



# Chapter 13

## Baseline and Impact Results

**Krystallia Mantziki, Achilleas Vassilopoulos, Gabriella Radulian, Jean-Michel Borys, Hugues Ruault du Plessis, Maria João Gregório, Pedro Graça, Stefaan de Henauw, Svetoslav Handjiev, Tommy LS Visscher, Carry M. Renders, Jacob C Seidell**

### 1. Baseline results

A total of 1266 children and their families were included in the EPHE evaluation study. In all samples boys and girls represented almost 50% each and the average age of the participant children was 7 (SD:0.9) years old. The response rate was more than 85% in all countries, excluding the Netherlands where the response rate was 65%.

Given the large variation of identified differences per country, we focus on discussing the statistically significant differences in the samples.

#### 1.1. Inequalities in energy balance-related behaviours

Children of the high education groups consumed fruit significantly more frequently during the week than their peers from the low education group. Vegetable consumption was also higher for the high education group in some countries (table 1).

Table 1. Inequity gaps in energy balance-related behaviours at baseline ( $T_0$ ) per country.

| Behaviour component                   | Country | Belgium | Bulgaria | France | Greece | Portugal | Romania | The Netherlands |
|---------------------------------------|---------|---------|----------|--------|--------|----------|---------|-----------------|
| Dietary intake                        |         |         |          |        |        |          |         |                 |
| Fruit consumption                     |         | -       | -        | -      | -      | +        | +       | +               |
| Cooked vegetables consumption         |         | -       | -        | -      | -      | +        | +       | -               |
| Salad/grated vegetables consumption   |         | -       | -        | -      | -      | +        | -       | -               |
| Fluid intake                          |         |         |          |        |        |          |         |                 |
| Water consumption                     |         | -       | -        | -      | -      | -        | -       | -               |
| Fruit juices frequency (weekly)       |         | -       | -        | -      | -      | -        | +       | -               |
| Fruit juices amount (ml)              |         | +       | +        | -      | -      | -        | +       | +               |
| Soft drinks frequency (weekly)        |         | -       | -        | -      | -      | +        | +       | -               |
| Soft drinks amount (ml)               |         | -       | -        | -      | -      | +        | +       | -               |
| Screen exposure                       |         |         |          |        |        |          |         |                 |
| TV watching week days (h/day)         |         | +       | -        | +      | +      | +        | +       | -               |
| TV watching weekend days (h/day)      |         | +       | -        | +      | -      | +        | -       | -               |
| Computer playing week days (h/day)    |         | +       | +        | -      | -      | -        | -       | -               |
| Computer playing weekend days (h/day) |         | +       | +        | -      | -      | -        | +       | -               |
| Total screen time (weekly)            |         | +       | +        | +      | +      | +        | -       | -               |
| Sleep                                 |         |         |          |        |        |          |         |                 |
| Sleep hours week days                 |         | -       | -        | -      | -      | +        | +       | +               |
| Sleep hours weekend days              |         | -       | -        | -      | -      | -        | -       | +               |

+: Identified inequity between low and high education groups  
 -: No inequity identified between low and high education groups

With regard to fruit juices and soft drinks consumption, differences between the high and low education groups were observed mainly in the amount consumed (table 1). Children with mothers of low education in all countries were more likely to have a higher amount (in ml) of intake when they drank fruit juices/soft drinks; though statistical significance varied at country-level and was not found in all countries. With regard to the frequency of drinking fruit juices it was observed that in most of the communities it was higher in the low education group, although the difference was significant only for one community. Water consumption frequency was significantly higher for the low education group in two of the communities, whereas no difference was found in the rest of them (table 1).

Furthermore, for the children of the low education group in all countries higher amounts of screen time were reported, with a statistically significant difference between the two groups in the majority of the participant countries. A noteworthy finding is the amount of time spent watching TV during the week, which was higher for the low education group in all countries and the difference with the high education group reached statistical significance in almost all countries. Similar were the differences regarding the time spent watching TV in weekend days, reaching statistical significance in some of the samples (table 2). Computer time was significantly higher for the low education group in a few samples during weekdays and weekend days as well. There was also disparity between the groups in terms of sleep duration in two countries, indicating that children of the high education group were sleeping more hours.

## 1.2. Inequalities in determinants of dietary intake

*All results of inequity gaos between low and high education groups in determinants are reported in table 2.*

### 1.2.1. Social environment

In some of the communities parental practices related to fruit and vegetable consumption differed significantly between the low and high education groups, indicating that the high education groups had better practices. Specifically, high educated parents asked their child more frequently to eat fruit (parental demand), allowed their child to consume fruit and vegetables more often and cut-up/served fruit and vegetables more often than the low educated parents. Differences in other social environmental determinants (eating fruit/vegetables together with the child, parental knowledge on recommendations) were rare.

### 1.2.2. Physical environment

The availability of fruit and/or vegetables at home was more frequent reported by parents of the high education group of most countries, although statistical significance was reached for only some of them. On the other hand, having the habit of eating vegetables daily differed between low and high education groups only in one country.

**Table 2. Inequity gaps between low- and high-education groups in determinants –related to the four EPHE themes– of the social and physical environment of the child for each country, in a nutshell.**

| Country  | Significant Inequity gaps at T <sub>0</sub> per behaviour  |  |  |
|----------|--|--|--|
|          | Dietary intake   | Fluid intake   | Screen exposure  |
| Belgium  | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Availability</b> of fruit at home</li> </ul> | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Parental allowing</b> for consuming fruit juices</li> </ul>   | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>• TV <b>available</b> in child's bedroom</li> <li>• Having <b>TV on</b> during mealtime</li> <li>• <b>Monitoring</b> the time the child watches</li> <li>• TV Parents <b>watching TV together</b> with the child</li> </ul> <p><i>PC exposure</i></p> <ul style="list-style-type: none"> <li>• Child <b>nagging</b> when computer playing is forbidden</li> <li>• <b>Parents playing</b> computer games/<b>using</b> computer <b>together</b> with the child</li> </ul> |
| Bulgaria | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Allowing</b> fruit consumption</li> </ul>    | <p><i>Soft drinks consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Availability</b> of soft drinks at home</li> </ul>   | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>• TV <b>available</b> in child's bedroom</li> </ul> <p><i>PC exposure</i></p> <ul style="list-style-type: none"> <li>• <b>Parents playing</b> computer games/<b>using</b> computer <b>together</b> with the child</li> </ul>  |
| France   |  | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>• Child <b>nagging</b> when drinking fruit juices is forbidden</li> <li>• Parental <b>efficacy</b> to <b>retain rules</b> related to child's intake</li> </ul> <p><i>Soft drinks consumption</i></p> <ul style="list-style-type: none"> <li>• Child <b>nagging</b> when drinking soft drinks is forbidden</li> </ul> | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>• <b>Negotiate</b> for allowed time to watch TV</li> <li>• Parents <b>watching TV together</b> with the child</li> </ul> <p><i>PC exposure</i></p> <ul style="list-style-type: none"> <li>• Child <b>nagging</b> when computer playing is forbidden</li> </ul>  |

| Country  | Significant Inequity gaps at T <sub>0</sub> per behaviour  |   |  |
|----------|--|---|--|
| Greece   | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Habit</b> to eat fruit every day</li> </ul> <p><i>Vegetable consumption</i></p> <ul style="list-style-type: none"> <li>• Parental <b>knowledge</b> on vegetable <b>recommendations</b></li> </ul>  | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Negotiating</b> about the amount of fruit juices the child is allowed to drink</li> </ul>  | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>• Having <b>TV on</b> during mealtime</li> <li>• <b>Parental efficacy</b> to forbid TV watching</li> </ul>  |
| Portugal | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>• Fruit <b>availability</b> at home</li> <li>• <b>Eat fruit together</b> with the child</li> </ul> <p><i>Vegetable consumption</i></p> <ul style="list-style-type: none"> <li>• Parental <b>knowledge</b> on <b>vegetable</b> recommendations</li> <li>• Parental <b>allowance</b> to eat vegetables</li> <li>• <b>Facilitating</b> vegetable consumption</li> <li>• Vegetable <b>availability</b> at home</li> </ul> | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>• Giving fruit juices as <b>reward</b> or to <b>comfort</b> child</li> </ul> <p><i>Soft drinks consumption</i></p> <ul style="list-style-type: none"> <li>• Communicating <b>health belief</b> regarding soft drinks consumption</li> <li>• <b>Availability</b> of soft drinks at home</li> <li>• <b>Drinking</b> soft drinks <b>together</b> with the child</li> <li>• Child <b>nagging</b> when drinking soft drinks is forbidden</li> </ul>                                      | <p><i>Screen exposure</i></p> <ul style="list-style-type: none"> <li>• Parental <b>allowance</b> for TV watching</li> <li>• <b>Reward</b> child by allowing TV watching</li> <li>• Child <b>nagging</b> for TV</li> <li>• <b>TV available</b> in child's bedroom</li> <li>• Having <b>TV on</b> during mealtime</li> </ul>   |
| Romania  | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Facilitating</b> fruit consumption</li> <li>• Fruit <b>availability</b> at home</li> </ul> <p><i>Vegetable consumption</i></p> <ul style="list-style-type: none"> <li>• Vegetable <b>facilitation</b></li> <li>• Vegetable <b>availability</b> at home</li> </ul>  | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>• <b>Monitoring</b> child's fruit juice consumption</li> <li>• Parental <b>efficacy</b> to forbid fruit juices consumption</li> </ul> <p><i>Soft drinks consumption</i></p> <ul style="list-style-type: none"> <li>• Parental <b>allowance</b> for soft drinks consumption</li> <li>• Avoid <b>drinking</b> soft drinks in <b>presence</b> of child</li> <li>• <b>Drinking</b> soft drinks <b>together</b> with child</li> <li>• Soft drinks <b>availability</b> at home</li> </ul> | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>• <b>Watching TV together</b> with the child</li> <li>• <b>TV available</b> in child's bedroom</li> <li>• Parental <b>allowance</b> for TV watching</li> <li>• <b>Negotiating</b> for the time allowed to watch TV</li> </ul> <p><i>PC exposure</i></p> <ul style="list-style-type: none"> <li>• <b>Negotiating</b> for the time allowed to use the computer/play computer games</li> </ul> |

| Country                      | Significant Inequity gaps at T <sub>0</sub> per behaviour  |  |  |
|------------------------------|--|--|--|
| The Netherlands <sup>a</sup> | <p><i>Fruit consumption</i></p> <ul style="list-style-type: none"> <li>Parental <b>demand</b> for fruit consumption</li> </ul> <p><i>Vegetable consumption</i></p> <ul style="list-style-type: none"> <li><b>Facilitating</b> vegetable consumption</li> <li><b>Habit</b> to eat vegetables every day</li> </ul> | <p><i>Fruit juices consumption</i></p> <ul style="list-style-type: none"> <li>Parental <b>efficacy</b> to forbid fruit juices consumption</li> <li>Giving fruit juices as <b>reward</b> or to <b>comfort</b> the child</li> <li>Child <b>nagging</b> when fruit juices consumption is forbidden</li> </ul> | <p><i>TV exposure</i></p> <ul style="list-style-type: none"> <li>TV <b>available</b> in the child's bedroom</li> <li><b>Monitoring</b> the <b>time</b> child is watching TV</li> <li>Parental <b>allowance</b> for TV watching</li> <li><b>Avoid watching TV</b> in presence of the child</li> </ul> <p><i>PC exposure</i></p> <ul style="list-style-type: none"> <li><b>Negotiate</b> about the allowed time of computer playing</li> <li>Parent <b>avoiding to use computer/playing computer games</b> in presence of the child</li> </ul> |

### 1.3. Inequalities in determinants of fluid intake

#### 1.3.1. Social environment

In all the samples there were parental rules related to fruit juices/soft drinks consumption that differed significantly between the low and high education groups, indicating stronger rules for the high education groups. Referring to other social environmental determinants, higher frequency of trying to drink fruit juices/soft drinks when intake was prohibited (nagging) was reported for children of low educated mothers, while low educated mothers were drinking soft drinks together with their child (perform energy-balance related behaviour together) more often than the highly educated ones.

#### 1.3.2. Physical environment

Availability of soft drinks at home was more frequent for the children of the low educated groups. The differences between the low and high education groups with regard to the situations of habitual intake for fruit juices, soft drinks and water were scattered across the countries (additional file).

### 1.4. Inequalities in determinants of screen exposure

#### 1.4.1. Social environment

Parental rules related to TV and computer exposure differed commonly between the two education groups in nearly all countries, illustrating better efficiency of the high educated parents. The low educated mothers seemed to negotiate more often the time allowed spending in screens, to allow screen occupations more often and

to monitor the time their child spends in TV less frequently compared to the high educated mothers. Furthermore, the majority of the low educated groups reported watching television with their children more frequently than the respective high educated groups, although statistical significance was not reached in all the samples. Moreover, children from the low education group were more likely to try playing computer games when it was forbidden (nagging), compared to their peers from the high education group. Finally, parents with low education reported playing computer games together with their child more frequently than the ones with high education.

### **1.4.2. Physical environment**

The majority of low education groups, reported having the television on during meal time significantly more frequently than the high education group. More children of low educated mothers had television in their bedroom than their peers of highly educated mothers. This difference was significant in almost all countries (ad. File 5).

## **1.5. Results after multiple testing adjustments**

Adjustments for multiple testing resulted in critical p-values lower than 0.05, as initially set by the authors. Consequently, less of the differences found within the education groups of each of the samples (based on  $\alpha=0.05$ ) were significant based on the adjusted lower threshold. As an illustration, the statistically significant differences between the two groups in the total sample analysis were initially 44 and after the adjustments these were 41. These results are available in the additional file 6 attached to the publication.

## **2. Interventions tailored to the needs of the low socio economic groups**

Based on the baseline measurements, the EPHE communities developed community-based interventions tailored to the needs of their low socio-economic group. These interventions are described in the previous chapters describing all the programmes involved.

## **3. Results after the interventions and a year after**

A total of 1061 children and their families were followed-up in the intermediate ( $T_1$ ) and 921 in the final measurements ( $T_2$ ). The overall loss to follow-up per country at  $T_1$  ranged from 1% to 50%, whereas it increased at  $T_2$  (ranging from 15% to 46.5%). Table x illustrates the dropout per education group, which was higher in the low education in nearly all countries in both follow-up periods.

At this stage of the EPHE evaluation study the aim was to assess whether there were improvements within the low and within the high education groups after the EPHE

interventions and if the potential improvements were maintained after a year after the interventions. Therefore changes between baseline ( $T_0$ ) and the time after the interventions were assessed within each of the low and high education groups, in the variables where inequality gaps were identified at baseline. Finally, the identified changes were assessed for their sustainability by comparing the measurements at  $T_1$  with the ones at  $T_2$ .

Given the large amount of data, here the statistically significant changes within the groups are presented and discussed.

### 3.1. Changes in energy balance-related behaviours

Changes in behaviours related to inequality gaps as identified at baseline within both the low and the high educational groups were observed, although they were small and often not significant.

More specifically, fruit frequency increased significantly within the Dutch low education group (table 3), reaching the same frequency as the high education group. Similarly fruit juices' amount decreased significantly within the Romanian low education group (table 4), despite the small difference observed. Moreover computer time both during weekdays and during weekend days increased significantly within the Bulgarian high education group, resulting in higher screen exposure during the week. In the Romanian sample, computer time during weekends increased as well, however within the low education (table 3). A notable finding was the decreased TV time during week days among the participants of the Belgian low education group (table 3), which was sustained a year after the interventions (table 5).

**Table 3. Changes in energy balance-related behaviours from  $T_0$  to  $T_1$  within levels of education per country.**

| Country         | Variable                              | Education group | Direction of change |
|-----------------|---------------------------------------|-----------------|---------------------|
| Belgium         | TV time on weekdays (h/day)           | High            | ↑                   |
|                 | Computer time on weekend days (h/day) | High            | ↑                   |
| Bulgaria        | Total screen time                     | High            | ↑                   |
|                 | Computer time on weekdays (h/day)     | High            | ↑                   |
| Romania         | Fruit juices amount (ml)              | Low             | ↓                   |
|                 | Computer time on weekend days (h/day) | Low             | ↑                   |
| The Netherlands | Fruit consumption                     | Low             | ↑                   |

\*Non-presented results showed no changes related to the inequity gaps identified at baseline.

**Table 4. Changes in determinants of energy balance-related behaviours from T<sub>0</sub> to T<sub>1</sub> within levels of education per country.**

| Country         | Variable  | Education group | Direction of change |
|-----------------|---|-----------------|---------------------|
| Belgium         | Parental allowance for fruit juices drinking                      | Low             | ↓                   |
|                 | Monitoring child's TV exposure                                    | Low             | ↑                   |
| France          | Child nagging to drink soft drinks                                | High            | ↑                   |
|                 | Parental negotiation for allowed time of TV watching              | High            | ↑                   |
| Greece          | Parental negotiation for allowed amount of consuming fruit juices | Low             | ↓                   |
|                 | Parental efficacy to manage child's TV exposure                   | Low             | ↑                   |
| Romania         | Parents watching TV together with child                           | High            | ↓                   |
|                 | Avoid drinking soft drinks in child's presence                    | Low             | ↓                   |
| Portugal        | Rewarding/comforting child by giving fruit juices                 | Low             | ↓                   |
|                 | Soft drinks availability at home                                  | Low             | ↓                   |
| The Netherlands | Parental allowance for TV watching                                | Low             | ↓                   |
|                 | Avoid using the computer in child's presence                      | Low             | ↓                   |

\*Non-presented results showed no changes related to the inequity gaps identified at baseline.

**Table 5. Sustainability of improved energy balance-related behaviours from T<sub>1</sub> to T<sub>2</sub> within the low-education groups per country.**

| Country         | Variable                             | Sustained improvement Yes/No |
|-----------------|--------------------------------------|------------------------------|
| Belgium         | TV time on weekdays (h/day)          | Yes                          |
| Romania         | Fruit juices amount (ml)             | No                           |
| The Netherlands | Fruit consumption (weekly frequency) | No <sup>a</sup>              |

\*Non-presented results showed no changes related to the inequity gaps identified at baseline.  
<sup>a</sup>The decrease in fruit consumption between T<sub>1</sub> and T<sub>2</sub> was not statistically significant; the statistical power of the test was very low.

### 3.2. Changes in determinants of energy balance-related behaviours

Similarly to the behavioural changes, we found a few significant changes related to inequality gaps identified at baseline in the determinants of the assessed behaviours, within the low and within the high education groups in all countries.

In particular, parental practices related to fruit juices consumption noted improvement within the low education group in Belgium, Greece and Portugal (table 4). The latter one was sustained a year after the interventions (table 6). For the determinants of soft drinks consumption the observed effects were mixed (table 4). A worth mentioning change in Portugal showed decreased home availability among the low education group; this decrease was maintained at T2 (table 6).

More changes in determinants of screen exposure were observed. More specifically, parental practices and rules improved within the low education groups, with exemption the negative modelling of Dutch low educated mothers for using the computer (table 4). As shown in table 6, some of those changes within the low education group were sustained a year after the EPHE interventions.

**Table 6. Sustainability of improved determinants from T<sub>1</sub> to T<sub>2</sub> within the low-education groups per country.**

| Country         | Variable  | Sustained improvement Yes/No |
|-----------------|---|------------------------------|
| Belgium         | Parental allowance for fruit juices drinking                      | No <sup>a</sup>              |
|                 | Monitoring child's TV exposure                                    | Yes                          |
| Greece          | Parental negotiation for allowed amount of consuming fruit juices | No                           |
|                 | Parental efficacy to manage child's TV exposure                   | Yes                          |
| Portugal        | Rewarding/comforting child by giving fruit juices                 | Yes                          |
|                 | Soft drinks availability at home                                  | Yes                          |
| The Netherlands | Parental allowance for TV watching                                | No <sup>a</sup>              |
|                 | Avoid using the computer in child's presence                      | Yes <sup>b</sup>             |

\*Non-presented results showed no changes related to the inequity gaps identified at baseline.

<sup>a</sup>The change between T<sub>1</sub> and T<sub>2</sub> was small and not statistically significant.

<sup>b</sup>Low statistical power of the test.

## 4. Discussion

### 4.1. Before interventions

The EPHE evaluation study showed that children from seven European communities of relatively high socio-economic status consumed fruits and/or vegetables more frequently than their peers of low socio-economic status. In addition, the latter group of children had a higher intake of fruit juices and/or soft drinks and had higher screen time. It is important to note that increased screen time found among children from lower socio-economic status is attributed to television watching, rather than computer activity. Similarly, important differences between the two socio-economic groups were observed in the determinants of the social and physical family-environment of the child. In all countries, parental rules and home availability (of fruit, vegetables, soft drinks and availability of TV in the child's bedroom) were consistently different between the two socio-economic groups; although a common pattern for the determinants in all behaviours was not found. This indicates the importance of the family environment, related to socio-economic inequalities in childhood obesity. In addition, the differences in the determinants varied to a large extent across countries, illustrating country-specific inequalities. This heterogeneity in inequalities is confirmed in other studies as well (1, 2).

The baseline results of our study are compatible with other studies across European countries which also demonstrate that children from lower socio-economic status have unhealthier dietary habits (2-7) and increased sedentary behaviour (8, 9) compared to their high socio-economic status peers. Although various studies showed that family environmental determinants have been associated with dietary intake, consumption of sugary beverages and sedentary lifestyle, little is known about socio-economic disparities in these associations. Papoutsi et al, after reviewing multi-disciplinary literature to identify the determinants of childhood obesity, concluded, among others, that *the shared environment created by parents, affects children's choices and eventually their body weight outcomes* (10). Related evidence demonstrates that parental rules and/or accessibility at home are significantly associated with energy balance-related behaviours, such as screen time, intake of sugary drinks and fruit and vegetable consumption (5, 11, 12). The increased accessibility of fruits and vegetables—measured in terms of home availability, parental facilitation and allowance—have been shown to mediate adolescents' intake (13-15). On the other hand, the presence of screens in the child's bedroom has been associated with higher adiposity in preadolescents and lower sleep efficiency [16], while it contributes to the excess of the screen time (16, 17). Accordingly, we consider that parental rules and practices and home availability are crucial to be addressed in interventions aiming to decrease inequalities in childhood obesity. Therefore, each of the EPHE programmes was advised to focus their interventions—which lasted for 4-6 months—on improving family-environmental determinants related to inequalities identified in their communities.

## 4.2. After interventions

The measurements after the EPHE interventions showed that in some communities some of the unfavourable behaviours and determinants were improved in both low and high socio-economic groups. These positive changes contradict the commonly observed phenomenon that public health interventions may result to differential effects across population groups and thus they may increase inequalities, despite of being effective to the general population (18-23). This phenomenon is defined as the “intervention-generated inequality”, meaning that the groups/populations mostly in need for health care are the least likely to benefit from it (18-21). Although in our intermediate measurements (exactly after the interventions) some new inequality gaps were identified (results not shown), these may be explained by the reduction of the samples due to lost to follow-up and thus could be inequalities that were not identified at baseline.

## 4.3. Evolution of inequalities in energy-balance related behaviour and family environmental determinants

Overall, the differences between low and high socio-economic groups in energy balance-related behaviours and family-related determinants were statistically significant but not large. Similarly, a few statistically significant and usually small changes were observed between baseline and after the interventions period within the low socio-economic groups and even less were sustained a year after. The duration of the intervention period was probably too short and consequently the intensity of the interventions low, due to the time constraints, to result in sustainable behaviour change. Acknowledging that behavioural change occurs after long-term sustainable interventions and endorsing evidence from recent systematic reviews, which shade light into effective strategies in reducing obesity-related inequalities, our results could be explained. In particular, the conclusions by Magneé *et al* and the recommendations of Hillier-Brown *et al* 2014b, suggest respectively that, long-term, multi-component and multi-level interventions, being embedded in ongoing structures and involving different settings have the most potential to reduce inequalities in obesity-related outcomes (19, 23). Worth mentioning the Fleurbaix – Laventie Ville Sante´ study, based on the EPODE methodology, which showed a reduction in obesity prevalence in the intervention lower socio-economic group compared to the respective control group only after conducting 12 years of community-based interventions (24).

## 4.4. Strengths and Limitations

To our knowledge, this is the first evaluation study that provides data on socio-economic inequalities in family-environmental determinants associated with energy-balance related behaviours. The cross-cultural character of the sample enables the exploration of inequalities in factors that have been highly associated with childhood obesity, across different European countries. Hence the opportu-

nity to enhance insight of health inequalities is given, particularly in the European region where the socio-economic factors are changing rapidly over time. Also there is the prospect to sensitize communities with respect to socio-economic inequalities in childhood obesity and overweight. In addition, our results give new insight into energy-balance behaviours and their determinants, which should be the focus for the development of effective interventions aimed at reducing inequalities in childhood obesity. Another strength of this study is the high response rate achieved in almost all countries and successful commitment of the target groups.

For the purposes of the EPHE evaluation study, the participant programmes were selected on the basis of implementing the EPODE or EPODE-like methodology. At this point it should be clarified that the interventions implemented within the EPHE project were new and specifically focused at the selected behaviours and determinants to reduce health inequalities. Similar to the programme selection, it was a prerequisite for the participant city to be already engaged in an EPODE structure. The schools from which the samples were recruited were selected based on accessibility and convenience criteria. These schools were also chosen due to a limited time-frame. Hence, one limitation of this study is that sampling bias is likely present at many levels and our samples may not be representative of each country's population.

In addition the population of middle socio-economic status was divided among the population of high and low socio-economic status; thus the ability to detect big differences among the cohorts might be hindered. Another weakness of this study could be that we used the educational level of the mother as a proxy for socio-economic status, instead of using more indicators. Although, parental education level has been characterised as an adequate socio-economic indicator by relevant and more elaborative studies (1, 25, 26), this still reduces the strength of detecting absolute inequalities. It is important to mention that the power of the associations observed is decreased, due to loss-to follow-up.

Moreover, the data were self-reported and recall bias and/or socially desirable answers are possible. Furthermore, errors from the constructed items are possible, given that they were not validated. Considering that the family environmental correlates are assessed mostly by one item each, the reliability of the instrument may be violated (6). Finally, this is an effect evaluation and thus conclusions on the quality of the interventions that were carried out cannot be drawn.

## 5. Conclusions

Our study indicates socio-economic inequalities in factors strongly related to childhood obesity and overweight and provides evidence for those in seven European communities. These findings are indicative of socio-economic inequalities in our samples, but the variability across the countries was large. Inequalities in family environmental determinants, such as parental rules and availability of fruit, vegetables,

soft drinks, and screens in the personal space of the child should be studied in the country level, considering the importance of changing parental rules and practices. Finally, monitoring of interventions and process evaluation are crucial to understand the observed results.

## References

1. BAMMANN K GW, LANFER A, BARBA G, DE HENAUW S, EIBEN G, FERNANDEZ-ALVIRA JM, KOVÁCS E, LISSNER L, MORENO LA, TORNARITIS M, VEIDEBAUM T, PIGEOT I; IDEFICS CONSORTIUM.: Socioeconomic factors and childhood overweight in Europe: results from the multi-centre IDEFICS study. *Pediatric Obesity* 2013, 8(11):1-12.
2. VERECKEN CA, INCHLEY J, SUBRAMANIAN SV, HUBLET A, MAES L: The relative influence of individual and contextual socio-economic status on consumption of fruit and soft drinks among adolescents in Europe. *Eur J Public Health* 2005, 15(3):224-232.
3. TIFFIN R, SALOIS M: Inequalities in diet and nutrition. *Proc Nutr Soc* 2012, 71(1):105-111.
4. VAN DER HORST K, PAW MJ, TWISK JW, VAN MECHELEN W: A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc* 2007, 39(8):1241-1250.
5. ELINDER LS, HEINEMANS N, ZEEBARI Z, PATTERSON E: Longitudinal changes in health behaviours and body weight among Swedish school children--associations with age, gender and parental education--the SCIP school cohort. *BMC Public Health* 2014, 14:640.
6. VAN STRALEN MM, TE VELDE SJ, SINGH AS, DE BOURDEAUDHUIJ I, MARTENS MK, VAN DER SLUIS M, MANIOS Y, GRAMMATIKAKI E, CHINAPAW MJ, MAES L et al: European Energy balance Research to prevent excessive weight Gain among Youth (ENERGY) project: Design and methodology of the ENERGY cross-sectional survey. *BMC Public Health* 2011, 11:65.
7. LORSON BA, MELGAR-QUINONEZ HR, TAYLOR CA: Correlates of fruit and vegetable intakes in US children. *J Am Diet Assoc* 2009, 109(3):474-478.
8. FAIRCLOUGH SJ, BODDY LM, HACKETT AF, STRATTON G: Associations between children's socioeconomic status, weight status, and sex, with screen-based sedentary behaviours and sport participation. *Int J Pediatr Obes* 2009, 4(4):299-305.
9. FERNANDEZ-ALVIRA JM, TE VELDE SJ, DE BOURDEAUDHUIJ I, BERE E, MANIOS Y, KOVACS E, JAN N, BRUG J, MORENO LA: Parental education associations with children's body composition: mediation effects of energy balance-related behaviors within the ENERGY-project. *Int J Behav Nutr Phys Act* 2013, 10:80.
10. PAPOUTSI GS, DRICHOUTIS AC, NAYGA RM: THE CAUSES OF CHILDHOOD OBESITY: A SURVEY. *Journal of Economic Surveys* 2013, 27(4):743-767.
11. VERLOIGNE M, VAN LIPPEVELDE W, MAES L, BRUG J, DE BOURDEAUDHUIJ I: Family- and school-based correlates of energy balance-related behaviours in 10-12-year-old children: a systematic review within the ENERGY (European Energy balance Research to prevent excessive weight Gain among Youth) project. *Public Health Nutr* 2012, 15(8):1380-1395.
12. VAN LIPPEVELDE W, TE VELDE SJ, VERLOIGNE M, DE BOURDEAUDHUIJ I, MANIOS Y, BERE E, JAN N, FERNANDEZ-ALVIRA JM, CHINAPAW MJ, BRINGOLF-ISLER B et al: Associations between home- and family-related factors and fruit juice and soft drink intake among 10- to 12-year old children. The ENERGY project. *Appetite* 2013, 61(1):59-65.
13. HILSEN M, VAN STRALEN MM, KLEPP KI, BERE E: Changes in 10-12 year old's fruit and vegetable intake in Norway from 2001 to 2008 in relation to gender and socioeconomic status - a comparison of two cross-sectional groups. *Int J Behav Nutr Phys Act* 2011, 8:108.
14. BERE E, VAN LENTHE F, KLEPP KI, BRUG J: Why do parents' education level and income affect the amount of fruits and vegetables adolescents eat? *Eur J Public Health* 2008, 18(6):611-615.
15. WYSE R. ET AL: Characteristics of the home food environment that mediate immediate and sustained increases in child fruit and vegetable consumption: mediation analysis from the Healthy Habits cluster randomised controlled trial. *Int J Behav Nutr Phys Act*. 2015 Sep 17;12:118.

16. CHAPUT JP, LEDUC G, BOYER C, BELANGER P, LeBLANC AG, BORGHESE MM, TREMBLAY MS: Electronic screens in children's bedrooms and adiposity, physical activity and sleep: Do the number and type of electronic devices matter? *Can J Public Health* 2014, 105(4):e273-279.
17. SANTALIESTRA-PASIAS AM, MOURATIDOU T, VERBESTEL V, BAMMANN K, MOLNAR D, SIERI S, SIANI A, VEIDEBAUM T, MARILD S, LISSNER L et al: Physical activity and sedentary behaviour in European children: the IDEFICS study. *Public Health Nutr* 2013:1-12.
18. VANDER PLOEG KA, MAXIMOVA K, MCGAVOCK J, DAVIS W, VEUGELERS P: Do school-based physical activity interventions increase or reduce inequalities in health?. *Soc Sci Med.* 2014 Jul;112:80-7.
19. HILLIER-BROWN FC, BAMBRA CL, CAIRNS JM, KASIM A, MOORE HJ, SUMMERBELL CD: A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst children. *BMC Public Health* 2014, 14:834.
20. GRYDELAND M, BERGH IH, BJELLAND M, LIEN N, ANDERSEN LF, OMMUNDSEN Y, KLEPP KI, ANDERSSON SA. INTERVENTION EFFECTS ON PHYSICAL ACTIVITY: the HEIA study – a cluster randomized controlled trial. *Int J Behav Nutr Phys Act.* 2013 Feb 5;10:17.
21. LORENC T, OLIVER K. ADVERSE EFFECTS OF PUBLIC HEALTH INTERVENTIONS: a conceptual framework. *J Epidemiol Community Health.* 2014 Mar;68(3):288-90.
22. MCGILL R, ANWAR E, ORTON L, BROMLEY H, LLOYD-WILLIAMS F, O'FLAHERTY M, TAYLOR-ROBINSON D, GUZMAN-CASTILLO M, GILLESPIE D, MOREIRA P et al: Are interventions to promote healthy eating equally effective for all? Systematic review of socioeconomic inequalities in impact. *BMC public health* 2015, 15:457.
23. MAGNEE T, BURDORF A, BRUG J, KREMERS SP, OENEMA A, VAN ASSEMA P, EZENDAM NP, VAN GENUGTEN L, HENDRIKSEN IJ, HOPMAN-ROCK M et al: Equity-specific effects of 26 Dutch obesity-related lifestyle interventions. *American journal of preventive medicine* 2013, 44(6):e57-66.
24. ROMON M, LOMMEZ A, TAFFLET M, BASDEVANT A, OPPERT JM, BRESSON JL, BORYS JM et al. Downward trends in the prevalence of childhood overweight in the setting of 12-year school- and community-based programmes. *Public Health Nutr.* 2009 Oct;12(10):1735-42.
25. GROTH MV, FAGT S, BRONSTED L: Social determinants of dietary habits in Denmark. *Eur J Clin Nutr* 2001, 55(11):959-966.
26. FERNANDEZ-ALVIRA JM, BAMMANN K, PALA V, KROGH V, BARBA G, EIBEN G, HEBESTREIT A, VEIDEBAUM T, REISCH L, TORNARITIS M et al: Country-specific dietary patterns and associations with socioeconomic status in European children: the IDEFICS study. *Eur J Clin Nutr* 2014.