

Body Image Perception and Adiposity in School-Age Children

by

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“The journey is the reward”

~ Chinese Proverb

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Dedication

To my parents, Yona and Ygal

To my husband, Ran

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Chapter 1:

Introduction

Overview

During the past years, countries in Latin America have been undergoing a nutritional transition as part of rapid demographic and economic changes, which resulted in an increase in the prevalence of obesity in the region(1-3). Economic development of a country usually brings about an increase of nutrient-poor processed foods that are high in their caloric intake, alongside with decreased opportunities for physical activity. Together, these processes impact the energy balance of an individual and lead to excessive weight gain over time. The rapid increase in prevalence of childhood obesity is of a special concern since it has both immediate and long-term health consequences(4-9). Therefore, there is a pressing need to adequately characterize its causes. Since these causes may be different across populations undergoing different stages of economic development and nutrition transition, they need to be considered carefully when investigating the predictors of childhood obesity in different settings around the world.

Weight status in children and adolescents is affected by various influences (10-14), including genetic background, sociodemographic characteristics such as sex, age, pubertal stage, and socioeconomic status. Additional important correlates of childhood obesity include familial, school and built environments, dietary patterns, level of engagement in physical activity, and many others. While dietary intake and physical activity are most likely direct predictors of obesity in children, there are also important psychological factors associated with it, such as body image perception. Several cross-sectional studies showed a positive correlation between body dissatisfaction and body mass index in various age groups and different populations(15-17). In other words, overweight and obese children, or parents to children from these weight groups, tend to perceive the child as being thinner than he or she actually measures, and also to desire a slimmer body image for the child, compared to normal-weight and thin peers.

In contrast, it has been suggested that body image perception or dissatisfaction may be a predictor of changes in one's weight. Dissatisfaction with physical appearance may result in intentional behaviors aimed toward weight loss or gain. body image dissatisfaction may also lead

to excessive weight gain through unintentional mechanisms. For example, it is possible that weight-related concerns and behaviors are reflected in child feeding practices(18) and family weight-talk in parents to children.(19), while the child's own dissatisfaction could lead indirectly to increased weight gain through increased sedentary behavior,(20, 21) social isolation, and depression,(22, 23) or through the emergence of weight-related anxiety, which may contribute to excessive weight gain over time.(24)

Due to their study design, cross-sectional studies cannot address the possibility of reverse causality between weight status and body image perception, and cannot determine whether body image dissatisfaction preceded overweight or vice versa. Prospective studies are required, therefore, to disentangle this 'chicken-and-the-egg' question in order to enhance our understanding of the phenomenon of childhood obesity in general, and specifically in populations undergoing the nutrition transition, where dramatic changes in both obesity rates and exposure to Westernized body image concepts take place.

An additional factor associated with childhood overweight is parental perception of the child's weight status(25, 26), which may be potentially distorted, as it depends on cultural background(27), socioeconomic status (28) and parental weight(29). To the best of our knowledge, body image dissatisfaction has not been extensively examined as a predictor for development of adiposity in prospective studies among school-age children. Furthermore, characterization of the predictors of body image dissatisfaction is lacking in this early age groups in general, and specifically in Latino children undergoing the nutrition transition.

This work was conducted in the context of the Bogotá School Children Cohort, an ongoing cohort of 3,202 schoolchildren and their mothers started in 2006 in Bogotá, Colombia. We explored potential correlates of body image perception in school-age children, and examined possible associations between maternal perceptions of the child and between body image perception in the children. In addition to this cross-sectional investigation of children's body image perception at time of recruitment, we prospectively investigated whether body image dissatisfaction in either the children or their mothers predicts development of childhood adiposity. Successful realization of this research will demonstrate a possible relation between body image dissatisfaction and growth trajectories in school-age children. It will also provide

novel insights into the causal chain leading to development of childhood adiposity in countries undergoing the nutrition transition. Body image dissatisfaction is potentially modifiable and can be addressed at the level of the individual or the family, or as part of the social context for the individual among his or her peers(30). Therefore it is crucial to determine whether adversely affect weight trajectories in children over time. Comprehensive understanding of its impact on health outcomes has important policy implications as it will provide the basis for future interventions.

Specific Aims

The overarching goal of this work is to identify correlates of body image perception among school-aged children from Colombia, a country undergoing the nutrition transition, and to determine the association of body image perception with weight trajectories in these children.

Aim 1: To identify sociodemographic, anthropometric and maternal correlates of body image perception among school-aged children from Colombia, a country undergoing the nutrition transition, and to characterize the potential contribution of psychosocial constructs of body image perception to the concept of body image dissatisfaction in the child.

Aim 2: To investigate whether body image dissatisfaction predicts development of adiposity in school-age children. To this end, we examined the associations between children's body image dissatisfaction at baseline and between their weight trajectories over a 2.5 year follow-up period in a cohort study of school-age children from Bogotá, Colombia.

AIM 3: To examine the relation between maternal BID and children's weight changes in a longitudinal study. Specifically, to investigate whether a mother's dissatisfaction with her own body image or with that of her child at the time of recruitment would predict weight changes in the children over time.

Summary of Chapters

This work contributes to the existing knowledge of body image perception in children by examining a wide range of correlates of body image dissatisfaction among low- and middle-income school-age children from a population experiencing the nutrition transition, and by prospectively investigating body image dissatisfaction in either child or mother as predictors of weight trajectories in these children according to their sex and weight at time of recruitment.

Chapter 2 presents a cross-sectional examination of potential correlates of body image perception among children enrolled in the Bogotá School Children Cohort, an ongoing study of a nutrition and health of primary schoolchildren in Bogotá, Colombia. These correlates included sociodemographic and anthropometric characteristics of both mother and child. In this chapter, we also assessed the contribution of various psychosocial constructs of body image perception, as reported by both the children and their mothers, to conceptualization of body image dissatisfaction in the children. In chapter 3 we determined whether body dissatisfaction in the child at time of recruitment predicts weight trajectories in children during follow-up, according to their sex and baseline weight status. We further examined maternal dissatisfaction with body image of herself or her child as two separate predictors of weight trajectories in the children. This investigation is described in detail in chapter 4. In the fifth and final chapter we summarize the main findings of the thesis, discuss their public health implications and provide suggestions for future research.

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Chapter 2:

Body Mass Index and Sociodemographic Correlates of Body Image Perception in School-aged Children

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INTRODUCTION

Low- and middle-income countries around the world are experiencing a rapid increase in the prevalence of overweight and obesity(31, 32). This trend, also evident in Latin American countries(33, 34), is associated with a nutrition transition, which entails marked changes in dietary habits and physical activity as a country moves from a traditional way of living to a more Westernized lifestyle. Accelerated increase in obesity rates among children is of special concern because childhood obesity not only has many short-term adverse effects(35), but is also likely to track into adulthood(36) and predict various chronic diseases later in life(37).

In addition to dietary intake and physical activity(38, 39), psychological factors like body image perception and weight-related concerns are associated with childhood obesity. For example, children may perceive their of current body image as either heavier or thinner than it really is, and the desire for a thinner body image compared to the current one(40, 41). These associations have been documented at ages as early as preschool years(42).

Parental perception of the child's body image may play an important role in shaping the child's body perception and behaviors related to body image, through parents' weight-related attitudes, diet-talk, and feeding practices(43-45). In addition to its potential influence on the child's own body image, parents' perception of the child's body image may pose a serious obstacle for clinicians or public health professionals who are attempting to address childhood obesity(46), particularly when interacting with parents who misperceive their child's actual weight (47-50).

Perceptions of body image by both the child and the parents depend on additional factors such as socioeconomic status (SES), and exposure to mass media and acculturation towards a

Westernized lifestyle that promotes stereotypical ideas of body shape(47, 49, 51-54). Although associations between the child's weight status and body image perceptions in children have been previously investigated in developed countries, little is known in populations undergoing the nutrition transition. In these populations, both obesity rates and exposure to Westernized ideals of thinness are expected to continuously increase among adults and children.

The aim of this study was to identify sociodemographic and anthropometric correlates of body image perception among school-aged children from Colombia, a country undergoing the nutrition transition. In addition, we characterized the potential contribution of psychosocial constructs of body image perception to the concept of body image perception in the child.

METHODS

Study population and field methods

We conducted this cross-sectional study in the context of the Bogotá School Children Cohort. This on-going nutrition and health study of primary school children in Bogotá, Colombia is described in detail elsewhere (55). Briefly, in February 2006 we recruited 3202 children aged 5-12 y to represent all primary public schools in Bogotá by the end of 2005. The children came from 2981 households, when accounting for siblings. The majority of children attending the public schools are from low- and middle-income families in the city (56); thus the study population is representative of these strata.

Parents or main caregivers filled out self-administered questionnaires (82% response) during the first week of classes. These questionnaires were used to obtain information on several characteristics of the child, including sex, age, birthplace, and number of hours spent weekly in front of a screen or engaging in outdoor physical activity. The questionnaires also elicited information on mother's age and birthplace, marital status, maternal parity, and years of education. Finally, caregivers were asked to provide information on various indicators of socioeconomic level, such as the number of home assets; household socioeconomic status based on the government's classification for tax and planning purposes; and home ownership status.

Trained research assistants visited the schools and obtained the children's height and weight measurements, using standard protocols (57). Height was measured without shoes to the nearest 1 mm with wall-mounted portable Seca 202 stadiometers, and weight was measured in light clothing to the nearest 0.1 kg on Tanita HS301 solar-powered electronic scales. At the same visits, information on body image perception of the child was obtained in a random subsample with the use of child-adapted Stunkard figure rating scales. These sex-specific scales, formally validated in children (58), portray 8 figurines in increasing order of body girth from 1 (thinnest) to 8 (heaviest). Using these scales, children were asked to indicate specific silhouette numbers in response to questions regarding aspects of body image, including psychosocial constructs related to body image and perception of body size. Children were asked to indicate the silhouette that 'looked normal', 'looked best', 'had more friends', 'looked strongest', and to identify the

silhouette that resembled their current body image and the one that represented the body image they desired to have. Similarly, mothers were asked to use the same child-adapted figurine scales to answer questions about the way they perceived their child's body image. These questions elicited responses about the silhouette that looked the 'healthiest for child's age', the silhouette that resembled the child's current body image, and the one the mother desired for her child.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving the participants were approved by the Ethics Committee of the National University of Colombia Medical School. The Health Sciences and Behavioral Sciences Institutional Review Board at the University of Michigan approved the use of data from the study. Prior to enrollment informed consent was obtained in writing from parents or primary caregivers of all children.

Data analysis

Upon recruitment, information on body image perception was obtained from 629 children. These constituted the analytic sample for this study. Data on maternal perception of the child's body image were obtained for a sub-sample of 367 of these children. The children did not differ from the rest of the cohort in sex, age, SES, or anthropometric characteristics. We examined three main outcomes of interest: silhouette indicated as current by the child; silhouette indicated as desired by the child; and the difference between the two, which we identified as a body image dissatisfaction (BID) score. A negative BID score was obtained when desired body image was greater than current body image; i.e, a desire for a larger body size. A zero BID score was obtained when desired body image was equal to current body image, representing satisfaction with body image. Finally, a positive BID represented a desired body image that was smaller than the current body image—a reflection of the desire for a thinner body.

We first examined the distribution of child and maternal characteristics. Height- and BMI-for age z -scores (HAZ and BAZ, respectively) were estimated based on the 2007 World Health Organization growth references(59). Maternal BMI was calculated from measured height and weight in 40% of the mothers and from self-reported data in all other mothers. On the basis of a sum from among six items—refrigerator, bicycle, blender, television, stereo, and washing

machine—we created for analysis an index of home asset ownership. Household socio-economic stratum was determined according to the local government's classification of public service fees, which are higher in wealthier neighborhoods than in poorer ones (1–4 in the sample, with 1 being lowest).

Next, we compared the distribution of each of the 3 body image perception outcomes (silhouettes indicated as current and desired by the child and BID score) by categories of sociodemographic and anthropometric predictors by estimating means (\pm SD). Differences in the outcomes distribution by dichotomous predictors were tested using the Wilcoxon's rank-sum test, whereas for ordinal predictors, a test for trend was obtained with the use of Wald test, by introducing a continuous variable representing the ordinal categories of the predictor into a linear regression model. We used multivariable linear regression to examine the associations of child's BAZ with each outcome of body image perception. In these models, outcomes were silhouetted indicated as current, silhouette indicated as desired, or BID score. Explanatory variables included BAZ and potential confounders such as child's age, HAZ, and home ownership, an indicator of SES. Because the association of BAZ with these outcomes was non-linear, we used restricted cubic splines (60) to accurately represent its curvilinear shape. One linear term and three spline terms for BAZ were used in the models. These analyses were conducted separately for boys and girls.

Finally, we analyzed the associations of the two components of child's BID, i.e. silhouettes indicated as current and desired, with different child's and mother's responses to additional body image perception questions, representing psychosocial constructs of body image, in order to identify those components which contributed predominantly to the child's concept of BID. Because these variables originated from an ordinal scale and were not normally distributed, we calculated the Spearman correlation coefficients between each pair of variables. Partial correlations were obtained by adjustment for child's age. These analyses were stratified by child's sex and weight status (thin if $BAZ < -1$; normal if $BAZ \geq -1$ and < 1 ; heavy if $BAZ \geq 1$), on the assumption that body image perception depends on those characteristics.

All analyses were conducted with the use of the Statistical Analyses System software (version 9.2; SAS Institute Inc., Cary, NC, USA).

RESULTS

Mean age (\pm SD) of children was 8.6 ± 1.7 years; 51% were boys (**Table 2.1**). Boys had a higher mean (\pm SD) BAZ than girls (0.23 ± 1.17 SD vs. 0.04 ± 0.99 SD, $P=0.10$). Nevertheless, compared to boys, girls chose a slimmer silhouette as their desired body image (3.5 ± 1.3 vs. 3.8 ± 1.4 , $P=0.02$) and had a slightly higher body image dissatisfaction (BID) score (0.2 ± 1.7 vs. 0.0 ± 1.8 , $P=0.17$), representing a greater desire to be thinner. Mothers also chose an average heavier silhouette as the desired body image for their sons (4.3 ± 0.7) compared to their daughters (3.9 ± 0.8 , $P=0.002$), and maternal dissatisfaction with the child's body image score reflected a desire to have heavier children, especially for boys.

Mean silhouettes indicated as current and desired were positively associated with child's age (P , trend= 0.01 and 0.002 , respectively) (**Table 2.2**). Taller children ($HAZ \geq 1$ SD) reported a current silhouette heavier by an average of 0.6 units and a mean higher BID score by 1.2 units, compared to shorter children ($HAZ < -2$ SD) (P , trend= 0.006 and 0.002 , respectively). Silhouette indicated as current and BID score were both positively associated with child's BAZ, with mother's BMI, and with her dissatisfaction with the child's body image. By contrast, silhouette indicated as desired was strongly associated with these three characteristics in an inverse manner. Children whose families owned their house indicated a slimmer silhouette as desired by 0.2 units and had a 0.2 units significantly higher BID score, compared to children whose families did not own their houses ($P=0.03$ and $P=0.04$, respectively). Socioeconomic status according to the government's classification of household was not associated with body image perception of the child.

We further studied the associations of child body image dissatisfaction components (silhouettes indicated as current or desired, and BID score) with actual current weight status (BMI-for-age z -score, BAZ), using multivariable linear regression adjusted for child's age, height-for-age z -score, and home ownership, an indicator of SES (**Figure 2.1**). Silhouette indicated as current was positively associated with BAZ in boys and girls. A steep linear relation was observed above $BAZ > -1$. Compared to boys, girls chose a heavier current body image silhouette at BAZ values of about < -0.5 or > 0.5 ; however, this difference was statistically significant only at BAZ values > 1.5 . The mean estimated silhouette value \pm SE for $BAZ=0$ was

about the same for boys and girls (3.9 ± 0.1 vs. 3.8 ± 0.1 , respectively; mean difference = 0.1, 95% CI = -0.2, 0.4). There was a weak positive association of desired body image score with BAZ at BAZ values < 0 and a weak inverse relation at BAZ > 0 . This association did not vary significantly by sex. The association of BID score with BAZ followed a 'J'-shape in boys and girls. BID was larger in girls than boys at any level of BAZ, although this difference was statistically significant only at BAZ values between 1.2 and 1.9. Estimated mean \pm SE BID score at BAZ = 0 was -0.1 ± 0.2 in boys and 0.0 ± 0.2 in girls (mean difference = -0.1, 95% CI = -0.6, 0.3).

We next examined the correlations of body image dissatisfaction components with other constructs related to body image that were reported by the children and mothers, after adjustment for child's age. Silhouette indicated as current by the child was not correlated with any of the child's body image perception constructs in boys (**Table 2.3**). It was positively correlated with silhouette indicated as 'normal' in thin girls, and with the one indicated as 'looks best' among normal-weight girls. Silhouette indicated as desired was positively correlated with silhouette indicated as 'looks best' in all boys and among normal-weight girls. It was also positively correlated with silhouette indicated as 'normal' in normal-weight boys and girls; and strongly among thin girls ($r = 0.7$). Desired silhouette was also positively associated with silhouette indicated as 'has more friends' in normal-weight boys. Among thin boys, silhouette indicated as desired was positively correlated with silhouette indicated as 'strongest' ($r = 0.4$). Silhouette indicated as current by the mother was positively correlated with silhouette indicated as current by the child among normal-weight children. Silhouette indicated as desired by the child was positively associated with silhouette indicated as desired by the mother in normal-weight boys and, even more strongly, in thin and heavy girls.

DISCUSSION

We examined sociodemographic and anthropometric correlates of body image perception in Colombian school children. Body image perception of the child was associated with child's weight and height, as well as with the mother's BMI and her dissatisfaction with the child's body. In addition, we found that the constructs associated with the components of body image dissatisfaction vary according to the child's sex and weight status.

The strongest predictor of body image dissatisfaction was the children's actual weight status. Consistent with previous reports in other populations(20, 40, 61-64), thin children express a strong desire to be larger, whereas heavy children characteristically desire to be slimmer. Because silhouette indicated as desired varied less by measured weight categories than by the children's perception of their current weight; the positive association of BAZ with BID score was mostly driven by the latter. We also found strong positive associations between maternal BMI and the child's body image perception. These associations result from a high correlation between maternal and child BMI due to common causes. However, it is also possible that the child's perception of his or her mother's actual weight has an independent effect on the child's own body perception. Previous studies (65, 66) suggested that children's perception of their mothers is a more reliable indicator of maternal impact on the child's own body image perception than maternal self-report, because children's perception of their mother correlates more closely with children's awareness of maternal weight-related concerns and behaviors. Although an extensive body of literature documents the positive association between the weight status of parents and their perceptions of their child's body image(13-16), less is known about the way children perceive their parents' actual weight, and whether these perceptions in turn are reflected in their perceptions of their own body image independent of their own actual weight.

In addition to sex and weight, height was also a significant correlate of body image perception of the child. This finding is especially interesting, because the child-adapted scales are composed of silhouettes of the same height. It is possible that taller children perceive themselves as being heavier, independent of their actual weight status. An extensive body of literature reviewed in detail elsewhere (67, 68) found that both men and women overestimate their height; and so do short children and their parents (69). These studies, however, did not

examine height perception in relation to body image concerns. Most research on body image dissatisfaction has been conducted in relation to a person's weight status, and only few studies have examined height in relation to body image concerns. For example, studies conducted in patients with eating disorders (70, 71) found that body image dissatisfaction may be related to nonweight-related body image concerns, including height. In a study of adolescents and young adults in China(72), physical stature was an important correlate of body image dissatisfaction because tallness conforms to local norms of desired physical appearance, independent of weight. Our results are consistent with these studies, but extend them by suggesting that height may play an important role in shaping body image perceptions of weight in healthy school-aged children experiencing the nutrition transition.

Consistent with previous studies showing that higher SES was associated with increased dissatisfaction with body image (62, 73-76); house ownership, an indicator of higher SES, was positively associated with increased body image dissatisfaction in our study. Higher SES is also positively associated with obesity in societies at the early stages of the nutrition transition(77), including ours (78). It is therefore possible the association between SES and body weight be mediated by body image perception. The fact that the association of house ownership with BID seemed driven by the higher SES children's desire for a slimmer body, rather than by a misperception of current body size, supports the notion that higher SES children may be more exposed to Westernized ideals of thinness(21, 33, 40-43).

Girls in our study perceived themselves as heavier compared to boys, regardless of their actual weight. These sex-differences in perception of current body image resulted in an average BID score that was typically higher in girls than boys, reflecting girls' greater desire for a slimmer body. Our results are consistent with other studies(62, 73) which found greater body image dissatisfaction among female children and adolescents, compared to boys. In addition, although none of the psychosocial constructs of body image perception were related to silhouette indicated as current in boys, some of them were positively associated with silhouette indicated as current in thin and normal-weight girls. These results suggest that in contrast to boys, psychosocial factors may play a larger role in girls' perception of their body image, and they are consistent with previous studies conducted in comparable settings. For example, Chen and colleagues(51) found that compared to boys, Taiwanese girls expressed increased awareness and

internalization of sociocultural ideals of physical appearance, and these psychological characteristics affected their overall self-perception. Similarly, a study conducted among Chinese adolescents(79) found that among girls, but not boys, dissatisfaction with one's weight was associated with greater exposure to foreign media and with concerns regarding physical appearance. A longitudinal study among US adolescents(80) found that compared to boys, for whom body image dissatisfaction stemmed mainly from ideals of muscularity, social interactions and social norms contributed more to body image dissatisfaction in girls. Knauss, Paxton and Alsaker(81) also found sex-specific differences in the sociocultural factors contributing to body image dissatisfaction among Australian adolescents, among whom girls, compared to boys, showed higher levels of body dissatisfaction, internalization of media body ideals, and perceived pressure to achieve these ideals.

That body image dissatisfaction is composed of different constructs in boys and girls echoes in sex-differences in correlations of desired body image with other body image constructs after children are stratified according to their sex and weight status. For example, desired body image was correlated with silhouette indicated as 'looks best' in all children except for thin and heavy girls. We also found an exceptionally high correlation between desired body image and silhouette indicated as 'normal' in thin girls only. Associating desired body image with that perceived as normal could be attributed to the fact that these girls perceive themselves as being abnormally thin compared to their normal-weight and heavy peers. This perception of self as being abnormally-thin may thus have resulted in a desire for a larger body image. The absence of a similar correlation in thin boys may be explained by a possibly lower impact of psychosocial and sociocultural factors on body image perception in boys compared to girls, as we suggested above. The fact that thin and heavy girls did not associate their desired body image with the silhouette indicated as 'looks best' may also indicate that body image dissatisfaction in girls at the two ends of the weight distribution may be attributed to different components compared to their normal-weight peers and to boys in general.

An interesting finding was that silhouette indicated as 'strongest' was correlated with silhouette indicated as desired in thin boys only. While some studies found that muscularity ideals contributed greatly to development of body perception among boys in particular(80), there have been conflicting reports regarding a desire for a slimmer body vs. a larger one among male

children and adolescents(82). These inconsistencies across studies may have originated from failure to examine body image perception in boys with respect to their actual weight. Stratifying children according to their actual weight status has enabled us to find that physical strength is a unique component of body image perception in thin boys in particular. This could be due to the fact that thin boys tend to desire a more muscular body in particular, whereas normal-weight and heavy boys are possibly more concerned with being slimmer.

Correlations between silhouettes indicated as current by the child and by the mother were only observed in normal-weight children. These correlations may reflect higher levels of agreement between perceived body size and actual body in normal-weight children and their mothers. Previous studies found that weight misperception in both children and their parents is affected by a child's actual weight and therefore is more prevalent in children below or above the normal weight range(47-50). Therefore, it is likely that discordant misperceptions of child's actual weight between mothers and their thin or heavy children may explain the absence of observed mother-child correlations in perceived body image of the child.

Desired silhouette for the child, as indicated by the mother, seemed to affect body image dissatisfaction to a greater extent in girls compared to boys, and was highly correlated with silhouette indicated as desired by the child in thin and heavy girls in particular. Previous studies found a greater accordance in body perception between mothers and their daughters, compared to mothers and their sons(43, 44, 83, 84). Our results are consistent with previous studies that found that mother-daughter relationships affected child's body image to a greater extent compared to relationships of mothers with their sons(85, 86). Maternal modeling of weight-related attitudes and behaviors may, therefore, play a greater role in determining body image perception among girls than boys.

There was a disagreement between children and their mothers with regard to dissatisfaction with the child's body image. The observed child's BID score was positive on average, reflecting a desire to be thinner, whereas maternal dissatisfaction with the child's body was negative on average; representing a desire for a larger child. Of note, mothers in our study preferred a larger body for their child regardless of the fact that children were heavier on average than the international reference. These mother-child dissimilarities in dissatisfaction with the

child's body may be explained by intergenerational differences with regard to weight and health, which are characteristic of societies undergoing the nutrition transition. In other words, maternal desire for a larger child may be derived from traditional concepts associating improved health and physical appearance with heaviness of the child as a result of economic conditions or lack of health knowledge(50). In contrast, children in societies at more advanced stages of economic development are more likely to associate these qualities with a thinner body image due to greater internalization of Westernized ideals of thinness, and therefore tend to desire a slimmer body image for themselves.

Our study has several strengths. Participants represented low- and middle-income children from a population experiencing the nutrition transition. Additionally, we were able to investigate various components of the child's body image perception according to the sex and the weight of the child. There are also some limitations to the study. First, its cross-sectional design limits the possibility of inferring the temporal sequence of the associations observed. Second, because study participants were of low- and middle-SES levels generalization of the results to higher SES groups is limited. Finally, although the child-adapted figurine rating scale has been formally validated in comparable settings(58, 87), it has not been validated in our population.

In conclusion, we found that body image perception is associated with child's weight and height, as well as with maternal BMI and dissatisfaction with the child's body image, in a setting that is at the earlier stages of the nutrition transition. We also found that the psychosocial meaning of body image perception components varies by sex and actual weight status of the child. Additional research is needed to further clarify correlates of maternal perception of the child's body image, including the mother's perception of her own body image. In addition, longitudinal studies may enhance our understanding of the impact of body image perception on weight trajectories in the child and whether interventions geared toward modification of these perceptions affect growth trajectories during childhood and into adolescence.

Table 2.1: Characteristics of school-aged children and their mothers at time of recruitment

	Mean ± SD or %		
	All (n=629)	Boys (n=320)	Girls (n=309)
Child's characteristics			
Age, years	8.6 ± 1.7	8.6 ± 1.7	8.5 ± 1.7
Child was born in Bogotá	88.4%	89.0%	87.7%
Height-for-age z-score ¹	-0.66 ± 0.93	-0.69 ± 0.94	-0.64 ± 0.92
Body mass index-for-age z-score ¹	0.14 ± 1.09	0.23 ± 1.17	0.04 ± 0.99
Playing outside, hours/wk	7.0 ± 8.5	7.5 ± 9.0	6.3 ± 7.8
TV viewing/video game playing, hours/wk	17.3 ± 13.5	17.6 ± 14.3	17.1 ± 12.6
Maternal characteristics			
Age, years	35.6 ± 6.9	35.6 ± 7.0	35.6 ± 6.7
Mother was born in Bogotá	39.0%	35.9%	42.1%
Education, years	9.0 ± 3.3	9.0 ± 3.3	9.0 ± 3.2
Mother is a single parent	23.5%	24.1 %	23.0%
Parity			
1	12.7%	13.4%	12.1%
2	38.3%	36.6%	40.0%
3	28.0%	26.0%	30.0%
≥4	21.0%	24.0%	17.9%
Height, cm	158.0 ± 6.3	157.7 ± 6.2	158.3 ± 6.3
BMI, kg/m ²	24.2 ± 3.9	24.2 ± 3.9	24.1 ± 4.0
Household characteristics			
Number of home assets ²	4.1 ± 1.6	4.1 ± 1.6	4.1 ± 1.5
Lower socioeconomic status ³	24.2%	27.2%	21.1%
House is owned by family	31.3%	31.7%	30.9%
Child's body image perception⁴			
Silhouette indicated as "normal"	4.4 ± 1.2	4.5 ± 1.1	4.3 ± 1.3
Silhouette indicated as "looks best"	3.8 ± 1.5	3.9 ± 1.5	3.8 ± 1.5
Silhouette indicated as "has more friends"	4.4 ± 2.1	4.4 ± 2.1	4.4 ± 2.1
Silhouette indicated as "strongest"	6.7 ± 1.5	6.6 ± 1.6	6.8 ± 1.5
Silhouette indicated as current	3.8 ± 1.3	3.8 ± 1.3	3.8 ± 1.3
Silhouette indicated as desired	3.6 ± 1.3	3.8 ± 1.4	3.5 ± 1.3
Body image dissatisfaction score ⁵	0.1 ± 1.7	0.0 ± 1.8	0.2 ± 1.7
Maternal body image perception of child⁶			
Silhouette indicated as "healthiest for child's age"	4.0 ± 0.9	4.2 ± 0.8	3.9 ± 0.9
Silhouette indicated as current	3.6 ± 1.1	3.6 ± 1.2	3.5 ± 1.1
Silhouette indicated as desired	4.1 ± 0.8	4.3 ± 0.7	3.9 ± 0.8
Dissatisfaction with child's body image score ⁵	-0.5 ± 1.1	-0.7 ± 1.2	-0.4 ± 1.1

¹ According to the World Health Organization 2007 growth references (59).

² From a list that included bicycle, refrigerator, blender, television, stereo, and washer machine.

³ Stratum 1 or 2 of a maximum 4 in the sample and a maximum of 6 total, according to the government's classification for tax and planning purposes.

⁴ Mean ± SD rating of child-adapted Stunkard scales consisting of 8 silhouettes in increasing order of girth from 1 (thinnest) to 8 (heaviest).

⁵ Body image dissatisfaction was calculated as the desired body image subtracted from current body image, according to the interviewee's rating of child-adapted Stunkard scales.

⁶ In a sub-sample of 367 children.

Table 2.2: Body image perception in 629 school-aged children according to sociodemographic and anthropometric characteristics

	% (n ¹)	Mean ±SD ²		
		Silhouette indicated as <u>current</u>	Silhouette indicated as <u>desired</u>	Body Image Dissatisfaction Score ³
Child's sex				
Boys	50.9 (320)	3.8 ± 1.3	3.8 ± 1.4	0.0 ± 1.8
Girls	49.1 (309)	3.8 ± 1.3	3.5 ± 1.3	0.2 ± 1.7
P ⁴		0.79	0.02	0.17
Child's age, years				
5-6	22.9 (144)	3.5 ± 1.5	3.4 ± 1.9	0.1 ± 2.4
7-8	28.5 (179)	3.8 ± 1.3	3.6 ± 1.3	0.2 ± 1.7
9-10	42.9 (270)	3.9 ± 1.1	3.8 ± 1.0	0.1 ± 1.3
11-12	5.7 (36)	3.8 ± 1.1	3.8 ± 1.0	-0.1 ± 1.4
P, trend ⁴		0.01	0.002	0.51
Child was born in Bogotá				
Yes	88.4 (524)	3.8 ± 1.3	3.6 ± 1.4	0.2 ± 1.7
No	11.6 (69)	3.7 ± 1.2	3.9 ± 1.2	-0.2 ± 1.8
P ⁴		0.32	0.09	0.13
Child's height-for-age z-score ⁵				
<-2	7.1 (45)	3.5 ± 1.3	4.0 ± 1.5	-0.4 ± 2.1
≥-2 and <-1	29.1 (183)	3.6 ± 1.3	3.7 ± 1.4	0.0 ± 1.8
≥-1 and <1	60.1 (378)	3.9 ± 1.2	3.6 ± 1.3	0.2 ± 1.6
≥1	3.7 (23)	4.1 ± 1.0	3.3 ± 1.9	0.8 ± 1.7
P, trend ⁴		0.006	0.11	0.002
Child's BMI-for-age z-score ⁵				
<-2	2.1 (13)	2.8 ± 0.9	3.5 ± 1.2	-0.6 ± 1.6
≥-2 and <-1	13.0 (82)	3.0 ± 1.1	4.1 ± 1.4	-1.1 ± 1.5
≥-1 and <1	63.9 (402)	3.6 ± 1.2	3.7 ± 1.4	0.0 ± 1.6
≥1 and <2	15.7 (99)	4.6 ± 1.1	3.3 ± 1.2	1.3 ± 1.6
≥2	5.3 (33)	5.4 ± 0.5	3.4 ± 1.3	1.9 ± 1.3
P, trend ⁴		<0.0001	0.0007	<0.0001
TV viewing/video game playing, h/wk				
≤10.0	35.9 (188)	3.7 ± 1.3	3.7 ± 1.4	0.1 ± 1.8
10.1-20.0	29.0 (152)	3.8 ± 1.3	3.6 ± 1.3	0.2 ± 1.6
20.1-30.0	19.9 (104)	3.9 ± 1.3	3.4 ± 1.3	0.5 ± 1.6
>30.0	15.1 (79)	3.8 ± 1.1	3.9 ± 1.4	0.0 ± 1.7
P, trend ⁴		0.31	0.85	0.58
Playing outside, h/wk				
≤2.0	22.6 (111)	3.8 ± 1.4	3.7 ± 1.5	0.0 ± 2.0
2.1-5.0	30.1 (148)	3.7 ± 1.2	3.4 ± 1.3	0.3 ± 1.7
5.1-8.0	24.9 (122)	3.9 ± 1.2	3.8 ± 1.5	0.1 ± 1.6
>8.0	22.4 (110)	3.7 ± 1.3	3.6 ± 1.1	0.1 ± 1.7

P, trend ⁴		0.89	0.87	0.99
Maternal age, years				
20-29	23.4 (136)	3.8 ± 1.3	3.6 ± 1.5	0.1 ± 2.0
30-34	25.8 (150)	3.7 ± 1.2	3.5 ± 1.3	0.2 ± 1.6
35-39	23.6 (137)	3.8 ± 1.3	3.7 ± 1.4	0.1 ± 1.9
≥ 40	27.2 (158)	3.8 ± 1.2	3.7 ± 1.2	0.1 ± 1.6
P, trend ⁴		0.61	0.55	0.93
Maternal BMI (kg/m ²)				
<18.5	3.3 (18)	3.4 ± 0.9	3.8 ± 1.6	-0.3 ± 1.6
18.5-24.9	62.3 (344)	3.7 ± 1.3	3.7 ± 1.4	0.0 ± 1.8
25.0-29.9	25.9 (143)	3.9 ± 1.2	3.5 ± 1.3	0.4 ± 1.7
≥30	8.5 (47)	4.0 ± 1.4	3.3 ± 1.4	0.7 ± 1.9
P, trend ⁴		0.02	0.02	0.0004
Maternal dissatisfaction with child's body ²				
Desire for a larger body	45.8 (168)	3.2 ± 1.3	3.9 ± 1.5	-0.6 ± 1.7
Satisfied	39.0 (143)	3.9 ± 1.1	3.3 ± 1.3	0.6 ± 1.6
Desire for a thinner body	15.2 (56)	4.8 ± 1.0	3.4 ± 1.1	1.4 ± 1.5
P, trend ⁴		<0.0001	0.002	<0.0001
Socioeconomic status ⁶				
1	2.1 (13)	3.7 ± 1.2	3.8 ± 1.1	-0.2 ± 1.2
2	22.1 (139)	3.9 ± 1.2	3.6 ± 1.5	0.3 ± 1.8
3	62.1 (39)	3.7 ± 1.3	3.6 ± 1.3	0.1 ± 1.7
4	13.7 (86)	3.8 ± 1.3	3.7 ± 1.3	0.2 ± 1.8
P, trend ⁴		0.57	0.99	0.69
House owned by the family				
Yes	31.3 (183)	3.8 ± 1.3	3.5 ± 1.3	0.3 ± 1.7
No	68.7 (401)	3.8 ± 1.2	3.7 ± 1.3	0.1 ± 1.8
P ⁴		0.74	0.03	0.04

¹ Totals may be <629 due to missing values.

² Mean ± SD rating of child-adapted Stunkard scales consisting of 8 silhouettes in increasing order of girth from 1 (thinnest) to 8 (heaviest).

³ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the interviewee's rating of adapted Stunkard scales. A negative score represents a desire for a larger body. A zero score represents body image satisfaction. A positive score represents a desire for a thinner body. Values are means ± SD.

⁴ From Wilcoxon's rank-sum test for dichotomous variables. For all other variables (ordinal), P was for a test of linear trend when a variable that represented the ordinal categories of the predictor was introduced into a linear regression model as continuous (Wald test).

⁵ According to the World Health Organization 2007 growth references (59).

⁶ According to the government's classification for tax and planning purposes.

Table 2.3. Correlations of body image perception components in school-aged children^{1,2}

	Boys		Girls	
	Silhouette indicated <u>as current</u>	Silhouette indicated <u>as desired</u>	Silhouette indicated <u>as current</u>	Silhouette indicated <u>as desired</u>
BMI-for-age z-score < -1 ³				
Silhouette indicated as “normal”	-0.02	0.08	0.36*	0.73*
Silhouette indicated as “looks best”	0.13	0.39*	0.29	0.02
Silhouette indicated as “has more friends”	-0.03	0.16	0.29	0.29
Silhouette indicated as “strongest”	0.08	0.44*	-0.05	0.16
Silhouette indicated as current by mother	0.07	-0.06	0.21	0.18
Silhouette indicated as desired by mother	-0.05	-0.07	0.28	0.53*
BMI-for-age z-score ≥-1 and <1 ³				
Silhouette indicated as “normal”	0.13	0.25*	0.06	0.18*
Silhouette indicated as “looks best”	0.02	0.20*	0.21*	0.33*
Silhouette indicated as “has more friends”	0.07	0.25*	-0.01	0.03
Silhouette indicated as “strongest”	0.14	0.14	-0.17	-0.01
Silhouette indicated as current by mother	0.42*	0.02	0.21*	-0.11
Silhouette indicated as desired by mother	0.08	0.22*	-0.08	-0.05
BMI-for-age z-score ≥1 ³				
Silhouette indicated as “normal”	-0.15	0.23	0.24	-0.13
Silhouette indicated as “looks best”	0.09	0.33*	-0.06	0.25
Silhouette indicated as “has more friends”	-0.01	-0.14	0.05	0.05
Silhouette indicated as “strongest”	0.01	-0.07	0.20	-0.03
Silhouette indicated as current by mother	0.20	-0.15	0.32	0.28
Silhouette indicated as desired by mother	0.03	0.00	-0.02	0.38*

¹ Partial Spearman correlations, adjusted for child’s age. Significant correlation coefficients ($P \leq 0.05$) are noted by asterisk (*).

² Based on the interviewee’s rating of child-adapted Stunkard scales consisting of 8 silhouettes in increasing order of girth from 1 (thinnest) to 8 (heaviest). Child’s body image perception: n=629. Maternal body image perception: n= 347.

³ According to the World Health Organization 2007 growth references(59).

Figure 2.1: Body image components in school-aged boys and girls according to child's BMI-for-age z-score (BAZ)

Figure 1a. Silhouettes indicated as current and desired according to child's BAZ

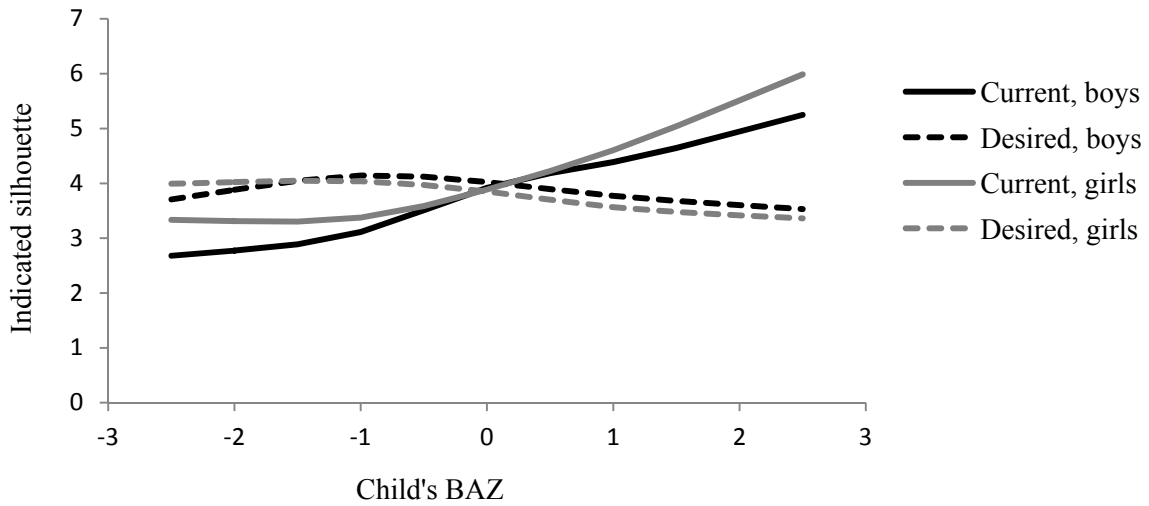
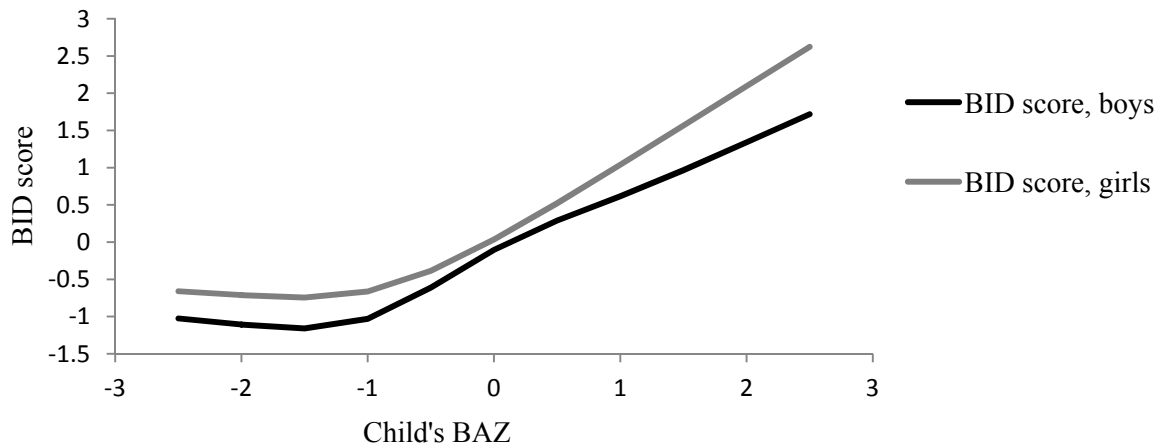


Figure 1b. Body image dissatisfaction (BID) score according to child's BAZ



Body mass index z -score-for-age (BAZ) was calculated according to the World Health Organization 2007 growth references(59).

Silhouettes indicated as either current or desired were based on child's ratings of child-adapted Stunkard scales. Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image.

Curves were constructed using linear regression models with silhouette indicated as either current or as desired, or BID, as the outcome and spline terms for BAZ as predictors. All models were adjusted for child's age and height-for-age z -score (HAZ), as well as for home ownership status. Values are plotted at the population mode for age (11-12 y), mean HAZ and no home ownership. Robust estimates of variance were used in all models.

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Chapter 3:

A prospective study of body image dissatisfaction and BMI change in school-age children

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INTRODUCTION

Many developing countries have been undergoing a rapid nutrition transition with sharper increases in rates of obesity and obesity-related chronic diseases compared to those observed in developed countries(3, 88, 89). Childhood obesity is of special concern because, in addition to its multiple adverse effects on health in the short term(35), it tracks into adulthood(36) and predicts the development of chronic diseases later in life(35). While research has focused on the immediate causes of childhood obesity that affect energy balance, including dietary intake and physical activity(38, 39), fewer studies have focused on the role that psychosocial characteristics may play on this epidemic. Body image perception, defined as “the picture we have in our minds of the size, shape and form of our bodies; and our feelings concerning these characteristics and our constituent body parts”(90), is one critical psychosocial factor that is related to body weight. While mostly investigated in the context of eating disorders, body image dissatisfaction is highly prevalent among healthy boys and girls(40, 42, 91, 92).

Body image dissatisfaction is associated with weight status, as heavier individuals tend to be more dissatisfied with their body image compared to normal-weight people. The common assumption is that increased weight leads to dissatisfaction with one's body. However, body image dissatisfaction may lead to obesity through increase in sedentary behavior(20, 21), or through social isolation and depression(22, 23). Body image concerns and weight-related anxiety may also contribute to excessive weight gain over time(24). Yet, the vast majority of these studies investigating the associations between body image dissatisfaction and weight status in children have been cross-sectional in nature. While obesity can lead to body image dissatisfaction, cross-sectional studies do not allow ascertaining whether body image dissatisfaction could also lead to obesity.

Body image dissatisfaction is likely to increase in developing countries(93) in parallel with urbanization and exposure to mass media that promote stereotypical ideas of body shape(51-54). Because body image perception is potentially modifiable(30), it is crucial to determine whether it can lead to the development of adiposity in children over time.

We conducted a prospective study to investigate whether body image dissatisfaction predicts development of adiposity in school-age children. These children were recruited from public schools of Bogotá, Colombia, an upper middle income level country undergoing epidemiologic and nutrition transitions in recent years. We hypothesized that body image dissatisfaction may predict differences in the growth trajectories of children.

METHODS

Study population and field methods

The study was conducted using the Bogotá School Children Cohort, a nutrition and health study of primary schoolchildren in Bogotá, Colombia. As previously described(55), recruitment was based on a cluster sampling strategy, in which clusters were defined as classes from all 361 primary public schools in Bogotá by the end of 2005. In February 2006, we enrolled 3,202 children ages 5-12 years who represented 2,983 households, after accounting for siblings. The study population is representative of low- and middle-income families in the city, since the majority of children in the public school system are from these strata(56). Self-administered questionnaires were filled by parents during the first week of classes (82% response rate). The questionnaires inquired about sociodemographic characteristics, including maternal age, birthplace, marital status, parity, years of education, and indicators of household socioeconomic level such as the government's classification of neighborhoods for tax and planning purposes, home ownership status, and number of home assets (including bicycle, refrigerator, blender, television, stereo, and washer machine).

Maternal body mass index (BMI) was calculated from measured height and weight in 26% of the mothers and from self-reported data otherwise. Information on the child's time spent playing outdoors or in front of a screen was also collected at baseline.

During the three weeks post-recruitment, professionally-trained research assistants visited schools and obtained information on body image perception from a randomly-chosen sub-sample of 651 children. This was achieved with use of a Stunkard-like figurine rating scale(94) which had been previously adapted and validated in children(58). This sex-specific visual tool depicts eight silhouettes in an increasing order of body girth from one (thinnest) to eight (largest). Children were asked to choose the silhouette that resembled the way they looked (current body image), and the one that represented how they would like to look (desired body image). At the same school visits, height and weight of the children were measured using standard protocols(57). Height was measured without shoes to the nearest 1 mm using wall-mounted

portable Seca 202 stadiometers, and weight was measured in light clothing to the nearest 0.1 kg on Tanita HS301 solar-powered electronic scales.

Study dietitians visited children at schools again in June and November 2006 and annually thereafter until 2008. At these visits, new anthropometric measurements were obtained, following the same protocol. When children were absent from school on the day of assessment, home visits were arranged and the measurements took place at home. Sex- and age-specific height- and BMI-for age z -scores were calculated according to the World Health Organization reference(59).

Written informed consent was obtained from parents or primary caregivers of all children prior to enrollment. The study protocol was approved by the Ethics Committee of the National University of Colombia Medical School. The Health Sciences and Behavioral Sciences Institutional Review Board at the University of Michigan approved the use of data from the study.

Data analysis

Of the 650 children in the subsample with body image information, 629 had anthropometric measurements available at baseline and at one or more follow-up assessments, and they constituted the analytic sample for this study. These children did not differ from the rest of the cohort in terms of sex, age, socioeconomic status, or anthropometric characteristics. Body image dissatisfaction (BID) score was calculated as the silhouette number indicated as desired subtracted from the silhouette number indicated as current, according to the child's rating of the adapted Stunkard scale. BID was categorized as negative when desired body image was greater than current body image, representing a desire for a larger body size; zero when desired body image was equal to current body image, reflecting satisfaction with body image; or positive when desired body image was smaller than current body image, i.e, a desire for a thinner body.

Average BMI-for-age growth curves were estimated for each BID category with the use of mixed-effect models for repeated measurements with restricted cubic splines(60). Cubic splines represent non-linear terms for age at each assessment that allow the smoothing of a growth curve. Piecewise cubic polynomials were smoothly jointed at joint points or "knots"(60).

We placed these knots at 6, 8, 10, 12 and 13 years of age in order to properly capture the curvilinear segments of the BMI-for-age curve during this period. Each model included BMI as the outcome, whereas predictors were indicator variables for BID categories, linear and spline terms for child age in decimal years, and interaction terms between BID category indicators and the linear and spline terms for age. We included random effects for the intercept and the linear term of age (slope) to account for within-child correlations of measurements in the estimation of variance(95). All available measurements were included in the models since these methods do not require that all participants provide the same number of measurements or that these measurements be obtained at the same time(96). The outcome of interest was change in BMI between ages 6 and 14, estimated from the growth curves for each BID group. Adjusted differences in change with 95% confidence intervals (95% CI) were estimated by introducing potential confounders into the mixed models as additional covariates. These included previously reported correlates of child overweight in this population, such as child birthplace, maternal marital status and BMI, and household socioeconomic status(78). Analyses were conducted separately for boys and girls. In addition, since we hypothesized that both BID and weight trajectories depend on weight status of the child, we categorized participants by their BMI-for-age z-scores at time of recruitment (BMI-for-age z -score < -0.5 , ≥ -0.5 and < 0.5 , or ≥ 0.5 , representing thin, normal-weight, and heavy children at baseline, respectively). These cut-offs were chosen to assure that the normal-weight children had an especially low risk of being either under- or overweight at baseline by carefully separating them from the groups of thinner or heavier children.

All analyses were conducted with the use of the Statistical Analyses System software (version 9.2; SAS Institute Inc).

RESULTS

Forty-nine percent (n=309) of children in the study were girls (**Table 3.1**). Mean (\pm SD) age at time of recruitment was 8.6 ± 1.7 years. Mean height-for-age z-score (HAZ) and BMI-for-age z-score (BAZ) were -0.7 ± 0.9 and 0.1 ± 1.1 , respectively. Overall, mean (\pm SD) body image dissatisfaction score (current minus desired silhouette) was 0.1 ± 1.7 . Thirty-eight, twenty-two, and forty percent of the children had negative, zero, and positive BID, respectively. Mean (\pm SD) follow-up time was 28.0 ± 7.1 months, during which a median of 4 anthropometric measurements per child were obtained.

In univariate analyses, BID was not significantly associated with change in BMI between ages 6-14 y (**Table 3.2**). However, among children with low or high BMI at baseline, BID significantly predicted BMI trajectories (**Figure 3.1**). In multivariable analyses (**Table 3.3**), thin boys (baseline BMI-for-age z-score < -0.5) who desired to be thinner gained an estimated 5.8 kg/m^2 more BMI from ages 6 to 14 y, compared to thin boys without BID ($P=0.0004$) (**Table 3.3**). Overweight boys (baseline BMI-for-age z-score ≥ 0.5) who desired to be larger gained an estimated 4.2 kg/m^2 more BMI than overweight boys without BID at time of recruitment ($P=0.003$). Overweight boys who desired to be thinner gained an estimated 3.3 kg/m^2 ($P=0.007$) more BMI than their overweight peers who were satisfied with their body image at baseline. Thin girls who desired to be larger gained an estimated 3.1 kg/m^2 less BMI compared to thin girls without BID at the time of recruitment ($P=0.008$). Similarly, thin girls who desired to be thinner gained an estimated 2.2 kg/m^2 less BMI between ages 6 and 14 y, compared to their thin peers who were satisfied with their body image at baseline ($P=0.05$). Among overweight girls, those who desired to be larger gained 4.8 kg/m^2 less BMI than those without BID at enrollment ($P=0.0006$). No associations were observed between the level of BID and BMI change among boys or girls of normal weight at baseline (BMI-for-age z-score ≥ -0.5 and < 0.5).

DISCUSSION

In this longitudinal study of school-age children from Bogotá, Colombia, we found that baseline body image dissatisfaction was associated with BMI change during follow-up, with important differences according to sex and baseline weight status. BID was related to faster weight gain in overweight boys and to slower weight gain in thin girls; in addition, overweight girls who desired to be larger gained less weight than those without BID whereas, paradoxically, thin boys who desired to be thinner gained more weight than those without BID. Although it is not possible to determine whether body image perception is causally related to the development of adiposity from this observational study, the results indicate that children's dissatisfaction with their body may play an important role in their growth process.

Previous studies had suggested that childhood obesity was associated with a desire to be thinner whereas thinness was related to a desire to be larger(20, 40, 62, 97). In other words, overweight and obese boys and girls tend to desire a thinner body image, while thin children usually desire to be larger (or less thin). However, these studies had a cross-sectional design which prevented them from establishing whether BID influences weight status or vice versa.

Our results extend the current body of literature in several ways. First, we conducted a longitudinal investigation in which BMI change, as it relates to baseline BID levels, was ascertained overtime. Second, we examined the associations between BID and BMI after stratifying the children according to their sex and their actual weight status at baseline. Associations of BID with BMI trajectories were found among overweight and thin children, who were likely to be more concerned with their body image compared to normal-weight children. We found that BID in any direction among overweight boys led to faster weight gain; similarly, BID in any direction among thin girls led to slower weight gain. This indicates that the mere presence of body image dissatisfaction, and not necessarily its specific direction, might influence weight gain over time and this may worsen any ongoing trends toward adiposity or thinness. Furthermore, a potential effect of BID would seem to occur in opposite directions for boys and girls. The associations between BID and weight gain could be explained by weight-control behaviors like skipping meals or binge eating(98), or by overweight-related anxiety that may impair one's coping capabilities and thus lead to additional weight gain(24). Body image

dissatisfaction could potentially contribute to the development of adiposity via additional behavioral and social pathways, including a reduction in physical activity(20, 21), social isolation, and depression(22, 23).

Of note, BID in normal-weight children was not associated with the development of adiposity over follow-up in our study. These findings differ from those of previous longitudinal studies of the association of BID with weight trajectories among normal-weight individuals. A prospective study conducted in Norway(99) found that normal-weight adolescents of both sexes who perceived themselves as overweight at baseline gained significantly more weight during an 11-year period, compared to adolescents who were satisfied with their body weight. These differences remained statistically significant after adjusting for physical activity and sedentary behavior, SES, social activity, and eating behaviors. In the longitudinal Coronary Artery Risk Development in Young Adults (CARDIA) study conducted in adult men and women in 4 U.S cities(24), normal-weight white men and women who perceived themselves as overweight at baseline gained more weight compared to adults of the same sex or race who perceived themselves as normal weight. The fact that we did not observe an association of BID with weight trajectories in normal-weight children, by contrast with previous studies, may be a result of various factors, including differences in the length of follow-up, varying prevalence of body image concerns and associated behaviors across populations, and the age distribution at baseline, since participants were younger in our study than those in previous investigations, and concerns with body image may increase with age.(92).

There are several strengths to our study. First, it was conducted in a large sample of children representative of a population that is undergoing rapid increases in childhood obesity. We used state-of-the-art analytic techniques to fit growth curves and had the possibility to examine sex- and weight-specific associations. In addition, the longitudinal design provides an opportunity to examine the directionality of the associations between BID and the development of adiposity, and therefore offers an advantage over prior cross-sectional studies. Last, this study enhances our understanding of the relation of BID on weight gain in children from developing countries, where information is scant.

One limitation of the study is the reliance on a single measurement of exposure (BID) at baseline. We assumed that it remained constant during the follow-up period. If this assumption does not hold, it is not possible to completely preclude reverse causality as a potential explanation of the findings. For example, higher weight gain in children who were already overweight and therefore dissatisfied could have led to continuous dissatisfaction over follow-up. Also, although we controlled in the analyses for important covariates, residual confounding by unmeasured common causes of BID and BMI change cannot be completely ruled out. Finally, while the adapted Stunkard scale has been successfully validated in comparable settings(58, 87), it has not been formally evaluated in our population.

In sum, our findings suggest that body image self-perception in school-age children may play an important role in the development of adiposity during this sensitive period. Since childhood obesity is increasing at an alarming rate in developing countries, meticulous characterization of its causes in the context of the nutrition transition is required for the design and implementation of successful public health interventions. Body image dissatisfaction can be ameliorated through family(100)- and school(101)-based interventions. Thus, clinical or public health activities dealing with BID might have a potential impact on childhood obesity. Future studies are needed to determine whether interventions geared toward modification of body image perception in school-age children affect growth trajectories during childhood and into adolescence.

Table 3.1: Characteristics of school children and their mothers at time of recruitment

	Mean \pm SD or %		
	All	Boys	Girls
	(n=629)	(n=320)	(n=309)
Child's characteristics			
Age, years	8.6 \pm 1.7	8.6 \pm 1.7	8.5 \pm 1.7
Child was born in Bogotá	88.4%	89.0%	87.7%
Height-for-age z-score ¹	-0.66 \pm 0.9	-0.69 \pm 0.9	-0.6 \pm 0.9
Body mass index-for-age z-score ¹	0.14 \pm 1.1	0.23 \pm 1.2	0.04 \pm 1.0
Body image dissatisfaction score ²	0.1 \pm 1.7	0.0 \pm 1.8	0.24 \pm 1.7
Playing outside, hours/wk	7.0 \pm 8.5	7.5 \pm 9.0	6.3 \pm 7.8
TV viewing/video game playing, hours/wk	17.3 \pm 13.5	17.6 \pm 14.3	17.1 \pm 12.6
Maternal characteristics			
Age, years	35.6 \pm 6.9	35.6 \pm 7.0	35.6 \pm 6.7
Mother was born in Bogotá	39.0%	35.9%	42.1%
Education, years	9.0 \pm 3.3	9.0 \pm 3.3	9.0 \pm 3.2
Mother is a single parent	23.5%	24.1 %	22.9%
Parity			
1	12.7%	13.4%	12.1%
2	38.3%	36.6%	40.0%
3	28.0%	26.0%	30.0%
≥ 4	21.0%	24.0%	17.9%
Height, cm	158.0 \pm 6.3	157.7 \pm 6.2	158.3 \pm 6.3
BMI, kg/m ²	24.2 \pm 3.9	24.2 \pm 3.9	24.1 \pm 4.0
Household characteristics			
Number of home assets ³	4.1 \pm 1.6	4.1 \pm 1.6	4.1 \pm 1.5
Lower neighborhood socioeconomic stratum ⁴	24.2%	27.2%	21.1%
House is owned by family	31.3%	31.7%	30.9%

¹ According to the World Health Organization 2007 growth references(59).

² Body image dissatisfaction was calculated as the desired body image subtracted from current body image, according to the child's rating of child-adapted Stunkard scales. [-]: desired > current body image (i.e. "a desire to be larger"); [0]: desired = current body image (i.e. "satisfied with body image"); and [+]: desired < current body image (i.e. "a desire to be thinner").

³ From a list that included bicycle, refrigerator, blender, television, stereo, and washer machine.

⁴ Stratum 1 or 2 of a maximum 4 in the sample and a maximum of 6 total, according to the government's classification for tax and planning purposes.

Table 3.2: BMI change according to body image dissatisfaction in school-age children, Bogotá, Colombia¹

Child's dissatisfaction with body image ²	n	BMI (kg/m ²) at age 6	BMI (kg/m ²) at age 14	BMI change	Adjusted difference (95% CI)
Boys					
Desire to larger (BID=[-])	129	14.8 ± 0.1	18.1 ± 0.3	3.3 ± 0.3	-0.2 (-1.6, 1.2)
Satisfied with body image (BID=[0])	70	15.3 ± 0.4	18.8 ± 0.5	3.5 ± 0.6	reference
Desire to be thinner (BID=[+])	121	16.3 ± 0.3	20.6 ± 0.6	4.3 ± 0.6	0.8 (-0.8, 2.4)
Girls					
Desire to larger (BID=[-])	112	14.4 ± 0.2	20.0 ± 0.4	5.6 ± 0.4	-1.3 (-2.6, 0.1)
Satisfied with body image (BID=[0])	70	15.0 ± 0.3	21.8 ± 0.5	6.8 ± 0.6	reference
Desire to be thinner (BID=[+])	127	15.6 ± 0.2	21.2 ± 0.4	5.6 ± 0.5	-1.4 (-2.8, 0.0)

¹ Values are means ± SE, unless noted otherwise. All values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for child's height-for-age z-score and birthplace, and for maternal BMI and marital status at baseline, as well as for household socioeconomic status. Robust estimates of variance were used in all models.

² Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the child's rating of adapted Stunkard scales.

Table 3.3: Estimated BMI change from ages 6 to 14 years according to body image dissatisfaction in school-age children, stratified by weight status of the child at baseline

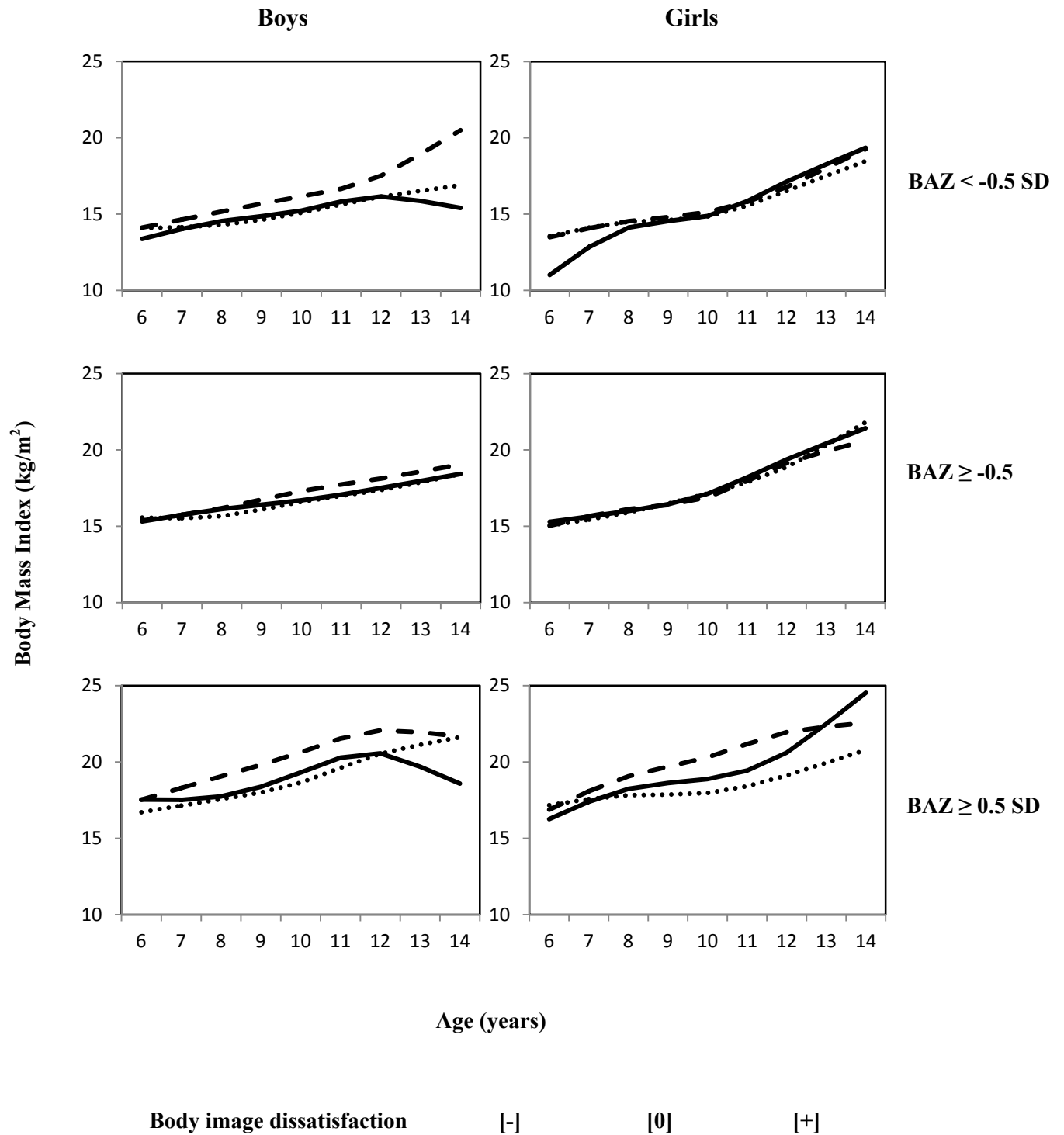
	Boys			Girls		
	BMI change (kg/m ²) ¹ ,		Adjusted difference	BMI change (kg/m ²) ¹ ,		Adjusted difference
	n	Mean ± SE	(95% CI) ¹	n	Mean ± SE	(95% CI) ¹
Baseline BAZ² < -0.5 SD						
Desire to larger (BID=[-]) ³	60	2.8 ± 0.5	1.4 (-1.2, 3.9)	57	4.9 ± 0.4	-3.1 (-4.9, -1.3)
Satisfied with body image (BID=[0])	13	2.0 ± 1.2	reference	20	8.3 ± 0.9	reference
Desire to be thinner (BID=[+])	13	6.4 ± 1.2	5.8 (2.6, 8.9)	13	5.6 ± 0.8	-2.2 (-4.3, 0.0)
Baseline BAZ ≥ -0.5 and < 0.5 SD						
Desire to larger (BID=[-])	52	2.8 ± 0.4	-0.4 (-1.9, 1.0)	41	6.8 ± 0.9	0.8 (-1.4, 3.0)
Satisfied with body image (BID=[0])	32	3.1 ± 0.6	reference	35	6.1 ± 0.6	reference
Desire to be thinner (BID=[+])	28	3.9 ± 0.8	0.6 (-1.4, 2.5)	49	5.6 ± 0.5	-0.5 (-2.1, 1.2)
Baseline BAZ ≥ 0.5 SD						
Desire to larger (BID=[-])	17	4.9 ± 1.0	4.2 (1.4, 7.0)	14	3.6 ± 0.5	-4.8 (-7.5, -2.1)
Satisfied with body image (BID=[0])	25	1.0 ± 1.0	reference	15	8.3 ± 1.3	reference
Desire to be thinner (BID=[+])	80	4.2 ± 0.7	3.3 (0.9, 5.6)	65	5.7 ± 0.6	-2.6 (-5.5, 0.2)

¹ Values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for child's height-for-age z-score and birthplace, and for maternal BMI and marital status at baseline, as well as for household socioeconomic status. Robust estimates of variance were used in all models.

² Body mass index z-score for age, according to the World Health Organization 2007 growth references(59).

³ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the child's rating of child-adapted Stunkard scales.

Figure 3.1: Estimated BMI change from ages 6 to 14 years according to body image dissatisfaction in school-age children, stratified by weight status at baseline



BMI-for-age growth curves were constructed using restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Robust estimates of variance were used in the models.

Body image dissatisfaction was calculated as the desired body image subtracted from current body image, according to the child's rating of child-adapted Stunkard scales. [-]: desired > current body image (i.e. "a desire to be larger"); [0]: desired = current body image (i.e. "satisfied with body image"); and [+]: desired < current body image (i.e. "a desire to be thinner").

BAZ: Body mass index z-score for age, according to the World Health Organization 2007 growth references(59).

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Chapter 4:

You Are What Your Mother Sees: Maternal Body Image Perception and BMI Change in School-age Children

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INTRODUCTION

The rapid nutrition transition in many developing countries has resulted in increased obesity rates and obesity-related chronic diseases⁽³²⁾. Childhood obesity is of special concern because, in addition to its numerous adverse effects on health in the short term,⁽³⁵⁾ it persists into adulthood⁽³⁶⁾ and predicts the development of chronic diseases later in life.⁽³⁵⁾ Earlier studies focused on the immediate causes of childhood obesity—for instance, dietary intake and physical activity—that affect energy balance.^(38, 39) However, little is known about the possible influence on childhood obesity of psychosocial characteristics of the mother.

It is well-known that parent-child interactions, such as child feeding practices⁽¹⁸⁾ and family weight-talk⁽¹⁹⁾, play an important role in the development and prevention of childhood obesity. ^(102, 103) On the other hand, parents may have misperceptions of their body images and those of their children. In particular, overweight and obese parents, as well as parents of overweight and obese children, tend to underestimate the actual weight of their children, that is, they perceive their children as thinner than they really are.⁽⁴⁷⁻⁵⁰⁾ These parental misperceptions are cause for concern, because they may hamper intervention attempts aimed at treating childhood obesity.⁽⁴⁶⁾

Previous studies have examined the associations of parental body image perception with children's weight using a cross-sectional design.⁽¹⁰⁴⁻¹⁰⁷⁾ This study design does not address the temporal sequence of these associations; thus, their interpretation is subject to reverse causality. In other words, it is not possible to determine whether parental body image dissatisfaction (BID) predicts childhood obesity or vice versa. We examined the relation between maternal BID and children's weight changes in a longitudinal study. Specifically, our study examined whether a mother's dissatisfaction with her own body image or with that of her child at the time of recruitment would predict weight changes over a 2.5 year follow-up period in a

cohort study of school-age children from Bogotá, Colombia. Previous studies have shown that BID is a potential risk factor for the development of adiposity because BID increases sedentary behavior,(20, 21) social isolation and depression,(22, 23) and weight-related anxiety.(24) We therefore hypothesized that children whose mothers desire that she or her child be thinner or heavier had different BMI trajectories compared to children whose mothers were satisfied with her body image or with her child's body image.

METHODS

Study population and field methods

This study was conducted as part of the Bogotá School Children Cohort, a nutrition and health investigation of primary school children in Bogotá, Colombia. Detailed descriptions of the study have been provided elsewhere.⁽⁵⁵⁾ In brief, we recruited a sample of 3,202 children in February 2006, which represented all children enrolled in the primary public schools of Bogotá, Colombia. These children came from 2,981 households, after accounting for siblings. Since most children in the public school system belong to low- and middle-income families in the city,⁽⁵⁶⁾ the study population is representative of these strata.

At the time of enrollment, parents filled out self-administered questionnaires (n=2,451 households, for an 82% response rate). The questionnaire inquired into sociodemographic characteristics, including child's age and birthplace, maternal age and birthplace, marital status, maternal parity, and years of education. In addition, caregivers were asked to provide information on socioeconomic level, such as the government's classification of the household for tax and planning purposes, home ownership status, and number of home assets (including bicycle, refrigerator, blender, television, stereo, and washing machine). Maternal BMI was calculated either from physical measurements of height and weight in 42% of the mothers or from self-reported data.

The questionnaires also inquired about mother's perception of her body and that of her child. Maternal perception of her own body was obtained with the use of the Stunkard figure rating scale, which was developed and validated for use in adults.⁽⁹⁴⁾ This visual tool depicts nine silhouettes in an increasing order of body girths from 1 (thinnest) to 9 (heaviest). Using the Stunkard figure rating scale, mothers were asked to identify the silhouette that most resembled the way they looked (current body image), and the one that represented how they would like to look (desired body image). Mother's perception of her child's body was obtained by using child-adapted versions of the Stunkard scale, which are sex-specific and have been validated in children.⁽⁵⁸⁾ The children's version depicts eight silhouettes in ascending order of girth, from 1 (thinnest child) to 8 (heaviest child). Mothers were asked to identify the child's silhouette that

most resembled how their child looked (mother's current body image of child), and the one representing how they wished their child would look (mother's desired body image of child).

During the three weeks post-recruitment, trained research assistants visited schools and measured height and weight of the children using standard protocols.(57) Height was measured without shoes to the nearest 1 mm using wall-mounted portable Seca 202 Stadiometers, and weight was measured in light clothing to the nearest 0.1 kg on Tanita HS301 solar-powered electronic scales. Study dietitians visited schools again in June and November 2006 and annually thereafter until 2008. At these visits, new anthropometric measurements were taken following the same protocol. When children were absent from school on the day of assessment, home visits were arranged to conduct the measurements at home. Sex- and age-specific height- and BMI-for age z -scores (BAZ) were calculated according to the World Health Organization's growth references.(59)

Before children were enrolled, written informed consent was obtained from parents or primary caregivers of all children. The study protocol was approved by the Ethics Committee of the National University of Colombia Medical School. The Health Sciences and Behavioral Sciences Institutional Review Board at the University of Michigan approved the use of data from the study.

Data analysis

Of the 2,451 households with baseline questionnaires, we retained 2,040 in which the mothers of participating children had filled out the survey. These households represented 2,214 children. The mother's perception of her own body was indicated by 1,431 mothers of 1,551 children from these 2,040 households. Information on the mothers' perceptions of their children's body was available for 1,442 children from the 2,040 households retained.

Mother's perception of her own or of her child's body was available for 1,591 children. Of these children, 1,523 had valid anthropometric measurements at baseline and one or more follow-up assessments. These 1,523 children constituted the analytic sample for this study.

There were some differences between these children and the cohort participants who were excluded from the study. Compared to those excluded, the 1,523 children studied were younger (mean age of 8.7 vs. 9.0 years, $P=0.001$), had higher mean baseline height-for-age z-scores [HAZ] (-0.73 vs. -0.84 SD, $P=0.002$), were more likely to have been born in Bogota (90% vs. 86%, $P=0.003$), and had mothers with more years of education (9.2 vs. 7.9 years, $P<0.0001$), less parity (2.6 vs. 2.8 children, $P<0.0001$), higher BMI (24.3 vs. 23.8 kg/m², $P=0.01$) and more household assets (4.0 vs. 3.8, $P<0.0001$). They also had longer median duration of follow-up (30.1 vs. 28.5 months, $P<0.0001$). There were no significant differences with regard to child's sex, BMI, or household socioeconomic status.

The body image dissatisfaction (BID) score of the mother with her own body was calculated for 1,377 mothers to 1,485 children, as the silhouette number indicated as desired subtracted from the silhouette number indicated as current, according to the mother's rating of the Stunkard scale. Mother's dissatisfaction with her child's body was calculated for 1,385 children in a similar fashion, using the mother's rating of the sex-specific child-adapted Stunkard scales. We categorized BID as negative when desired body image was greater than current body image, i.e, a desire for a larger body size; zero when desired body image was equal to current body image, representing satisfaction with body image; or positive when desired body image was smaller than current body image, reflecting a desire for a thinner body.

The two primary exposures of interest were the mother's dissatisfaction with her own body and with her child's body. For each exposure, average BMI-for-age growth curves were estimated for each BID category with the use of mixed-effect models for repeated measurements with restricted cubic splines.(60) Cubic splines represent non-linear terms for age at each assessment that allow the smoothing of a growth curve. Piecewise cubic polynomials were smoothly jointed at joint points or "knots".(60) We placed these knots at 6, 8, 10, 12, and 13 years of age to properly capture the curvilinear segments of the BMI-for-age curve during this period. Each model included BMI as the outcome; whereas predictors were indicator variables for BID categories, linear and spline terms for child age in decimal years, and interaction terms between BID category indicators and the linear and spline terms for age. We included random effects for the intercept and the linear term of age (slope) to account for within-child correlations of measurements in the estimation of variance.(95) In the analyses of mother's dissatisfaction

with her own body as the exposure, we also included a random effect to account for within-family correlations among siblings and specified an unstructured covariance matrix. All available measurements were included in the models because these methods do not require that all participants provide the same number of measurements or that these measurements be obtained at the same time.(96) Change in BMI between ages 6 and 14 was estimated from the growth curves for each BID group. Adjusted differences in change and 95% confidence intervals (95% CI) were estimated by introducing potential confounders into the mixed models as additional covariates. These were previously reported correlates of overweight in this population(78), including maternal age, BMI, and marital status at baseline, and household socioeconomic status. We conducted the analyses separately for boys and girls. In addition, since we hypothesized that both BID and weight trajectories depend on weight status of the child, we categorized participants by their BAZ scores at the time of recruitment (BAZ score <-0.5 , ≥-0.5 and <0.5 , or ≥ 0.5 , representing respectively thin, normal-weight, and heavy children at baseline). These cut-off points were chosen to carefully separate normal-weight children from the groups of thinner and heavier children.

All analyses were conducted with the use of the Statistical Analyses System software (version 9.2; SAS Institute Inc., Cary, NC).

RESULTS

Mean \pm SD age of children at recruitment was 8.7 ± 1.7 years; 49% were boys (**Table 4.1**). Mean height-for-age z-score (HAZ) and BMI-for age z-score (BAZ) \pm SD were -0.73 ± 0.97 and 0.14 ± 1.04 , respectively. Overall mean \pm SD score of maternal dissatisfaction with the child's body (current minus desired silhouette) was -0.6 ± 1.2 . Forty-seven percent of mothers desired a larger body for their children, whereas 39% were satisfied with their children's bodies, and 14% desired a thinner body for their children. Mean \pm SD score of mother's dissatisfaction with her own body was 0.7 ± 1.3 . Fifteen percent of mothers desired a larger body size for themselves, 27% were satisfied with their own body, and 58% desired a thinner body. The correlation (Spearman rho) between maternal dissatisfaction with her own body and dissatisfaction with her child's body was 0.14. Mean \pm SD follow-up time was 27.9 ± 7.2 months, during which a median of 4 anthropometric measurements per child were obtained.

Maternal dissatisfaction with the child's body and child BMI trajectories

In boys, mothers' dissatisfaction with the children's body was significantly associated with their BMI trajectory (**Table 4.2**). A desire to have a boy with a thinner body was related to a 1.3 kg/m^2 larger estimated BMI increase between ages 6 and 14 years compared to being satisfied with the boy's body image (P, trend=0.03). This association varied according to the child's actual weight status at baseline (**Table 4.3**). Heavy boys (baseline BAZ ≥ 0.5 SD) whose mothers desired a thinner child gained 1.7 kg/m^2 significantly more than heavy boys whose mothers were satisfied with their child's body, after adjusting for several potential confounders (P=0.04). On the other hand, normal-weight boys (baseline BAZ ≥ -0.5 SD and < 0.5 SD) whose mothers desired a thinner child gained 1.8 kg/m^2 significantly less than normal-weight boys whose mothers were satisfied with their child's body (P=0.02). Among girls, maternal dissatisfaction with the child's body was related to BMI trajectories only in those who had low BAZ at recruitment. Thin girls (BAZ < -0.5 SD at recruitment) whose mothers desired a thinner child gained significantly less BMI (-2.4 kg/m^2 , P=0.004) compared to thin girls whose mothers were satisfied with the child's body.

Mother's dissatisfaction with her own body and child BMI trajectories

Mother's dissatisfaction with her own body was positively related to BMI change in the children (**Table 4.4**). In multivariable analyses, every unit difference in maternal BID score was related to a 0.6 kg/m² (P<0.0001) and 0.3 kg/m² (P=0.03) greater estimated BMI increases from ages 6 to 14 years, in girls and boys, respectively. Among heavy boys, however, the association was non-linear (**Table 4.5**). In this group, compared to mothers who were satisfied with their own bodies, a desire for a larger body was related to a 4.6 kg/m² lower estimated BMI gain (P=0.0008), whereas a desire for a thinner body was associated with a 1.8 lower estimated BMI gain (P=0.03).

DISCUSSION

In this longitudinal investigation, maternal dissatisfaction with her own or her child's body were significantly associated with differences in the BMI trajectories of children during follow up, depending on the child's sex and weight status at the time of recruitment. A maternal desire for a thinner child was associated with a greater BMI gain among heavy boys, whereas it was related to a lower BMI gain in normal-weight boys and thin girls. Maternal dissatisfaction with her own body image was significantly associated with lower BMI gain in heavy boys, whereas a desire for a thinner self was related to higher BMI gain in girls.

Whether maternal body image perception could influence BMI trajectories of children had not been studied before. Existing evidence is limited to cross-sectional investigations of whether maternal perception of the child's body actually matched the child's current weight. Several of these studies found that parents of overweight and obese children tend to underestimate their children's weight status. Mitchell and colleagues(106) found a significant correlation between child's BMI and maternal perception of the child's weight among 317 mother-child dyads in Melbourne, Australia. Olvera et al(107) studied 80 Mexican-American mothers and their 6- to 12-year-old children, and observed that mothers tended to perceive their daughters' body size as ideal, even though a third of the girls were classified as overweight. However, this discrepancy between perceived weight and actual weight was not seen in mothers of boys. Killion and colleagues(105) also found similar discrepancies among low-income African-American and Hispanic mothers of 4-and 5-year-old children enrolled in Head Start programs. In this study, mothers tended to misperceive their children's body as thinner than the children's actual weight; and approximately two-thirds of mothers of children who were classified as either overweight or obese were either satisfied with their children's body size or wished their children were heavier. Another study(104) investigated maternal perception of children's body size in relation to children's actual size in low-income mothers of children aged 9-13 from diverse ethnic backgrounds. In that study, mothers also significantly underestimated their children's height and weight, and mothers of overweight or obese children showed the greatest misperception of their child's weight. Since the design of these studies was cross-sectional, researchers could not determine whether body image perception predicted weight, or vice versa.

The results of our longitudinal investigation indicate that a mother's dissatisfaction with either her own body image or that of her child may play a role in the child's growth trajectory. We noted that maternal dissatisfaction with her own body was weakly correlated with her dissatisfaction with the child's body. In addition, the associations of each exposure with the outcomes differed from each other. This suggests that these exposures represent different constructs. An effect of maternal dissatisfaction with herself on the child's growth trajectory could be explained in various ways. For example, it is possible that weight-related concerns and behaviors are reflected in child feeding practices(18) and family weight-talk.(19) In addition, maternal BID could lead to similar dissatisfaction of the child with his or her own body image. The child's BID could in turn lead indirectly to increased weight gain through increased sedentary behavior,(20, 21) social isolation, and depression,(22, 23) or through the emergence of weight-related anxiety, which may contribute to excessive weight gain over time.(24) The possible impact of maternal dissatisfaction with her own body seemed paradoxical, since a desire to be thinner was associated with higher BMI in girls. This might indicate that the sole presence of BID, and not necessarily its direction, could have an influence on weight gain trajectories. Thus, BID is unlikely to work as an effective mechanism to compensate altered BMI trajectories.

We also found that maternal dissatisfaction with her child's body was related to differences in BMI trajectories over time. Of note, whereas maternal dissatisfaction with self was, on average, positive, representing a desire to be thinner; maternal dissatisfaction with the child's body was, on average, negative; suggesting that mothers may prefer a larger body for their children than what they want for themselves. This is regardless of the fact children in this population have a mean BMI-for-age above the international reference. Possible reasons to desire a 'larger' child may include economic conditions, lack of health knowledge, and influences of sociocultural traditions associating heaviness of the child with better health and physical appearance(108). This particular maternal preference for larger body sizes in their children could be specifically deleterious on the children's BMI trajectories. We observed that among normal-weight boys, not only was maternal dissatisfaction highly prevalent (especially 'a desire for a larger body'), but a desire for a thinner body was related to less weight gain. Similarly, among thin girls, a maternal desire for a thinner child resulted in lower BMI gain. This indicates that maternal dissatisfaction with the child's body image might worsen any ongoing

trends toward thinness. As urbanization and exposure to mass media increase in developing countries(32, 52), it becomes critical to monitor the impact of body image dissatisfaction on children's growth and health.

Our longitudinal study is innovative in several respects. First, its prospective design allowed us to examine the directionality of the associations between maternal BID and weight gain in children over time, and therefore it is more instructive than previous cross-sectional studies. Second, we separately investigated two types of maternal body image dissatisfaction as potential predictors of BMI change in school-age children. Third, we used advanced analytical methods when fitting growth curves, which enabled us to investigate sex- and weight-specific associations. Finally, this study improves our understanding of the association between maternal BID and weight change in children in general, and especially among populations living in transitional countries, where information is limited.

Limitations of this study include its reliance on a single measurement of exposure (BID) at baseline. If our principal assumption that maternal BID remained constant during the follow-up period does not hold, it is impossible to rule out reverse causality altogether as a plausible explanation of the findings. Second, the representativeness of our findings may have been affected by the fact that the children included in this study differed in several sociodemographic characteristics from the underlying population they represented. Third, the fact that several subgroups in our stratified analyses consisted of a relatively small number of participants could have decreased precision of the estimates in these strata. Additional limitations include possible residual confounding by unmeasured common causes of BID and BMI change which cannot be completely ruled out, and the lack of formal evaluation of the child-adapted Stunkard scale in our population, although it has been validated in comparable settings.(58, 87)

In summary, our study suggests that a maternal dissatisfaction with either her own body or that of her child may predict excessive weight gain or loss during childhood. As long as childhood obesity continues to increase in countries undergoing the nutrition transition at a rapid rate, a comprehensive understanding of the factors contributing to this alarming trend is necessary because only this knowledge will allow the design and effective implementation of public health interventions to slow down this trend, if not reverse it altogether. Furthermore,

body image dissatisfaction among parents to school-age children is also expected to increase as part of the process of internalization of Westernized 'thin-ideals', which goes hand-in hand with other cultural changes occurring throughout the developing world. Since BID can be modified through proper interventions,(30) clinical programs and public health initiatives that address it may have a favorable impact on reversing childhood obesity. Future studies are needed to determine whether interventions geared toward modifying unfavorable body image perception in the parents, and more specifically in the mothers, of school-age children can affect the growth process during the pre-adolescence years.

Table 4.1: Characteristics of school-age children and their mothers at recruitment

	Mean \pm SD or %		
	All	Boys	Girls
	(n=1523)	(n=751)	(n=772)
Child's characteristics			
Age, years	8.7 \pm 1.7	8.7 \pm 1.7	8.7 \pm 1.7
Child was born in Bogotá	89.6%	88.6%	90.7%
Height-for-age z-score ¹	-0.73 \pm 0.97	-0.76 \pm 0.90	-0.71 \pm 1.03
BMI-for-age z-score ¹	0.14 \pm 1.04	0.23 \pm 1.10	0.06 \pm 0.96
Maternal characteristics			
Age, years	35.0 \pm 6.5	35.1 \pm 6.7	35.0 \pm 6.3
Mother was born in Bogotá	46.6%	44.4%	48.7%
Education, years	9.2 \pm 3.2	9.2 \pm 3.1	9.1 \pm 3.2
Mother is a single parent	26.5%	25.4%	27.6%
Parity			
1	13.1%	13.8%	12.3%
2	37.9%	39.4%	36.5%
3	29.2%	26.8%	31.6%
≥ 4	19.8%	20.0%	19.6%
Height, cm	157.8 \pm 6.3	157.4 \pm 6.2	158.1 \pm 6.5
BMI, kg/m ²	24.3 \pm 3.8	24.4 \pm 3.8	24.1 \pm 3.8
Household characteristics			
Number of home assets ²	4.1 \pm 1.6	4.1 \pm 1.6	4.1 \pm 1.6
Lower neighborhood socioeconomic stratum ³	39.5%	40.9%	38.1%
House is owned by family	33.4%	31.4%	35.3%

¹ According to the World Health Organization 2007 growth references(59).

² From a list that included bicycle, refrigerator, blender, television, stereo, and washer machine.

³ Stratum 1 or 2 of a maximum 4 in the sample, according to the government's classification for tax and planning purposes.

Table 4.2: BMI change in school-age children according to maternal dissatisfaction with her child's body image¹

	n	BMI (kg/m ²) at age 6	BMI (kg/m ²) at age 14	BMI change (kg/m ²)	Adjusted difference (95% CI)	P, trend ²
Maternal dissatisfaction with her child's body ³						
Boys						0.03
Desire for a larger body (BID=[-])	338	14.9 ± 0.1	18.6 ± 0.2	3.7 ± 0.2	-0.3 (-1.0, 0.5)	
Satisfied with body image (BID=[0])	258	16.0 ± 0.2	19.9 ± 0.3	4.0 ± 0.3	reference	
Desire for a thinner body (BID=[+])	78	18.3 ± 0.3	23.5 ± 0.6	5.2 ± 0.6	1.3 (-0.1, 2.8)	
Girls						0.21
Desire for a larger body (BID=[-])	317	14.5 ± 0.1	19.5 ± 0.3	5.0 ± 0.3	-0.2 (-0.9, 0.6)	
Satisfied with body image (BID=[0])	284	15.4 ± 0.2	20.5 ± 0.2	5.2 ± 0.3	reference	
Desire for a thinner body (BID=[+])	110	17.2 ± 0.3	23.1 ± 0.6	5.9 ± 0.6	0.7 (-0.7, 2.0)	

¹ Values are means ± SE, unless noted otherwise. All values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for maternal age, BMI, and marital status at baseline, and for household socioeconomic status. Robust estimates of variance were used in all models.

² Test of linear trend when a variable that represented the ordinal categories of body image dissatisfaction was introduced into the growth curve models as continuous (Wald test).

³ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the mother's ratings on child-adapted Stunkard scales. [-]: desired > current body image (i.e. "a desire for a larger body"); [0]: desired = current body image (i.e. "satisfied with body image"); and [+]: desired < current body image (i.e. "a desire for a thinner body").

Table 4.3: Estimated BMI change from ages 6 to 14 years in school-age children according to maternal dissatisfaction with her child's body image¹, stratified by weight status of the child at baseline

	Boys (n=674)				Girls (n=711)			
	n	BMI change (kg/m ²) Mean ± SE ²	Adjusted difference (95% CI) ²	P, trend ³	n	BMI change (kg/m ²) Mean ± SE ²	Adjusted difference (95% CI) ²	P, trend ³
Baseline BAZ ^{4,5} < -0.5 SD				-				0.25
Desire for a larger body (BID=[-])	132	3.7 ± 0.3	0.3 (-0.8, 1.3)		147	4.6 ± 0.3	0.3 (-0.8, 1.5)	
Satisfied with body image (BID=[0])	41	3.5 ± 0.5	reference		43	4.3 ± 0.5	Reference	
Desire for a thinner body (BID=[+])	-	-	-		7	1.9 ± 0.6	-2.4 (-3.9, -0.8)	
Baseline BAZ ⁴ ≥ -0.5 and < 0.5 SD				0.86				0.96
Desire for a larger body (BID=[-])	153	3.6 ± 0.3	-0.2 (-1.2, 0.8)		141	5.6 ± 0.4	0.7 (-0.4, 1.7)	
Satisfied with body image (BID=[0])	86	3.8 ± 0.4	reference		136	4.9 ± 0.3	Reference	
Desire for a thinner body (BID=[+])	6	2.0 ± 0.6	-1.8 (-3.3, -0.3)		18	6.3 ± 0.7	1.4 (-0.2, 2.9)	
Baseline BAZ ⁴ ≥ 0.5 SD				0.03				0.99
Desire for a larger body (BID=[-])	53	3.9 ± 0.7	0.0 (-1.6, 1.7)		29	6.1 ± 1.9	0.9 (-2.9, 4.7)	
Satisfied with body image (BID=[0])	131	3.9 ± 0.5	reference		105	5.2 ± 0.6	Reference	
Desire for a thinner body (BID=[+])	71	5.5 ± 0.6	1.7 (0.0, 3.3)		85	5.6 ± 0.8	0.3 (-1.7, 2.4)	

¹ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the mother's ratings on child-adapted Stunkard scales.

² Values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for maternal age, BMI, and marital status at baseline, and for household socioeconomic status. Robust estimates of variance were used in all models.

³ Test of linear trend when a variable that represented the ordinal categories of body image dissatisfaction was introduced into the growth curve models as continuous (Wald test).

⁴ Body mass index-for-age z-score, according to the World Health Organization 2007 growth references(59).

⁵ The category 'Desire for a thinner body' (BID=[+]) was omitted among boys because of small sample size (1 boy).

Table 4.4: BMI change in school-age children according to maternal dissatisfaction with her own body image¹

	n	BMI (kg/m ²) at age 6	BMI (kg/m ²) at age 14	BMI change	Adjusted difference (95% CI)	P, trend ²
Maternal dissatisfaction with her own body ³						
Boys						0.09
Desire to be larger (BID=[-])	96	15.5 ± 0.2	18.5 ± 0.5	3.0 ± 0.6	-1.0 (-2.2, 0.3)	
Satisfied with body image (BID=[0])	209	15.4 ± 0.1	19.4 ± 0.3	4.0 ± 0.3	Reference	
Desire to be thinner (BID=[+])	425	15.8 ± 0.1	20.0 ± 0.2	4.1 ± 0.3	0.2 (-0.6, 0.9)	
Girls						0.01
Desire to be larger (BID=[-])	127	14.6 ± 0.2	19.1 ± 0.3	4.5 ± 0.3	-0.4 (-1.5, 0.6)	
Satisfied with body image (BID=[0])	205	15.3 ± 0.2	20.2 ± 0.4	4.9 ± 0.4	Reference	
Desire to be thinner (BID=[+])	423	15.6 ± 0.1	21.1 ± 0.3	5.5 ± 0.3	0.6 (-0.3, 1.6)	

¹ Values are means ± SE, unless noted otherwise. All values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for maternal age, BMI, and marital status at baseline, and for household socioeconomic status. Robust estimates of variance were used in all models.

² Test of linear trend when a variable that represented the ordinal categories of body image dissatisfaction was introduced into the growth curve models as continuous (Wald test).

³ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the mother's rating on the Stunkard scale. [-]: desired > current body image (i.e. "a desire to be larger"); [0]: desired = current body image (i.e. "satisfied with body image"); and [+]: desired < current body image (i.e. "a desire to be thinner").

Table 4.5: Estimated BMI change from ages 6 to 14 years in school-age children according to maternal dissatisfaction with her own body image¹, stratified by weight status of the child at baseline

	Boys (n=730)				Girls (n=755)			
	n	BMI change (kg/m ²) Mean ± SE ²	Adjusted difference (95% CI) ²	P, trend ³	n	BMI change (kg/m ²) Mean ± SE ²	Adjusted difference (95% CI) ²	P, trend ³
Baseline BAZ ⁴ < -0.5 SD				0.03				0.62
Desire to be larger (BID=[-])	34	2.8 ± 0.3	-0.4 (-1.3, 0.5)		61	4.3 ± 0.5	0.1 (-1.1, 1.4)	
Satisfied with body image (BID=[0])	69	3.2 ± 0.3	reference		57	4.1 ± 0.4	reference	
Desire to be thinner (BID=[+])	83	4.1 ± 0.5	0.9 (-0.2, 2.0)		91	4.6 ± 0.4	0.4 (-0.7, 1.5)	
Baseline BAZ ⁴ ≥ -0.5 and < 0.5 SD				0.31				0.44
Desire to be larger (BID=[-])	33	3.5 ± 0.5	0.3 (-0.9, 1.6)		48	4.9 ± 0.4	-0.6 (-1.8, 0.7)	
Satisfied with body image (BID=[0])	80	3.2 ± 0.4	reference		103	5.4 ± 0.5	reference	
Desire to be thinner (BID=[+])	159	3.9 ± 0.3	0.7 (-0.3, 1.7)		166	5.4 ± 0.4	0.0 (-1.1, 1.2)	
Baseline BAZ ⁴ ≥ 0.5 SD				0.32				0.12
Desire to be larger (BID=[-])	29	1.7 ± 1.1	-4.6 (-7.2, -1.9)		18	4.7 ± 0.9	0.8 (-1.8, 3.5)	
Satisfied with body image (BID=[0])	60	6.4 ± 0.7	reference		45	4.1 ± 0.9	reference	
Desire to be thinner (BID=[+])	183	4.6 ± 0.3	-1.8 (-3.4, -0.2)		166	5.9 ± 0.5	1.9 (-0.2, 4.0)	

¹ Body image dissatisfaction (BID) was calculated as the desired body image subtracted from current body image, according to the mother's rating on the Stunkard scale.

² Values are estimated from BMI-for-age growth curves obtained with restricted cubic splines mixed models with BMI as the outcome and spline terms for age, indicator variables for body image dissatisfaction (BID), and their interaction terms as predictors. Differences in change and 95% confidence intervals (CI) were adjusted for maternal age, BMI, and marital status at baseline, and for household socioeconomic status. An unstructured covariance matrix was specified to account for within-family correlations among siblings.

³ Test of linear trend when a variable that represented the ordinal categories of body image dissatisfaction was introduced into the growth curve models as continuous (Wald test).

⁴ Body mass index-for-age z-score, according to the World Health Organization 2007 growth references(59).

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Chapter 5:

Conclusions

Summary of Main Findings

The work included in this thesis enhances the knowledge regarding body image dissatisfaction as a factor influencing weight trajectories in school-aged children undergoing the nutrition transition. The increasing rates of childhood obesity in developing countries warrants meticulous characterization of its causes in the context of the nutrition transition for the design and implementation of successful public health interventions.

In chapter 2, we conducted a cross-sectional analysis of potential correlates of body image perception in a setting that is at the earlier stages of the nutrition transition. The strongest predictor of body image dissatisfaction was the children's actual weight status. Overweight and obese children were more likely to desire a thinner body image compared to their thin and normal-weight peers in both boys and girls. In addition, taller children perceived themselves as larger in size, and were more likely to desire a slimmer body image, compared to their shorter peers. This was despite of the fact that the figurine rating scale used in the study was composed of silhouettes equal in height. Children's body image dissatisfaction also increase with maternal BMI and with the mother's dissatisfaction with the child's body image in unadjusted analyses. Higher socioeconomic status was also associated with increased dissatisfaction with body image. This associations may bein direct, through the effect of SES on weight of the child. However, it could plausibly be exerted directly through increased exposure to Westernized ideals of thinness.

Various psychosocial components were associated with the concept of body image dissatisfaction, and they varied by sex and actual weight status of the child. Girls in our study perceived themselves as heavier, desired a thinner body image and were therefore less satisfied with their body image, compared to boys. These sex-specific differences were observed despite the fact that boys in our study were heavier on average compared to boys. Thin and heavy girls in particular seemed more prone to psychosocial impacts, including maternal influences. However, maternal perception of the child's actual weight was correlated with the child's weight in normal-weight boys and girls only. Our stratified analyses also revealed that perception of

physical strength was a unique component of the concept body image dissatisfaction in thin boys, and suggested that thin girls tended to perceive their body weight as less normal, compared to children in other sex- and weight-specific strata.

In chapter 3, we found that child's body image dissatisfaction at time of recruitment was associated with weight trajectories during follow-up, with important differences according to sex and baseline weight status of the child. Body image dissatisfaction was related to faster weight gain in overweight boys and to a slower weight gain in thin girls; in addition, overweight girls who desired to be larger gained less weight than those who were satisfied with their body image, whereas, paradoxically, thin boys who desired to be thinner gained more weight than those without body image dissatisfaction. Although we cannot determine causality due to the observational design of the study, our findings extend the current body of literature by indicating that the mere presence of body image dissatisfaction, and not necessarily its specific direction, might influence weight gain over time and worsen any ongoing trends toward adiposity or thinness, possibly through sex-specific pathways. Possible mechanisms through which body image dissatisfaction could possibly be associated with weight gain include weight-control behaviors, in addition to overweight-related concerns that may lead to additional weight gain through impaired coping capabilities of the child. Additional potential behavioral and social pathways include increase in sedentary behaviors, social isolation, and even depression, which may stem from increased body image dissatisfaction.

Based on findings from our cross-sectional investigation, we also examined the prospective relationships between maternal dissatisfaction with her own body or with her child's body and between BMI changes in the children during follow up. This longitudinal study is presented in the fourth chapter of this thesis. Our findings indicate that a maternal desire for a thinner child was associated with a greater BMI gain among heavy boys, whereas it was related to a lower BMI gain in normal-weight boys and thin girls. Maternal dissatisfaction with her own body image was significantly associated with lower BMI gain in heavy boys, whereas a desire for a thinner self was related to higher BMI gain in girls. To the best of our knowledge, whether maternal body image perception could prospectively impact BMI trajectories of children had not been studied before. The effect of maternal dissatisfaction with herself on the child's growth trajectory could be explained in various ways, including reflection of maternal weight-related

concern, child's feeding practices and family weight-talk. In addition, this type of maternal dissatisfaction could also lead to similar dissatisfaction of the child with his or her own body image, and thus to indirectly results in increased weight gain as discussed above. An additional important finding was that regardless of the fact children in this population have a mean BMI-for-age above the international reference, maternal dissatisfaction with self was, on average, positive, representing a desire to be thinner, whereas maternal dissatisfaction with the child's body was, on average, negative; suggesting that mothers may prefer a larger body for their children than what they want for themselves. Possible reasons to desire a 'larger' child may be due to influences of sociocultural traditions that associate heaviness of the child better health and physical appearance. Maternal preference for larger body sizes in their children could be specifically deleterious on the children's BMI trajectories, and may present a substantial challenge when dealing with the alarming rise in childhood obesity in developing countries.

Our research is novel for various reasons. It is conducted in a large sample of children representative of a population undergoing the nutrition transition, and therefore are susceptible to increased levels of exposure to Westernized thin-ideals, as well as to rapid increase in rates of overweight and obesity. In the cross-sectional section of this dissertation, we carefully examined various correlates of body image perception in the children, and identified sex- and weight-specific psychosocial constructs influencing the concept of body image perception among these children. Our prospective investigations examine the prospective associations between three different types of body image perception and between weight trajectories in school-age children, and the relationships among those types. They enhance our understanding of the association between body image perception and children's weight. In particular, the cutting-edge analytical techniques we used enabled us to examine the prospective associations between body image dissatisfaction in the children or their mothers and between weight trajectories of the children, depending on the sex and weight status of the children at baseline. This research improves our understanding of body image perception and its association with children's weight trajectories in populations experiencing the nutrition transition.

There are several limitation to our study. First, its observational design does not enable us to completely rule out the possibility of reverse causality between our exposures of interest and weight trajectories in children. Furthermore, we cannot rule out reverse causality if the our

assumption that body image dissatisfaction remained stable during follow up does not hold. Second, children of the highest SES levels were not included in our study, and therefore our results cannot be generalized to these population. Third, our stratified analysis by sex and weight status of the children resulted in several strata with relatively small sample size. This may have affected the precision of estimates for these strata, and thus impact our results. Additional limitations include possible residual confounding by unmeasured common causes of body image perception and BMI change which cannot completely ruled out, and the lack of formal evaluation of the child-adapted Stunkard scales in our population, although it has been validated in comparable settings.

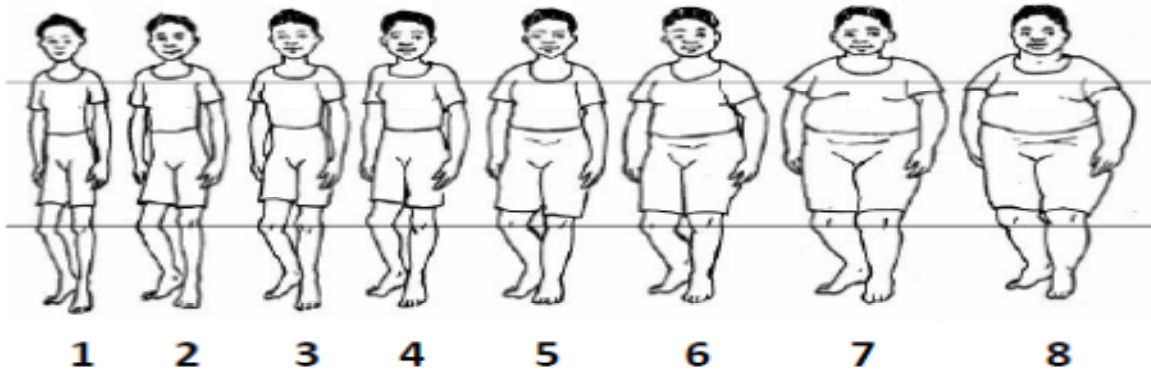
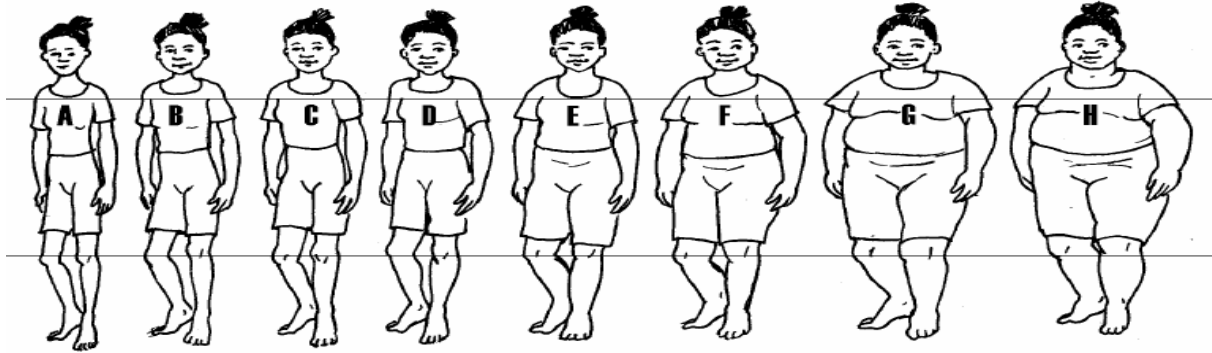
Public Health Implications and Suggestions for Future Research

In conclusion, our study suggests that body image dissatisfaction in either school-age children or their mothers is associated may adversely affect weight trajectories during childhood, and that maternal dissatisfaction contributes to shaping body image perception in children, in addition to various other psychosocial components. We also conclude that body image dissatisfaction may be particularly deleterious to high-risk groups. In these groups, dissatisfaction with the image of the body may worsen ongoing trends toward obesity or thinness. It is therefore possible that such high risk groups, such as heavy boys and thin girls at baseline, may benefit the most from interventions aimed to address body image concerns which are specially tailored to the needs and concerns of children in those groups.

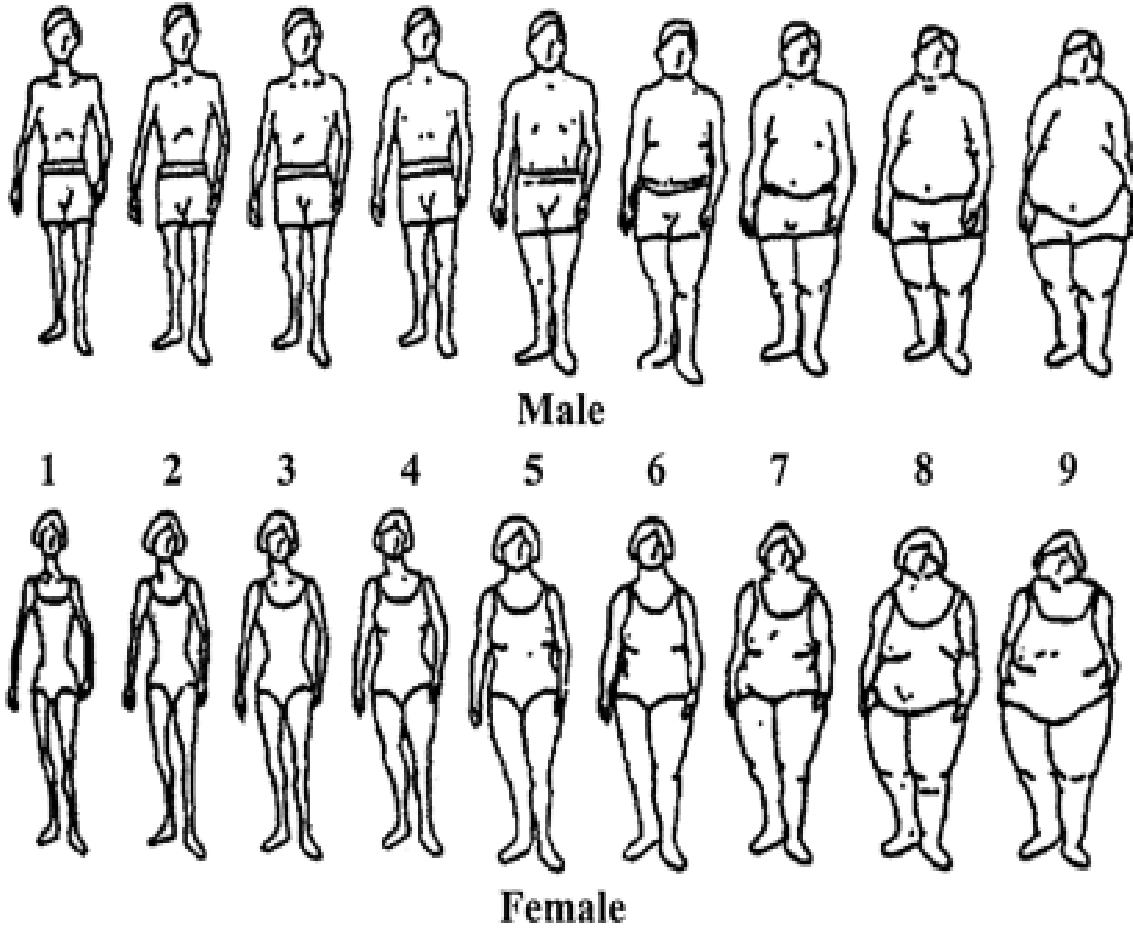
As long as childhood obesity continues to increase in countries undergoing the nutrition transition at a rapid rate, a comprehensive understanding of the factors contributing to this alarming trend is necessary; because only this knowledge will allow the design and effective implementation of public health interventions to slow down this trend, if not reverse it altogether. Furthermore, body image dissatisfaction among parents to school-age children is also expected increase as part of the process of internalization of Westernized ‘thin-ideals’ which goes hand-in hand with other cultural changes occurring throughout the developing world. Since body image dissatisfaction can be ameliorated through family(100)- and school(101)-based interventions, clinical programs and public health interventions that address it may have a favorable impact on reversing childhood obesity. Additional research is needed to further clarify correlates of maternal perception of the child’s body image, including the mother’s perception of her own body image. In addition, longitudinal studies may enhance our understanding regarding the impact of body image perception in either the mother or the child on weight trajectories in the child and whether interventions geared toward modification of these perceptions affect growth trajectories during childhood and into adolescence.

Appendices

Appendix 1: Child-adapted Stunkard Figurine Ratings scales (Adapted from: Stevens J, Story M, Becenti A, et al. Weight-related attitudes and behaviors in fourth grade American Indian children. *Obes Res.* Jan 1999;7(1):34-42.)



Appendix 2: Stunkard Figurine Ratings for Adults (From: Stunkard AJ, Sorensen T, Schulsinger F. Use of the Danish Adoption Register for the study of obesity and thinness. *Res Publ Assoc Res Nerv Ment Dis.* 1983;60:115-120)



Appendix 3: Questions Related to Body Image Perception which were presented to children and mothers in the Bogotá School Children Cohort (2006 Questionnaires, English translation)

To the child: Carefully look at the following drawings (appendix 1). Of the drawings above, which one you believe that (write the number corresponding to the drawing that looks closest to):

1. Is normal
2. Looks the most like you
3. Looks like you would like to look
4. Has the most friends
5. Looks the best
6. Looks the strongest

To the mother: Carefully look at the following drawings (appendix 1). Of the drawings above, which one you believe that (write the number corresponding to the drawing that looks closest to):

1. Looks closest to what the child looks
2. Looks like you would like your child to look
3. Is the healthiest for your child's age

To the mother: Carefully look at the following drawing (appendix 2). Of the drawings above, which one you believe that (write the number corresponding to the drawing that looks closest to):

1. Looks the most like you
2. Looks like you would like to look
3. Looks the healthiest