

## CASE REPORT

# Childhood obesity in Mexico: social determinants of health and other risk factors

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## SUMMARY

Approximately 50 million children and adolescents in Latin America are affected by the childhood obesity pandemic. We present the case of a 5-year-old Mexican girl with obesity and gastro-oesophageal reflux disease (GORD), in whom prenatal, lifestyle and environmental risk factors were identified. Here, we demonstrate how childhood obesity is rooted since pregnancy and the perinatal stage, and how the social determinants of health like unsafe outdoor conditions, lack of infrastructure to exercise and a suboptimal physical activity curriculum in government schools strongly influence the development and maintenance of childhood obesity and complicate management.

## CASE PRESENTATION

A 5-year-old Mexican girl was brought to the gastroenterology and nutrition department by her mother to participate in a paediatric abdominal pain clinical trial. She was diagnosed with gastro-oesophageal reflux (GORD) and obesity.

She was born by caesarean section to a 32-year-old primigravida mother at 36 weeks 5 days of gestation due to severe preeclampsia. Her weight was 3080 g and length 50 cm. The mother's pregnancy weight was 100 kg, and during pregnancy she gained 15 kg. There were no complications in the postnatal period. The mother was supplemented with folic acid and iron; she did not have infections or smoked during pregnancy. Immunisations were up to date.

## Family history

Thirty-eight year-old mother with obesity and type 2 diabetes (T2DM), under treatment with metformin. Forty-four-year-old father with T2DM, under treatment with metformin. Paternal grandmother with T2DM and paternal grandfather with hypertension.

## Nutrition history

She was exclusively breast fed for the first 2 months of life, afterwards, antireflux formula was added until 6 months of age. At 6 months of age, complementary food was initiated in conjunction with a lactose-free formula. The 24-hour diet recall diet was the following: at 7:00, yoghurt and chocolate milk; at 10:00, a sandwich and sugar-sweetened beverage (SSB)—in fact, she drank one 125 mL SSB every day at school. At 14:30, soup, bread and

meat; at 19:00 the same meal and at 22:00, a glass of milk. They denied taking vitamins. Her daily caloric requirements were 1225 kcal/day based on her ideal body weight.<sup>1</sup> However, based on the 24-hour diet recall, her caloric intake was approximately 1700 kcal/day.

## Social history

She is an only child. She lives with her mother and father in a two-bedroom apartment. The mother is a stay-at-home mom with a sedentary lifestyle. The father is a taxi driver, also with a sedentary lifestyle. Their monthly income was approximately MXN8000 (or US\$431). They did not have pets. They denied household smoking exposure. They also denied difficulty affording healthy foods. She only exercised 1 hour per week in sports class at her school; they avoided going to the park because the unsafe outdoor conditions and the park's poor infrastructure. She had a 1 hour nap every day. She went to bed at midnight every night and woke up at 7:00 to go to school. They revealed 5 hours of screen use daily—in fact, the mom watched television with her.

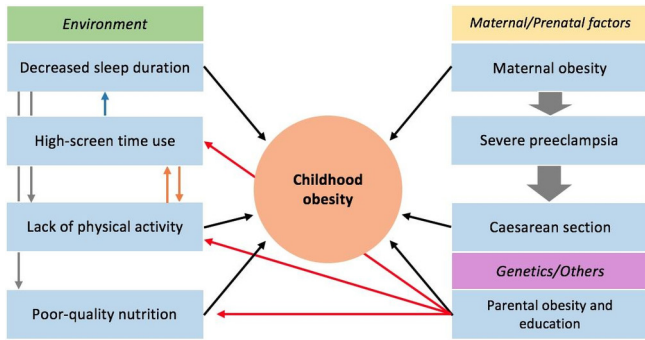
Vital signs were within normal limits. Anthropometric data were the following: weight, 29.9 kg (99th percentile); height, 121 cm (92th percentile); body mass index (BMI), 20.9 kg/m<sup>2</sup> (2 SD above the mean). The WHO growth charts were used. Body composition bioelectrical impedance analysis (InBody) revealed the following: total body water, 13.9 kg (normal); lean body mass, 3.7 kg (normal); minerals, 1.27 kg (normal) and adipose tissue, 11.00 kg (high); BMI, 20.4 kg/m<sup>2</sup> (high); body fat percentage, 36.7% (high); degree of obesity, 129% (high) and ideal body weight was 23.10 kg. Physical exam did not show abnormalities. Complete blood count, liver enzymes, liver function tests, urinalysis, fasting glucose and lipid panel were normal; stool ova and parasite exam was negative.

## Management

First, the family was motivated, educated and provided with information about childhood and adult obesity. For GORD, lifestyle changes (weight reduction and diet modification (reduction of chocolate and spicy foods)) and esomeprazole (1 mg/kg/day) were indicated. For obesity, the family was instructed to lower (or quit if possible) the consumption of SSBs, chocolate milk, candy and



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**Figure 1** Shows the main factors contributing to the patient's obesity and how they interact with each other.

refined carbohydrates and to increase fruit, vegetables, legumes and fibre; to reduce screen time to 1 hour per day of high-quality programmes; to exercise for 1 hour everyday of moderate-to-vigorous-intensity physical activity and to improve sleep hygiene to accomplish a minimum of 10 hours of good quality sleep daily.

### Two-month follow-up appointment

Weight, 31.1 kg; height, 121. Body composition bioelectrical impedance analysis revealed the following: total body water, 14.9 kg (normal); lean body mass, 4 kg; minerals, 1.34 kg and adipose tissue, 10.9 kg (high); BMI, 20.7 (2 SD above the mean); body fat percentage, 35.1% (high).

### Lifestyle modifications

She decreased candy consumption and the daily SSB but increased milk consumption (from one glass to three glasses daily). She got a bicycle and started riding it in her apartment patio, three times in the weekdays during 5 min and 30 min in the weekends. She continued to watch television 5 hours per day and continued to have the same hours of sleep per day (8 hours).

The aim of this case report is to demonstrate how childhood obesity is rooted since pregnancy and the perinatal stage, and how the social determinants of health, like unsafe outdoor conditions, lack of infrastructure to exercise and a suboptimal physical activity curriculum in government schools strongly influence the development and maintenance of childhood obesity and complicate management [figure 1](#).

### GLOBAL HEALTH PROBLEM LIST

- ▶ The childhood obesity pandemic and its short- and long-term consequences;
- ▶ Maternal and prenatal factors as contributing factors for the development of childhood obesity;
- ▶ Social determinants of health, environmental and lifestyle factors are strongly associated with childhood obesity;
- ▶ Treatment of childhood obesity becomes even more complex when considering the social determinants of health in Mexico.

### GLOBAL HEALTH PROBLEM ANALYSIS

#### Childhood obesity pandemic and its short and long-term consequences

To talk about childhood obesity, one must first define it. By using the WHO growth charts, childhood obesity is defined as weight for height greater than 3 SD above median in the 0 to 5-year-old age group; and in the 5 to 19-year-old age group, as a BMI for age greater than 2 SD above the mean.<sup>2</sup> In the case of our

patient, obesity was a clear diagnosis based on anthropometric and body composition bioelectrical impedance analysis data. Although the patient is growing proportionally in weight and height, the strong family history of obesity and type 2 diabetes mellitus (T2DM) places her at increased risk of developing these comorbidities and being obese later in life. Therefore, we aimed for weight reduction and family-centred lifestyle modifications; however, they were poorly accomplished.

A recent systematic review estimated that approximately 42 to 51 million children and adolescents (0 to 18 years) in Latin America are overweight or obese.<sup>3</sup> According to the National Health and Nutrition Survey (ENSANUT-2012)—a national cross-sectional study performed in Mexico in 2012—the prevalence of overweight and obesity (national combined prevalence) in the 0 to 5-year-old age group was 9.7%; in the 5 to 11-year-old age group was 34.4% (19.8% for overweight and 14.6% for obesity); and in the 12 to 19-year-old age group, the national combined prevalence was 35%.<sup>4</sup> Hernández-Cordero *et al* estimated the prevalence and trends of overweight and obesity in Mexican children and adolescents by comparing the previous National Nutrition Surveys from 1988, 1999 and 2006 with ENSANUT-2012 (most recent data); they found that in 2012, 28.8% of children 0 to 19 years old were overweight, obese or at risk of overweight. The highest prevalence was seen among children and adolescents in urban areas and those from the highest socioeconomic level. They also found that in the last 13–24 years, the prevalence of overweight and obesity increased at the highest rate among female adolescents and school-aged girls. The authors concluded that the prevalence of childhood obesity in Mexico is one of the highest worldwide, and that the burden of childhood obesity is shifting towards groups with a lower socioeconomic level: in the case of our patient, her family belonged to the lower middle socioeconomic level.<sup>5</sup> Abarca-Gómez *et al* estimated the BMI of 2416 population-based studies (128.9 million participants 5 years and older) from 1975 to 2016 in 200 countries and found that the mean BMI and prevalence of obesity increased worldwide in children and adolescents from 1975 to 2016. They also found that despite the increase in mean BMI and obesity, more children and adolescents are underweight than obese worldwide; however, the authors postulated that if trends continue, childhood obesity is expected to surpass moderate and severe underweight by 2022.<sup>6</sup> The Organization for Economic Cooperation and Development projects that there will be a steady increase in obesity rates until at least 2030, particularly in the USA, Mexico and England.<sup>7</sup> More recently, a study predicted that more than 50% of children aged 2 to 19 years will be obese by the age of 35 years, and found that half of the total prevalence of obesity begins in childhood; indeed, a 2-year old who is obese is more likely to be obese at 35 years than a 19-year old with overweight.<sup>8</sup> Therefore, childhood comprehends a critical life stage for healthcare providers and parents to address obesity and prevent children from being obese in adulthood.

Multiple complications are associated with childhood obesity, such as: obstructive sleep apnoea; non-alcoholic fatty liver disease, gallstones and GORD; T2DM; polycystic ovary syndrome; pseudomotor cerebri; hypertension and hyperlipidaemia; depression; orthopaedic disorders and acanthosis nigricans (or insulin resistance).<sup>9 10</sup> In 2016, non-communicable diseases contributed 60% to the global disability-adjusted life years (DALYs). In Mexico for instance, the three leading causes of all-age DALYs were: diabetes, ischaemic heart disease and chronic kidney disease; all of which are complications/comorbidities of obesity.<sup>11</sup> In addition, childhood obesity is associated with an increased rate of death from endogenous causes

during early adulthood.<sup>12</sup> Based on the history, physical exam and laboratory tests our patient did not have other comorbidities apart from GORD.

### Maternal and prenatal factors as contributing factors for the development of childhood obesity

#### Maternal obesity, severe preeclampsia and caesarean section

Offspring of obese women are at increased risk of being overweight or obese later in life.<sup>13</sup> Multiple studies have found a strong association between maternal obesity and preeclampsia. Baeten *et al* found that women with a prepregnancy BMI of >30, 25–29.9 and 20–24.9 had a 3.3, 2.0 and 1.3 OR for preeclampsia, respectively.<sup>14</sup> Paré *et al* found a ‘dose–response’ effect between BMI and preeclampsia: being overweight or obese was the most important risk factor for the development of preeclampsia and severe preeclampsia, with a BMI greater than 25 having an attributable risk per cent of 64.9%.<sup>15</sup> According to multiple systematic reviews and meta-analyses, children who are born by caesarean section may be at higher risk of developing obesity in childhood.<sup>16–19</sup> The patient’s mother had a prepregnancy weight of 100 kg and a pregnancy weight of 115 kg (BMI >30), thus, the development of severe preeclampsia was concordant with the ‘dose–response’ effect as indicated by Paré *et al*. As a result, the patient was born by caesarean section, which may potentially be associated with the development childhood obesity. Therefore, the process described above (maternal obesity → severe preeclampsia → caesarean section) could have been prevented if maternal BMI had been <25. Ultimately, this leads us to ask ourselves the following questions: Is this a vicious cycle? Will this cycle repeat once the patient reaches fertility years? Obesity in pregnancy negatively affects the mother and the offspring; for example, these women are at increased risk of gestational diabetes, hypertensive disorders and instrumental and caesarean section; consequently, longer duration of hospital stay and increased costs. The offspring on the other hand is at increased risk of large-for-gestational age, preterm birth, congenital anomalies and fetal death.<sup>20</sup> Therefore, in addition to the cardiometabolic complications of obesity itself, obese pregnant women carry additional complications for them and the offspring.

### Social determinants of health, environmental and lifestyle factors are strongly associated with childhood obesity

#### Lack of physical activity

More than 40% of adolescents (>15 years) in Latin America are categorised as inactive.<sup>21 22</sup> The social determinants of health play a major role in this aspect. First, the fact that the family avoids going to the park because of the unsafe outdoor and poor park conditions are important impediments for the patient to exercise. As a consequence, she can only exercise either at her school or at home. These unequal living conditions clearly are not under the control of the patient but are the result of ineffective policy intervention. Second, this family lives in a small apartment with a small patio (3×4 m), so how much can this patient effectively exercise in this area? Although the patient got a bicycle and the parents encouraged her to ride it (in their patio), what is the impact of this on the patient’s caloric balance? When under normal circumstances, this girl could and should be riding her bicycle outdoors. Third, the suboptimal physical activity offered by government schools. The WHO recommends at least 60 min of moderate-to-vigorous-intensity physical activity daily for children 5 to 17 years old.<sup>23</sup> Tremblay *et al* compared physical activity of children among 15 countries and found that less than 50% of schools in Mexico had active schools policies (ie, daily physical activity, recess, ‘everyone

plays’ approach, bike racks at school, traffic calming on school property, outdoor time); less than 50% of students were taught by a physical activity specialist; and less than 50% of students were offered at least 150 min of physical activity per week.<sup>24</sup> In this case, 300 min of physical activity were lacking per week, and the patient’s school only offered 60 min of physical activity per week, which is consistent with the latter study. In addition, the parental educational level,<sup>25</sup> parental obesity and lack of exercise and the time spent in front of a television also contribute with the patient’s sedentary lifestyle.

#### Poor-quality nutrition

In the case of our patient, the total daily caloric intake surpassed her daily caloric requirements by approximately 500 kcal/day—most of which came from sweetened beverages, milk and candies. The family was instructed to lower or quit the daily SSB, chocolate milk and glass of milk and to eliminate the candies from her diet to achieve a negative caloric balance. At the follow-up visit, the parents reported an increase in milk consumption. She did decrease the amount of candy and stopped drinking the SSB and was eating more fruits; but overall, a negative caloric balance was not achieved.

Economic globalisation and the ‘nutrition transition’ have been major contributors to the growth of the childhood obesity epidemic in many developing countries. The ‘nutrition transition’ is defined as a high intake of refined carbohydrates, added sugars, fats and animal-source foods and a low intake of legumes, vegetables and grains. Food marketing exposure to children and the school food environment also have an impact on childhood obesity.<sup>21 26</sup> The consumption of SSBs is increasing in most developing countries; in 2014, Mexico was the second country with the highest SSB consumption worldwide.<sup>27</sup> In fact, a study found that SSBs comprehended 17.5% of the total daily caloric intake among Mexican children aged 1 to 19 years old.<sup>28</sup> The rationale behind the link between high consumption of SSBs and childhood obesity is that liquid calories fail to trigger satiety, which ultimately leads to an increased total daily caloric intake. However, to date, this mechanism is controversial.<sup>29 30</sup> As a result of the high SSBs consumption among Mexicans, in 2014, the government implemented an excise tax of 1 peso/L (10%) on several SSBs; a year later, the consumption of SSBs decreased by 6%, especially among households of lower socioeconomic status.<sup>29 31</sup> Moreover, a recent study concluded that doubling the SSBs tax to 20% could lead to larger benefits.<sup>32</sup> A recent meta-analysis concluded that there was a direct association between SSBs consumption and weight gain, overweight and obesity in children; although some discrepancies were identified in some studies.<sup>33</sup> Furthermore, the link between SSBs and childhood obesity is supported by a double-blinded, randomised, controlled trial that showed a reduction in weight gain and fat accumulation in children (4 to 11 years) who consumed sugar-free beverages as compared with children who consumed a 104 kcal SSB/day.<sup>34</sup> The front-of-package food labelling is also a promising intervention to promote healthy food choices among families and to decrease childhood obesity. This was implemented by the Mexican government to all foods and non-alcoholic beverages in 2015. To date, however, no studies have evaluated the impact of this on people’s food consumption and health outcomes.<sup>35 36</sup>

#### High screen time use

There is a clear association between high media use and childhood obesity,<sup>37 38</sup> which has been attributed to the children’s sedentary lifestyle and possibly to food advertising.<sup>39</sup> As per the

American Academy of Pediatrics (AAP), for children 2 to 5 years, screen use should be limited to 1 hour per day of high-quality programmes.<sup>40</sup> Multiple studies have found a strong association between high screen time use and childhood obesity; in fact, a large international study that included 77 000 children found a 20% to 27% increased risk of overweight and obesity in adolescents and children who watched 1 to 3 hours of television per day.<sup>38</sup> In the case of our patient, 5 hours of screen use per day clearly exceed the recommended daily screen use hours by the AAP, which also affects the duration of sleep and contribute to the patient's sedentary lifestyle.<sup>37</sup> The family was instructed to decrease screen time to 1–2 hours per day of high-quality programmes. At the follow-up visit, however, they still reported 5 hours of screen use per day.

#### Decreased sleep duration

According to the National Sleep Foundation,<sup>41</sup> preschoolers (3–5 years) should sleep from 10 to 13 hours per day, as the evidence shows that children who sleep less than 9 hours have greater odds of being obese than those who sleep more than 10 hours. A systematic review and bias-adjusted meta-analysis<sup>42</sup> found that sleep duration was inversely associated with later BMI in children and adolescents. In addition, later bedtimes are associated with childhood obesity and weight gain.<sup>43</sup> In the case of our patient, the parents reported a total of 8 hours of sleep per day (1 hour nap and 7 hours of sleep at night), which is clearly less than the minimum recommended hours of sleep for her age. The parents also reported a late bedtime (midnight), which is consistent with the latter study. Moreover, sleep duration positively influences healthy food choices among children,<sup>37</sup> which also has an impact on the caloric balance.

#### Treatment of childhood obesity becomes even more complex when considering the social determinants of health in Mexico

'Women and children in low socioeconomic groups are the most vulnerable and inequities in obesity are passed on from generation to generation'.<sup>44</sup> As previously mentioned, childhood obesity in Mexico is shifting towards groups with a lower socioeconomic level<sup>6</sup> in whom health inequities are more

prevalent. Multiple guidelines for the management of childhood obesity exist,<sup>11</sup> which mainly focus on lifestyle interventions (eg, dietary, physical activity and behavioural) to achieve a negative caloric balance; and in more severe cases, the use of medications or surgery. In clinical practice however, lifestyle modifications are extremely difficult to accomplish. When the social determinants of health (figure 2)<sup>46</sup> are included in the equation, it certainly becomes a more complex problem. In the case of our patient for example, lifestyle interventions were instructed and close follow-up was warranted, however, being a lower middle class family in Mexico and the inequalities this implies clearly affects management. Unsafe streets, lack of infrastructure to exercise (ie, parks) and a suboptimal physical activity curriculum in government schools are some of the social determinants of health that require more attention and action by governmental authorities. Although Mexico City has witnessed various improvements in terms of infrastructure and transportation in recent years, most community parks have been built in popular areas that are located far away from the most vulnerable.<sup>45</sup> Therefore, policy implementation in regard these aspects should also be a priority.

#### Patient's perspective

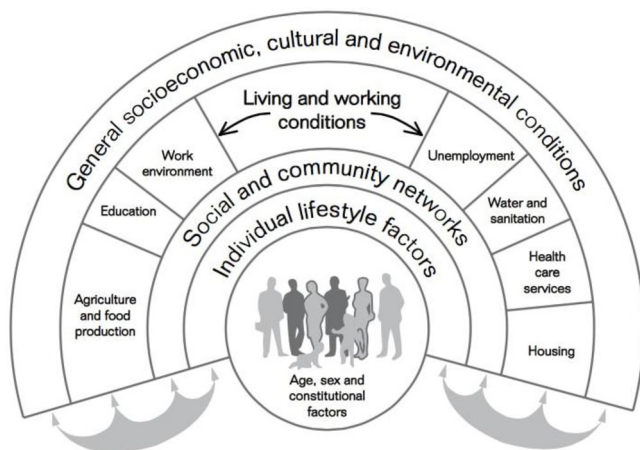
When we asked the parents about the long-term consequences of childhood obesity, they were aware of them: 'diabetes and heart disease' they said. We also asked them if they thought childhood obesity disappears on adolescence, but they said no, that 'it is a matter of exercise and a healthy diet for it to disappear'.

We asked the patient about her self psychological perception, and she said she thought she was 'chubby'; the parents stated the same. However, she seemed to think her body weight and image were normal. She did not report bullying at school.

They were afraid of going outdoors because of fear of getting robbed as there are many people doing drugs in the street. The patient mentioned that she would like to exercise and play outdoors with her friends more; 'it is dangerous to walk to the park; I get bored at home, after finishing homework I can only play with my dolls or watch TV, so I get bored. That's why every weekend my parents take me to the park 'La Mexicana'—the new one—so I can ride my bicycle more. In my house I only ride it three times a week.'

#### Learning points

- ▶ Keeping maternal prepregnancy body mass index <25 is essential to decrease the risk of preeclampsia and caesarean section and to possibly reduce the risk of childhood obesity in the offspring.
- ▶ Half of the total prevalence of obesity begins in childhood; therefore, this is a critical life stage to address it and prevent these children from being obese in adulthood.
- ▶ In addition to the family-centred lifestyle modifications and interdisciplinary approach, one must keep in mind the social determinants of health and how these affect management.
- ▶ Schools must offer more than 60 min of physical activity per week to achieve a negative caloric balance in children.
- ▶ Construction of new parks in vulnerable neighbourhoods and tackling crime are priorities to promote outdoor physical activity in Mexico.



**Figure 2** The main determinants of health. Reprinted from "European strategies for tackling social inequities in health: levelling up part 2, WHO Regional Office for Europe, Studies on social and economic determinants of population health, No.3. Göran Dahlgren, Margaret Whitehead. Copyright (2006). Page 20. Accessed on 14/02/2018 at [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0018/103824/E89384.pdf](http://www.euro.who.int/__data/assets/pdf_file/0018/103824/E89384.pdf)

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