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# Alternative conceptions of obesity and perception of obese people amongst children

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## ABSTRACT

Children's ideas, which differ from a scientific view, are termed as alternative conceptions (AC). AC are extremely resistant to change and arise from everyday experience. Investigation of children's AC about weight gain and their ability to discriminate between healthy and unhealthy foods is important, because it can help teachers reduce obesity amongst children. We investigated these issues in a sample of kindergarten and primary school children in Slovakia. More AC about weight gain were found in primary school children, despite the fact that their abilities to discriminate between healthy and unhealthy foods were more sophisticated than the abilities of kindergarten children. These differences were not influenced by gender and what is important, primary school children more frequently correctly noticed that the amount of food, not the food quality itself, impacts the occurrence of obesity in humans compared with kindergarten children. We also found that children's perceptions of obese people are negative and unrelated to children's age or AC about weight gain and the ability to discriminate food. These results suggest that both alternative conceptions about weight gain and children's perception of obese people are unrelated to age, gender and abilities to discriminate between healthy and unhealthy food.

## KEYWORDS

Alternative conceptions; food; health; weight gain; obesity

## Introduction

Children construct their knowledge through interaction with the environment, mostly based on an intuitive approach (Bishop 1985; Carey 1985; Lazarowitz and Lieb 2006), but these concepts do not necessarily correspond with scientific views (Fisher 1985). These concepts are called preconceptions, misconceptions, naive theories, alternative conceptions (AC) (Gomez-Zwiep 2008) and clearly pose barriers to learning. Many of these notions are not changed easily (Gilbert, Osborne, and Fensham 1982; Posner et al. 1982; Gilbert and Watts 1983; Wandersee, Mintzes, and Novak 1994; Duit and Treagust 2003) and they are extremely resistant to displacement by traditional instructional approaches (Trowbridge and Mintzes 1985; Driver 1989; Tekkaya 2002; Tanner and Allen 2005; Lucero and Petrosino 2017). Many AC arise from everyday personal experiences (Carey 1985; Hatano and Inagaki 1994; Inagaki 1997; Fraser and Tobin 1998) including direct observation of natural objects and events, peer culture, everyday language, contact with family, peers and the influence of mass media (Mintzes and Wandersee 2005). Prokop, Kubiátko, and Faňčovičová (2008) reported, for example, that about one-third of 10–19-year-old students believed that an owl's eyes light up at night. These AC may come from natural history films,

which often show an owl's eyes 'lighting up' when exposed to light at night (Prokop, Kubiátko, and Fančovičová 2008).

Research in the field of natural sciences has addressed a number of topics that have identified childrens' AC about the human body and organ systems (Nagy 1953; Mintzes 1984; Arnaudin and Mintzes 1985; Reiss and Tunnicliffe 2001; Sungur, Tekkaya, and Geban 2001; Reiss et al. 2002; Prokop and Fančovičová 2006; Prokop, Fančovičová, and Tunnicliffe 2009). Many researchers have been interested in AC about the structure and function of the digestive system (Teixeira 2000; Carvalho et al. 2004), for example, what children think happens to the food they eat (Rowlands 2004; Sorgo, Hajdinjak, and Briski 2008). It was found that children have no clear understanding of where the digestion of foods starts and finish (Teixeira 2000; Cakici 2005). For instance, certain children think that after food is eaten, it falls to the legs or moves through the body due to movements such as walking. Children apply their empirical knowledge, about the way matter falls, to the bodily functions. When children say that, after some time, food will rot in the abdomen and become excrement, they are also applying empirical knowledge, as they have seen food putrefy (Teixeira 2000). Many children simplify the digestive tract into one organ called the stomach (Nagy 1953) and in all cases, 4 to 7-year-old children draw a stomach with only a small number of children able to identify the intestine (Garcia-Barros, Martínez-Losada, and Garrido 2011). Ozgur and Pelitoglu (2008) found that children explain the digestion system through 49 concepts. Eighteen of these concepts are anatomy, 10 are mechanic and chemical digestion, four of these concepts are aliments and five are the concepts of other categories. These works collectively demonstrated that children have a solid misunderstanding of knowledge about their digestive system that can be described as a mixture of common knowledge, facts learned in their previous schooling and misconceptions (Sorgo, Hajdinjak, and Briski 2008).

Not only children but also teachers and even people in health-related sectors (e.g. nursing) have inadequate knowledge about nutrition, obesity and weight control (O'Dea and Abraham 2001; Triches and Giugliani 2005; Van Den Berg et al. 2012; Sharma et al. 2013). Students have a poor understanding of the caloric content of commonly consumed foods (Schmidt et al. 2017). This could further lead to weight gain and obesity. Power et al. (2010), for example, noted that adolescents had a limited understanding of what makes eating healthy. They mentioned fruits and vegetables as the most healthy foods, but whole grains, low-fat meats, nuts or legumes were not considered healthy. Early adolescents were confused about the healthiness of beverages such as milk or juices. They had a much better understanding of unhealthy foods (energy dense or high fat snack foods such as cookies, candy, potato chips, pizza, etc.). In addition, Wellman and Johnson (1982) noted that children thought that food and water have equivalent nutritional consequences and that excessive drinking of water might also cause obesity. Signorielli and Staples (1997) found a positive correlation between watching television and saying that an unhealthy food choice is healthier. The authors also found that primary school children who preferred eating unhealthy food were more likely to believe that the unhealthy foods were healthy. Not only the influence of mass media but also the influence of family during childhood affect their concepts of healthy and unhealthy eating. Children also adopt unhealthy eating habits from their parents and later suffer from obesity (Roblin 2007). Ozbas and Kilinc (2015) demonstrated that children have insufficient knowledge and misconceptions about a healthy lifestyle. Children are unable to explain what healthy food is and how to prevent abnormal weight gain and obesity.

Children's conceptions in regard to the topic of weight gain, healthy and unhealthy foods are not fully understood and call for future research, as obesity is currently a growing health problem.

The World Health Organisation (WHO) noted that 18% of children and adolescents aged 5–19 were overweight or obese and 39% of women and 39% of men aged 18 and over were overweight and 13% obese. The number of obese children and adolescents worldwide has risen tenfold in the past four decades (WHO 2017; Jaacks et al. 2019).

Obesity is associated with a number of diseases including coronary heart diseases, diabetes, stroke, asthma and cancers (Must et al. 1992; Grundy et al. 2004; Lobstein, Baur, and Uauy 2004; Yusuf et al. 2005; Cecchini et al. 2010; Abdullah et al. 2011). Moreover, obesity is also associated with negative

attitudes towards obese people (Vartanian 2010; McClure, Puhl, and Heuer 2011). Many studies suggest that not only adults with an optimal weight but also children characterise obese people with negative properties (Anesbury and Tiggemann 2000). Discrimination of obese children in the school environment is a key issue. The first negative attitudes of schoolmates begin to appear at schools (Adams, Hicken, and Salehi 1988; Zeller, Reiter-Purtill, and Ramey 2008; Puhl and Luedicke 2012). Obese children suffer from bullying (Van Geel, Vedder, and Taniol 2014), depression (Erickson et al. 2000) and various physical and mental problems (Wake et al. 2002) significantly more than children with a normal weight. Obese people are further discriminated in the labour market (Johansson et al. 2009; Flint and Snook 2014) and in searching for partners (Chen and Brown 2005; Boyes and Latner 2009), which results in their emotional and psychological problems, as well as in children. Discrimination is also associated with the development of depression, which may cause the onset of further illnesses in connection with being overweight (Puhl and Brownell 2003).

It is suggested that education, better knowledge and informing children about the ways and causes of weight gain is needed to improve children's conceptions about nutrition and also to help with prejudice towards obese people, which can also contribute to a reduction in overweight and obesity (Niederer et al. 2009; Ozbas and Kilinc 2015).

In this study, we investigated children's AC of weight gain and children's ability to discriminate between healthy and unhealthy food. We assume that AC about weight gain and children's skills in discriminating between healthy and unhealthy food could affect the perception of children towards obese people, which can also be reflected in the quality of interpersonal interactions.

## Methods

### *Participants*

Participants (N = 50) were randomly recruited from five Slovak kindergartens (one class from each of the five kindergartens) (mean age = 5.4 years., range = 4–7 years, SE = 0.13, N = 25, 14 females and 11 males) and five Slovak primary schools (mean age = 9 years., range = 8–10 years., SE = 0.13, N = 25, 13 females and 12 males). These schools were situated in territorial units in west, middle and east Slovakia.

### *Research instruments*

We used a semi-structured interview through which we learned about alternative conceptions about weight gain, children's ability to discriminate between healthy and unhealthy food, and children's perception of obese people (see Appendix).

All the children were interviewed by the first author of the article. The interview with each child lasted about 15 min and was carried out in a separate classroom to avoid distracting influences. The children responded without pressure, and the interview was friendly, without stress and on a voluntary basis. The children were assured that they would not be marked and were rewarded with colour pens after each interview. Interviews were recorded on a dictating machine and then rewritten.

### *Measuring alternative conceptions about weight gain*

Measuring of AC about weight gain was examined with two images of the same woman, showing both an obese person and with an optimal weight (after losing weight). We then asked the children: How did the woman in the picture gain weight? What happened to her body/in her body? The children's responses were encoded as follows: If the children did not respond, a value of 1 was assigned. If they responded with a lot of food ("She gained weight when she ate a lot of food") and named unhealthy food ("She gained weight when she ate

chocolate, bacon, etc.“) these answers were assigned the value of 2. The value of 3 was used for responses to the storage of food in the abdominal cavity (“The food she received is stored in the belly, remains in the belly, the belly grows“). The value of 4 was given to the responses that mention fat storage in a woman’s body because of unhealthy food (“Fats are stored in the body/fats are growing in the body”). The answers that extended the previous answer and included the storage of sugar were assigned the value of 5 (“Fat and sugar are stored in the body”). Children’s responses about a hint of metabolism of sugars and their changing into fat were assigned the value of 6 (“Fat is also stored from sweets.” “Fat is stored under the skin and sugars help us fatten”) (Table 1).

### **Measuring children’s ability to discriminate between healthy and unhealthy food**

After the first task mentioned above, we showed the same two images of the woman with an optimal weight and obesity. Children were asked which food was consumed by each of the two women. We used images of healthy and unhealthy food that were easy to discriminate (at least by adults) and can be applied to kindergarten children. Healthy foods were fruits and vegetables (apple, pear, tomato and carrot) and dairy products (milk, cheese) and the assignment of these meals to the woman with an optimal weight was considered correct. Unhealthy foods were common fattening foods (bacon, chips) and sweets (lollipop, chocolate) and the assignment of these meals to the woman with obesity was considered correct (example in Figure 1). Foods that were incorrectly discriminated were assigned the value of 1, correctly discriminated food received the value of 2, and if the children correctly discriminated the food and responded that it all depends on the amount of food received, these answers were assigned the value of 3 (Nguyen 2007). High values represent a more correct idea (better knowledge).

### **Measuring of children’s perception of obese people**

When looking at the perception of obese people, we again used images of women with obesity and women of an optimal weight. The children had to decide which personality traits are associated with obese women, and which with women of an optimal weight. They had the choices of the opposites: nice–ugly, clever–stupid, healthy–sick, happy–unhappy. The attributes such as nice, clever, healthy, happy were assigned the value of 1 (positive attitude). Contrasting properties such as bad, stupid, sick and unhappy were assigned the value of 3 (negative attitude). If children could not decide in sorting the traits that, for example, they answered both women are equally healthy/unhealthy, the value of two was used (neutral attitude). High values refer to more negative perception of obese people.

**Table 1.** Measuring alternative conceptions about weight gain and examples of the children’s answers.

Measuring Alternative Conceptions about Weight Gain		
Level	Conception	Examples of the children’s answers
1	no answer	I do not know.
2	A lot of food, unhealthy food	She gained weight when she ate a lot of food. She gained weight when she ate chocolate, bacon, etc.
3	storage of food in the abdominal cavity	The food she received is stored in the belly.
4	Fat storage in a woman’s body because of consumption of unhealthy food	Fats are stored in the body/fats are growing in the body.
5	The same as Level 4 with included the storage of sugar	Fat and sugar are stored in the body.
6	Hint of metabolism of sugars and their changing into fat	Fat is also stored from sweets. Fat is stored under the skin and sugars make us gain weight.



Figure 1. An example discriminates healthy and unhealthy food by child.

### **Statistical analyses**

Both parametric and non-parametric statistics were used depending on the type of data. Rank scores from alternative conceptions were analysed with ordinal probit model in the Generalized Linear Model (GLZ). Scores from healthy and unhealthy foods were analysed with the General Linear Model (GLM) with within-subject design, where both scores (healthy and unhealthy foods) were defined as dependent variables. Children's perception of obese people were analysed with GLZ with Gamma distribution of data.

## **Results**

### **Alternative conceptions about weight gain**

Kindergarten children manifested lower mean scores obtained from ranking of AC about weight gain compared with primary school children (GLZ, Wald's  $\chi^2 = 12.97$ ,  $df = 1$ ,  $P < 0.001$ , [Figure 2](#)). Neither the influence of gender nor the interaction between variables showed a significant influence on the mean scores (Wald's  $\chi^2 = 0.64$  and  $0.50$ ,  $df = 1$ ,  $P = 0.42$  and  $0.48$ , respectively).

### **Children's ability to discriminate between healthy and unhealthy foods**

Kindergarten children received lower overall mean scores from discrimination of healthy and unhealthy foods than primary school children (GLM,  $F_{1,47} = 37.24$ ,  $P < 0.001$ ), but these differences were not influenced by gender (GLM,  $F_{1,47} = 0.008$ ,  $P = 0.93$ ). Within-subject analyses showed that healthy foods were discriminated similarly as unhealthy foods (GLM,  $F_{1,47} = 0.08$ ,  $P = 0.78$ ) and there was no interaction between food type and gender (GLM,  $F_{1,47} = 1.29$ ,  $P = 0.26$ ). Interestingly, however, the interaction term school type and food type

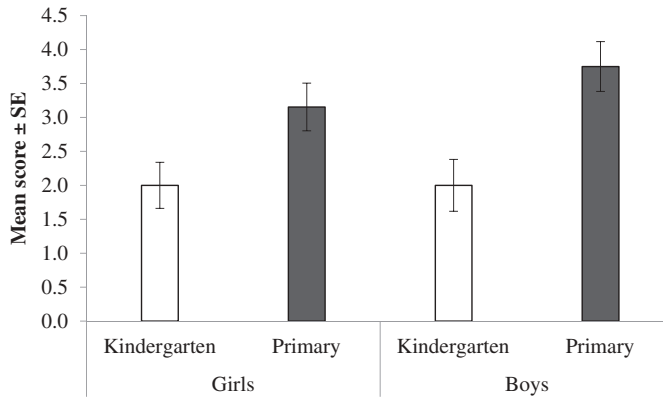


Figure 2. Differences in mean scores from AC about weight gain with respect to school type and gender.

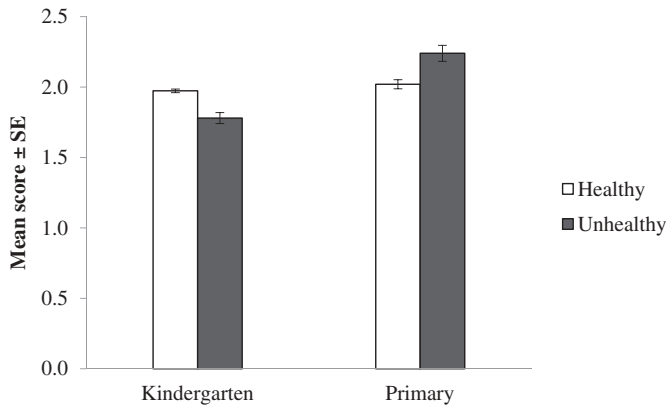


Figure 3. Differences in mean scores from healthy and unhealthy foods with respect to school type.

was highly significant (GLM,  $F_{1,47} = 33.7, < 0.001$ ), suggesting that primary school children reported that the amount of unhealthy food influences whether the food is really unhealthy or not (Figure 3).

### Children's perception of obese people

Children attributed negative characteristics to an obese looking woman ( $M = 11.5, SE = 0.1, N = 50$ ) significantly more than to optimally looking woman ( $M = 4.5, SE = 0.1, N = 50$ ). Descriptive statistics are shown in Tabs. 2 and 3. None of the previously reported variables (gender, school type, scores from alternative conceptions about weight gain and children's ability to discriminate healthy and unhealthy foods) showed any association with perception of obese people (GLM, all  $\chi^2 > 0.02$ , all  $P > 0.18$ ).

### Discussion

This study investigated the prevalence of AC among kindergarten and primary school children in the field of weight gain, discrimination between healthy and unhealthy foods and children's perception of obese people. We found that AC about weight gain were more frequent among

**Table 2.** Descriptive statistics for attribution of positive, neutral and negative characteristics by children to a woman with optimal weight. The numbers are the numbers of the answers.

	Woman with optimal weight					
	1 = positive perception		2 = neutral perception		3 = negative perception	
	Kindergarten	Primary	Kindergarten	Primary	Kindergarten	Primary
Healthy-sick	24	24	0	1	1	0
Happy-unhappy	25	24	0	1	0	0
Clever-stupid	21	10	4	15	0	0
Nice-ugly	24	24	1	1	0	0

**Table 3.** Descriptive statistics for attribution of positive, neutral and negative characteristics by children to an obese woman. The numbers are the numbers of the answers.

	Woman with obesity					
	1 = positive perception		2 = neutral perception		3 = negative perception	
	Kindergarten	Primary	Kindergarten	Primary	Kindergarten	Primary
Healthy-sick	1	0	0	1	24	24
Happy-unhappy	0	0	0	1	25	24
Clever-stupid	0	0	4	15	21	10
Nice-ugly	0	0	1	1	24	24

primary school children than among kindergarten children which suggests that personal experience and the older age of children increases the prevalence of AC. Primary school children, in contrast, have more knowledge about healthy and unhealthy food, because they have already thought about the amount of food received that can influence our weight. Children’s perception of obese people seems to be, however, very rigid and unrelated to children’s knowledge about weight gain.

**Alternative conceptions about weight gain**

From the results of the study of AC about the process of weight gain, it is apparent that primary school children have more alternative conceptions about this process than kindergarten children. Certain authors argue that many AC arise from everyday personal experiences (Carey 1985; Hatano and Inagaki 1994; Inagaki 1997; Fraser and Tobin 1998).

We categorised children’s AC into several levels. The first level of AC indicates that weight is gained due to excessive amounts of food or unhealthy food. The second level of AC states that weight is gained as a result of storing food in the abdominal cavity. The third level of AC indicates that the fat is stored in the body exclusively from unhealthy food, while the fourth level of AC (besides storing fat) also mentions the storage of sugar. The fifth level of AC hints at the conversion of sugar into fat (metabolism of sugar). Our results are partly parallel with Ozbas & Kilinc (2015) who earmarked six major conceptual patterns about weight gain based on a questionnaire used on a sample of secondary school students. This was an explanation of weight gain and the process that takes place at the cellular level. The first conceptual model concerned weight gain from “increasing body fat” (parallel to our level 3), the second one dealing with weight gained from “undigested food” (parallel to our level 2), the third concept claimed that weight is gained due to “sweets consumptions” (partly parallel to our level 1), the fourth concept involved weight gained due to “increased fat, carbohydrate and protein storage” (partly parallel to our level 4), the fifth concept discussed that weight gain causes “an increase of sugar in the blood” (this pattern was not observed in our study). The last sixth concept of Ozbas and Kilinc was related to weight gain as a result of “fast digestion of carbohydrates”, but this pattern was not observed in our study. Children associated weight gain primarily with food intake as they found in their study Xu and Nerren (2017). Children aged 5 to 8 years have identified overeating as the main cause of



obesity in people. Some children stated that the type of food makes obese people different from others. It was primarily the sugar that caused weight gain. As the main cause of slim people, they reported lower food intake. The results of our study suggest that children of all ages subscribe to a wide range of AC about weight gain. For example, some children stated that we weight gain from the stored food in the stomach. Many of the AC develop before and during the early school years and can persist relatively unchanged into adulthood (Yen and Chiu 2004). We can agree with the argument of Arnaudin and Mintzes (1985) that found AC children of different age groups (7–14 years old) and revealed clear trends. Older children tended to subscribe to more sophisticated and, in some cases, scientifically acceptable concepts, as was the case with primary school children in our research. Further research is important in finding ways to eliminate children's AC.

### ***Children's ability to discriminate between healthy and unhealthy foods***

Primary school children have more frequently correctly noticed that the amount of food, not the food quality itself, impacts the occurrence of obesity in humans compared with kindergarden children. This finding is in agreement with Rozin et al. (1986) who found that children of a pre-school age believe that if something is edible (e.g. sweets, chips), it can be part of a diet without limitation of quantity. Four to seven-year-old children are able to divide food into that which influences human health (e.g. food containing vitamins) and nutritious food (e.g. food containing fat) (Nguyen 2007). Hart, Bishop, and Truby (2002) noted that 7 to 11-year-old children, across all focus groups, associated food with health (e.g. "You can get a hole in your teeth from sweets"). Nutrient associations were the second most popular reason given for a food's status, most frequently in relation to sugar, vitamins or high energy content (e.g. "Fast foods have got lots of fat"). Preference or taste also featured amongst the justifications given by the children (e.g. "I like pizza"), with food quality an infrequent theme in the discussions (e.g. "Apples have got maggots"). In our study the children were able to determine the macronutrients contained in the foods, e.g. "the lollipops and chocolate contain sugar", "the chips contain fat" and therefore correctly ranked them as unhealthy foods.

Vitamins were verbally most frequently identified in fruit and vegetables by children (these data were not analysed), so they correctly ranked them as healthy foods, but they were unable to explain the term vitamins. Children also mentioned the health benefits of healthy foods, e.g. "milk is good for our growth", "carrot is healthy for our eyes" and negative experiences with unhealthy food, e.g. "lollipops cause toothache". Some children, in contrast, mentioned that "chocolate and lollipops contain sugar, but they do not contain fat so they are healthy" or "bacon is healthy because it is tasty, it is meat".

These results imply that children's ideas about healthy and unhealthy foods are relatively good, but they still need to be improved in terms of the influence of the amount of food on human health.

### ***Children's perception of obese people***

The results show that children prefer people with an optimal weight and attribute them with positive characteristics such as nice, clever, healthy and happy. In contrast, an obese woman in our research received predominantly negative attributes such as bad, stupid, sick and unhappy. These results are in agreement with Brylinsky & Moore (1994) who found that negative attitudes towards obese people have already been acquired by three-year-old children who refer to them as evil, stupid, ugly, unhappy and lazy. Kraig & Keel (2001) also found that 7 to 9-year-old children have more positive attitudes to children with an optimal weight than overweight, regardless of their own weight. Most children, therefore, unconsciously follow the theory of "what is beautiful is good" (Dion et al. 1972). Attitudes towards obese people were not influenced by the school type suggesting that older children showed similar (negative) attitudes as kindergarden children. It

would seem that attitudes towards obese people are rigid and hard to change by conventional methods. Many authors, for example, call for better education as a tool for improving these negative attitudes (Monteith 1993; Anesbury and Tiggemann 2000; Schwartz et al. 2003; Ozbas and Kilinc 2015), but our empirical results clearly suggest that the perception of obese people were not influenced by children's own AC about weight gain and/or their abilities to discriminate between healthy or unhealthy foods. Moreover, females are often labelled as more empathic than males (Hoffman 1977; Hartup 1996; Quince et al. 2011), but we failed to find more positive perception of obese people in females. Deeper evolutionary roots suggest that obesity is perceived as a morphological anomaly and it consequently triggers avoidance of these people similarly like individuals who carry diseases (Park et al. 2003). These arguments suggest that conventional educational methods need not be effective in changing children's perception of obese people.

## Conclusion

In conclusion, we argued that children's ideas about weight gain and discrimination between healthy and unhealthy foods lack the domain of the amount of food on human health. Moreover, children's perception of obese people are unrelated to children's age or to nutrition knowledge. Furthermore, a non-conventional approach is required to improve the perception of obese people by children.

## Educational implications

- In order to make a conceptual change, which would be effective in changing the existing AC of children (Carey 1985), teachers should use inductive teaching methods (inquiry learning, problem-based learning, project-based learning) rather than traditional teaching strategies (Prince and Felder 2006).
- We found that many children think that weight is gained as a result of storing food in the abdominal cavity, so teachers should pay attention to the digestive system and its function with the help of images or different computer applications (Sorgo, Hajdinjak, and Briski 2008).
- It is also important to focus on alternative conceptions about food. We also found that children from primary schools are beginning to think about the amount of unhealthy food intake. Some of them know that lollipops are unhealthy, but when we eat one of them, we will not be obese. We recommend that teachers integrate activities about food into teaching, discuss the health effects of foods, and pay attention to composition of foods, nutritional values and the amount of daily intake.
- More interpersonal contacts with obese persons and discussions about obesity are recommended. Teachers can try to evoke empathy towards obese people by reading stories and watching videos about discrimination of obese people.

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No potential conflict of interest was reported by the authors.

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## Appendix

### Interview

Sex:

Age:

School:

Date:

1. In the first picture, we see a woman with an optimal weight and in the second picture, we see a woman who is obese ("a fat woman"). How did the woman in the picture gain weight? What happened to her body/in her body?
2. We have pictures of food: chips, milk, chocolate, apple, tomato, cheese, carrot, bacon, lollipop, pear. Can you discriminate between this food? Which food was consumed by each of the two women (optimal weight woman and obese woman)? Which foods are healthy and which unhealthy?
3. Look at these pictures of women. You decide which personality traits are associated with an obese woman and which with woman of an optimal weight.
  - Which woman in the picture is healthy and which woman is sick? Can they both be healthy or sick?
  - Which woman in the picture is happy and which woman is unhappy? Can they both be happy or unhappy?
  - Which woman in the picture is clever and which woman is stupid? Can they both be clever or stupid?
  - Which woman in the picture is nice and which woman is ugly? Can they both be nice or ugly?