement. The majority of Foresight variables identified  
311 as being amenable to change through increasing physical capability related to physical activity (e.g.  
312 transport activity) and we identified good coverage of policy actions targeting these across most of  
313 the relevant Foresight variables. The majority of the Foresight variables related to psychological  
314 capability were psychological (e.g. stress, food literacy) or dietary (e.g. portion size) and we  
315 identified numerous policy actions targeting this based on education but gaps for actions based on  
316 training and enablement.

317

318 Within the COM-B model, opportunity comprises physical and social aspects. Physical opportunity  
319 relates to time, resources, locations and cues, whilst social opportunity relates to interpersonal  
320 influences, social cues and social norms. Both can be targeted using restriction, environmental

321 restructuring and enablement; physical opportunity can also be increased with training and social  
322 opportunity can be increased with modelling (i.e. setting a 'good' example). The majority of the  
323 Foresight variables across several domains (diet, physical activity, diet, economic) were related to  
324 opportunity and we identified reasonable coverage of policy actions across all of these. The  
325 Foresight variable 'market price of food' was a notable exception with no policy actions identified for  
326 either physical or social opportunity. The COM-B model goes onto identify reflective motivation  
327 (including self-conscious intentions and making evaluations) and automatic motivation (including  
328 emotional responses, impulses, and inhibitions). Both reflective and automatic motivation can be  
329 increased using multiple approaches from the BCW. The majority of the Foresight variables across  
330 several domains (diet, physical activity, diet, economic, physiology) were related to either reflective  
331 or automatic motivation. We identified numerous gaps in the coverage of policy actions to target  
332 these Foresight variables, with less than half having any actions. In particular, there were few policy  
333 actions relating to motivation for the following Foresight variables: stress, food advertising, self-  
334 esteem, demand for indulgence, tendency to graze, and market price of food.

335

336 Looking across the components in COM-B and the Foresight variables, the most common policy  
337 approach (as per the BCW) that we identified was education, along with a focus on guidelines  
338 targeting environmental restructuring and policies encouraging modelling opportunities (indirectly  
339 acting on the child via parent/carer behaviour change). We identified opportunities to further  
340 develop policy actions focused on enablement, persuasion, incentivisation, restriction, and coercion.  
341 For example; restriction is a possible approach for increasing physical and social opportunity, so  
342 policies based on restriction could be developed to promote physical activity (including both  
343 recreational and transport activity). Potential examples of this are restrictions on car use near  
344 schools to promote active school journeys or adding restrictions to tablets to limit their use to  
345 encourage active recreational time. Another example; since incentivisation is a possible approach for  
346 increasing reflective and automatic motivation, consideration could be given to developing policies

347 based on incentivisation in relation to the Foresight variable portion size, an example could be  
348 incentivising purchasing of smaller packaged snack foods. Together, this highlights the focus on  
349 education and indicates that there are opportunities to build upon efforts for upstream change. In  
350 particular, there are numerous opportunities for further developing policies which act via increases  
351 psychological capability, reflective motivation and automatic motivation. Strengthening policies  
352 which increase the latter, such as people's desires, emotions and inhibitions may be particularly  
353 powerful as they go beyond a reliance on people's self-conscious 'choices'.

354

355 There were a many policies addressing environmental change, with regards to both the food and  
356 physical activity environment. However, despite the UK's good record of developing evidence-based  
357 policy guidelines, implementation of guidelines (especially public health policies) has often been  
358 poor (27). A study of implementation, using the Food Environment Policy Index to map out and rate  
359 policies targeting childhood obesity in England, included a rating of implementation by experts (28).  
360 Implementation was rated highest for monitoring (of obesity, risk factors, diet), nutrient declarations  
361 on labels, access to information, availability of dietary guidelines, school food standards, and  
362 population level targets. Implementation was rated lowest for food subsidies, planning policies to  
363 encourage fruit and vegetables, and systems-based approaches. This supports our findings that  
364 upstream policies are particularly challenging to implement. A focus on strengthening existing policy  
365 recommendations to facilitate implementation, especially those targeting upstream actions, may be  
366 useful. An example of such an upstream action is the price of food which can have a huge impact on  
367 people's purchasing decisions, with less healthy foods typically costing less and being consumed  
368 more by lower SES groups than healthier foods (29); a lack of activity here may result in other  
369 policies having limited influence.

370

371 The emphasis on education and the limited action targeting automatic motivation indicates a  
372 reliance on policies primarily focusing on individual level change. A recent study found that, for

373 addressing obesity, governments from developed countries tended to concentrate on policy levers  
374 addressing individual-level change rather than the environment, even in countries (such as England)  
375 with a strong policy focus on childhood obesity (19). A recent systems-mapping exercise examined  
376 how local authorities in England address obesity using the 'Action Mapping Tool' (18). Consistent  
377 with our findings, this work found that whilst only a small proportion of the causes of obesity were  
378 coded as 'individual lifestyle factors', nearly 60% of the actions around obesity targeted individuals.  
379 This suggests that an individual-orientated approach is a common theme throughout both national  
380 and local obesity policy. Interventions based only on individual choice have limitations. They require  
381 families to perceive change as important and be in a position to make such changes. This is likely to  
382 be challenging for many families but particularly difficult in families from lower SES backgrounds;  
383 this may act to further widen the health inequalities apparent with obesity (30). A recent review  
384 indicated that all intervention types risk widening health inequalities but complex interventions  
385 which are targeted at multiple levels (systems, community, individual) and in multiple settings  
386 (school, health, population) appear to have less negative effects, and fiscal measures may even bring  
387 benefits (31). Successive UK governments' policies highlight obesity as a serious problem; however  
388 there is a political tension between state and individual responsibility. Health choices are assumed  
389 to be the individual's responsibility to control even though the behaviours leading to excess weight  
390 gain are acknowledged to be greatly influenced by the environment (32). Consistent with the  
391 findings in the current study, previous government policy documents have focused on information  
392 provision to change behaviour (33). One example comes from an analysis of the pledges within the  
393 Public Health Responsibility Deal which found that most pledges focused on providing information  
394 for consumers, rather than structural changes (e.g. reformulation) (34). Consumer views echo this,  
395 with analyses of online reactions to news stories about obesity policy finding either contradictory  
396 views around responsibility (35, 36) or that blame is attributed to the individual (37, 38). This  
397 discourse is at odds with the evidence for the important role of environmental factors in  
398 contributing to obesity (39). Of note, a greater emphasis on restricting of unhealthy food advertising

399 was observed with the mapping of COP2 policy actions suggesting a move to more upstream action.  
400 The recently published policy paper 'Tackling obesity: empowering adults and children to live  
401 healthier lives' (40) was prompted by increasing evidence of a link between obesity and severity of  
402 COVID-19 symptoms (41). A combination of individual level approaches (a weight management  
403 campaign and expansion of NHS obesity services) and environmental measures (such as legislation  
404 for calorie labelling and greater advertising restrictions) are outlined (40).

405

#### 406 Strengths and limitations

407 This study systematically identified national policies on childhood obesity using an authoritative  
408 system analysis of risk factors for obesity (Foresight) and took a behavioural science approach to first  
409 describe risk factors and policies, and then to conduct mapping work. We believe that this is the first  
410 time that a comprehensive mapping of obesity policies has been conducted using this approach. This  
411 allowed behavioural targets and policies to be systematically described in detail, allowing the  
412 identification of gaps and opportunities for further policy development. These gaps and  
413 opportunities were specifically characterised (according to the type of intervention, the method and  
414 the target) providing explicit information to inform the strengthening of current policy and future  
415 policy development. The work has potential to be built on and could be applied at a local level and  
416 used to inform needs assessments.

417

418 Our work is subject to a number of limitations. England is a populous country with high childhood  
419 obesity levels and a history of strong public health actions on obesity, thus findings are not  
420 necessarily generalisable to other countries. We focused on national-level policy and recognise that  
421 in most countries, including England, local or community policy actions may also be in place. We  
422 were unable here to include policy activity by the 152 upper-tier local authorities in England, but the  
423 approach used in the current study could be applied in that context. We included policy within  
424 primary schools, whilst this allowed us to capture actions directed at 4-5 year old children, this may

425 have detracted from the early years focus. This analysis recorded actions and recommendations, not  
426 how well they were being implemented, which was beyond the scope of the study. Estimating the  
427 expected impact of policy actions on behaviour and weight was also beyond the scope of this work  
428 but could be useful since the number of policies available does not necessarily correspond to their  
429 expected impact. In particular, insight into the implementation of NICE guidelines would be useful,  
430 especially for public health guidelines where there may not be the same accountability as the clinical  
431 guidelines, which are included in service commissioning processes. Tools to support implementation  
432 include the Food EPI, an established method using expert consensus to provide policy ratings and  
433 identifies gaps and policy priorities (28) and surveillance plans (19). The Foresight systems map was  
434 used to identify risk factors for childhood obesity as it is a comprehensive review of the evidence;  
435 however it was developed in 2007 so may not capture recent research. In addition, this is a fast  
436 moving field, the Childhood Obesity Plan (Chapter 3) was published as part of the Prevention Green  
437 Paper after the mapping work was completed and therefore not included (42), neither was the  
438 most recent policy paper addressing obesity (40). There is also considerable interest in the role  
439 of the pre-conception period for later obesity risk (43); however, the life-course stage for this work  
440 was restricted to pregnancy and early life to ensure that the study was feasible. The policy scoping  
441 was done via online searches, it is possible that there are additional policy actions not identified with  
442 this approach.

443

#### 444 **Conclusions**

445 This work generated a systematic map of current national government policy on obesity in England  
446 for the early years, with the purpose of identifying additional policy opportunities across the system.  
447 We identified a substantial amount of activity aiming to address early years obesity but scope for  
448 strengthening actions, especially upstream policies (acting on the environment and systems) and  
449 those targeting psychological factors contributing to obesity (stress, self-esteem, use of food for  
450 non-nutritive purposes). It is important to further consider implementation and likely impact of

451 policy action. We found that using the COM-B model and BCW was useful for characterising the risk  
452 factors and existing policies, allowing for a detailed exploration of the current policy landscape and  
453 identification of gaps.

454

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457

#### 458 **S1 Supporting information File**

459 Contains information relating to the searches and coding

460

461

462



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