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Emmanuel Cohen, Philippe Jean-Luc Gradidge, Lisa K Micklesfield, Shane A Norris. Relationship Between Body Mass Index and Body Image Disturbances Among South African Mothers and Their Daughters Living in Soweto, Johannesburg. *Family and Community Health*, 2019, 42, pp.140 - 149. 10.1097/fch.0000000000000220 . hal-04012509

**HAL Id: hal-04012509**

**<https://hal.science/hal-04012509>**

Submitted on 22 Mar 2023

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**Relationship between BMI and body image disturbances amongst South African mothers and their daughters living in Soweto, Johannesburg**

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11    **Abstract**

12    In South Africa, a paradox exists between African mothers’ acceptance of stoutness and their  
13    daughters’ acculturation of Western norms of “thinness”. A study sample of 615 mother-and-  
14    daughter pairs was recruited to assess their relationship towards obesity and several other  
15    body image dimensions. Despite a higher prevalence of obesity in mothers and higher risks of  
16    eating disorders in daughters, relationships between both groups were identified for body  
17    mass index and body image dimensions. Health authorities should consider that the high  
18    prevalence of obesity in mothers and their relative tolerance for stoutness could expose their  
19    daughters to eating disorders and obesity risks.

20

21    **Keywords:** Mothers/daughters Communication, Weight management, Eating and Feeding  
22    Disorders, Obesity.

## Introduction

Studies in high-income countries (HICs) have shown that overweight and obesity are positively associated with psychological disturbances frequently due to a social stigmatization of fatness.<sup>1-3</sup> As a result, people living in HICs are faced with a complex ambivalent situation, where the prevalence of overweight and obesity is increasing even though thinness is the predominant desired body size.<sup>4</sup> This paradox has also been observed amongst black populations living in HICs for which the prevalence of obesity is highly prevalent,<sup>5</sup> whilst the so-called traditional valorization of stoutness is questioned by Western norms promoting pronounced thinness in young adults.<sup>6-8</sup> Given the increasing urbanization, exposure to Western norms and obesity prevalence in sub-Saharan Africa (SSA),<sup>9,10</sup> researchers have started examining this ambivalence amongst African populations.

Body weight perception in African populations around the world has been assessed. Studies have identified sociocultural valorization of adiposity as a risk factor for obesity in African populations,<sup>9-13</sup> and a relationship between eating disorders and body weight perception amongst urban-dwelling African adolescents and young adults has been demonstrated, particularly recently in Africa.<sup>14,15</sup> Further, the media has been acknowledged to influence contemporary thinking towards favoring thinner body sizes amongst younger adults.<sup>16,17</sup> Thus, African cultural values of body size, perceived as a protective factor towards common modern body image disturbances and eating disorders, seems to be diluted in young people through acculturation of Western influence.<sup>14,18,19</sup> Hence, in the context of an increasing obesity epidemic in SSA, it is therefore, important to understand the acculturation towards thinness occurring in African populations, as well as the persistence of tradition valorization of stoutness.<sup>20-22</sup>

South Africa is a SSA country experiencing a particularly strong obesity epidemic,<sup>23</sup> with evidence of coexistence between valorization and devaluation of stoutness differing by age.

Older black populations consider stoutness as a symbol of health, wealth and prosperity whilst younger people consider body fat as an expression of morbidity and sexual undesirability.<sup>24,25</sup> Despite the acculturation of younger age groups through the urbanization and modernization of South Africa expressed by a devaluation of overweight/obesity,<sup>26,27</sup> parents may still represent the traditional African values and could influence the way their children perceive their bodies by encouraging behaviors that favor larger body size.<sup>25,28</sup> Studies from various countries such as Thailand, Israel and the United States of America (USA), including African ethnic minorities, have shown that parents, and particularly in those that are overweight/obese, tend to underestimate their children's body weight, especially when these ones are overweight.<sup>29-32</sup> In addition, other studies have shown that parents, through their dietary intake habits and global parenting style, can mediate and influence the relationship of their offspring's with their body weight management.<sup>33</sup> For instance, Cutting et al.<sup>34</sup> have shown that USA mothers' dietary disinhibition mediates familial similarities in degree of overweight for mothers and daughters. In addition, McDonald et al.<sup>35</sup> demonstrated that child overweight is associated with maternal obesity in Colombia. Beyond the nutritional status, other studies attested that parents can influence the relationship of their offspring's with their body weight perception,<sup>36</sup> with a potential intergenerational transmission of body image disturbances and eating disorders.<sup>37-41</sup> In South Africa, the influence of mothers as a determinant of both obesity and body image disturbances/eating disorders in their daughters remains mainly unknown. Yet, recent studies showed that adolescents are early exposed to these both disorders in urban areas.<sup>26,42</sup> Obesity and its deleterious psychological experience expressed by body image disturbances/eating disorders are often linked but rarely considered conjointly in South Africa, particularly in their potential intergenerational transmission from mothers to daughters. Therefore, this study aims to examine the relationship between mothers and daughters on (1) body image

disturbances, eating disorders and (2) obesity, by testing the association between mothers' and daughters' body weight perceptions, body esteem, eating attitudes and body mass index (BMI) within families living in a poor-urban South African township which is exposed to obesity.<sup>43</sup> The three first dimensions could respectively assess between generations body weight satisfaction, poor body esteem and eating disorders risk, and the last one overweight and obesity.

## **Methods**

### ***Sample***

For this study, we assembled a sample of 615 mother-daughter pairs, who are part of the Birth to Twenty Plus cohort study (Bt20), a cohort study investigating the determinants of health and development of South African families predominantly living in Soweto, Johannesburg.<sup>44</sup> Data was collected on maternal attitudes and practices when their daughters were age 12 years early adolescence, and data on the daughters' attitudes and practices were collected at age 18 years (late adolescence)

### ***Measures***

All following measures were implemented in both mothers and daughters.

#### ***Eating attitudes***

The participants' risk of eating disorders was measured using the Eating Attitudes Test-26 (EAT-26).<sup>45</sup> This questionnaire includes 26 items in the form of a Likert scale and was administered by trained field workers. The individual items were recoded according to the coding developed by Garner et al.<sup>45</sup> Total EAT-26 scores  $\geq 20$  indicate an increased risk of eating disorders, requiring clinical referral. The validity of this instrument has been reported in other South African (Cronbach's  $\alpha$  ranged from 0.75 to 0.79).<sup>19</sup>

## Body Esteem Scale

An adapted questionnaire was used to determine the estimated attitude towards own body image.<sup>46</sup> The instrument consisted of 21 questions, divided by components or subscales of body esteem, and in the form of a 5-point Likert scale ranging from options of ‘never’ to ‘always’. These components included eliciting questions on the participants overall feelings towards their own overall body appearance (the *appearance* subscale: BES-AP), contentment with personal body weight (the *weight* subscale: BES-WE), and positive perception of personal body image (the *attribution* subscale: BES-AT). The internal consistency of the tool is high (Cronbach’s  $\alpha$  ranged from 0.86 to 0.86).

## Body weight perceptions

Further, a body figures scale based on the Figure Rating Scale developed by Stunkard et al.<sup>47</sup> and adapted/validated in South African adolescent and adult females,<sup>48</sup> was used to determine body weight perceptions. The figures were coded 1 to 8 (underweight: 1-2, normal-weight: 3-4, overweight: 5-6, obesity: 7-8), and shuffled before being presented individually to participants for each interview.<sup>49</sup> Participants were required to select a body figure which they identified as representing their Current Body Size (CBS), as well as their Ideal Body Size (IBS). A *body weight self-satisfaction index* was calculated by the discrepancy between CBS and IBS, which is termed the ‘Feel minus Ideal Discrepancy’ (FID). Negative, zero and positive scores indicated desire to be fatter (FID-gain weight), contentment with body size (FID-satisfied), and a desire to be thinner (FID-lose weight), respectively.<sup>11</sup> We also created a *body weight self-assessment index* by the discrepancy between BMI categories of participants and their CBS assessed by the Figure Rating Scale adapted to South African populations. Negative, zero and positive scores indicated respectively an overestimation, a correct estimation, and an underestimation of body size. Then, we created a *valorisation of fatness*

*index* by the coding of all responses on IBS variable  $\geq 5$  as an appreciation for overweight and obesity.

In addition, we completed this assessment protocol on body weight perceptions using a question also assessing a Weight Change Attempt (WCA). Precisely, we asked if participants have already tried to lose weight by asking this question: “Have you already try to lose weight during the past?” A positive response coded as “lose weight desire” means a WCA and a negative response coded as “no lose weight desire” means an absence of WCA.

### *Anthropometry*

Height was measured using a portable stadiometer (Holtain, UK) and recorded to the nearest millimetre, and weight was measured to the nearest 100 g, using a digital weighing scale. Participants were measured in light clothing without shoes. Using height and weight measures of mothers and daughters (18 years old), BMI was calculated as weight (kg)/height (m)<sup>2</sup>. BMI categories included underweight (BMI<18.5 kg/m<sup>2</sup>), normal (BMI $\geq$ 18.5 to 24.9 kg/m<sup>2</sup>), overweight (BMI $\geq$ 25 to 29.9 kg/m<sup>2</sup>), obese (BMI $\geq$ 30 to 39.9 kg/m<sup>2</sup>), and morbidly obese (BMI $\geq$ 40 kg/m<sup>2</sup>).

### *Statistical analysis*

Statistical analysis was performed using Stata version 12 (StataCorp, Texas, USA). Stratifying by weight status of participants, we used Chi<sup>2</sup> and Fisher’s Exact test to evaluate the prevalence of underweight, overweight, obesity and eating disorders risk (EAT-26 scores  $\geq 20$ ), the frequency of weight change attempt and FID scores (FID-gain weight, FID-satisfied, FID-lose weight), and ANOVA/ANCOVA or paired t test to assess means of BMI, EAT-26 scores, the three body esteem dimensions (Appearance: BES-AP, Attribution: BES-AT, Weight: BES-WE) and Ideal Body Size (IBS). We also compared these variables each other between mothers and daughters. We used Pearson’s correlation and Cohen’s Kappa: simple



Kappa (k) and weighted Kappa (wk), to correlate and assess inter-rater agreement of BMI and all psychometric variables each other between mothers and daughters. Finally, we used binary logistic regression and multivariable linear regression models to identify respectively the predictors (including mothers' characteristics) of weight change attempt (lose weight desire) and BMI in daughters.

### ***Ethics***

The study was approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand. All participants gave written informed consent and minor assent was obtained if under the age of 18 years before being involved in the study.

### **Results**

Most of the participants were of black South African ethnicity (85.9%), with whites, Indians, and participants of mixed ethnicity making up the remainder of the sample. Mothers were  $41.4 \pm 8.0$  and daughters were  $17.9 \pm 0.39$  years old.

#### ***BMI and prevalence***

The prevalence of underweight, normal-weight, overweight and obesity were respectively 2.2%, 21.5%, 26.9% and 49.4% in mothers; and 10.8%, 63.5%, 16.4%, and 9.3% in their daughters ( $p < 0.001$ ). There was a significant BMI means difference between both groups:  $30.4 \pm 7.2 \text{ kg/m}^2$  in mothers versus  $23.0 \pm 4.8 \text{ kg/m}^2$  in daughters ( $p < 0.001$ ).

#### ***Mother's and daughter's body weight perceptions according to BMI status***

##### ***Ideal body size***

Mothers and their daughters had significantly different IBS and Body Esteem dimensions

according to their BMI status (Table 1). Even though IBS increased along increasing BMI categories of mothers and daughters, it was situated in the normal BMI range on the Figure Rating Scale: figural stimuli 3 and 4. Indeed, the BMI/IBS correlation in mothers was  $r=0.23$  ( $p<0.001$ ), and in daughters  $r=0.25$  ( $p<0.001$ ).

#### *Body esteem*

Concerning body esteem dimensions, normal-weight and overweight mothers had higher body esteem than underweight and obese mothers, whilst the global body esteem was observed to decrease with increasing BMI in the daughters.

**Table 1**

#### *Body weight self-assessment*

In addition, among all daughters, 23.8% overestimated, 61.6% correctly estimated and 14.6%, underestimated their weight, versus 4.7%, 35.7% and 59.7% in all mothers ( $p<0.001$ ). Among underweight/normal-weight subjects, 28.5% of daughters overestimated, 65.3% correctly estimated and 6.2% underestimated their weight, versus 16.8%, 73.3% and 9.9% in mothers ( $p<0.05$ ). Among overweight/obese subjects, 10.3% of daughters overestimated, 50.7% correctly estimated and 39.0% underestimated their weight, versus 0.7%, 23.6% and 75.7% in mothers ( $p<0.001$ ).

#### *Body weight self-satisfaction*

Table 2 shows a relative concordance between WCA (desire to lose weight) and FID-lose weight in both mothers and daughters. The desire to lose weight increased significantly with increasing BMI, while FID-gain weight decreased significantly with BMI. In addition, among underweight/normal-weight subjects, 22.6% of daughters had a desire to lose weight versus 9.2% in mothers ( $p<0.001$ ), whilst among overweight/obese subjects, 52.7% of daughters had a desire to lose weight versus 32.2% in mothers ( $p<0.001$ ). Among those subject who were underweight/normal-weight, 24.1%, 51.4% and 24.5% of daughters wanted respectively to

gain, maintain and lose weight, versus 35.4%, 46.9% and 17.7% in mothers ( $p<0.05$ ). Conversely, among overweight/obese subjects, 26.6% and 73.4% of daughters wanted respectively to gain/maintain (only when categories aggregated) and lose weight, versus 35.6% and 64.4% in mothers ( $p<0.05$ ). Finally, we noticed that 32.7% of mothers and 27.0% of daughters who desired to lose weight still valued overweight and obesity on the *valorisation of fatness index*.

### *Eating disorders risk*

The prevalence of eating disorders risk were respectively 11.0% in mothers and 10.8% in daughters. It was not significantly associated with higher BMI categories in mothers, whilst in their daughters eating disorders risk were significantly associated with increasing BMI (Table 2). Finally, among overweight/obese subjects, 17.7% of daughters had an eating disorders risk versus 11.4% in mothers ( $p=0.053$ ; overweight daughters/mothers: 19.2% vs 9.5%,  $p<0.05$ ; obese daughters/mothers: 15.1% vs 12.3%, not significant).

## **Table 2**

### *Relationship between mother's and daughter's BMI and body weight perceptions*

#### *Differences between mothers and daughters*

In Table 3, after controlling the confounding effect of maternal BMI, it was observed that mothers had significantly lower EAT-26 score and higher BES-AP, BES-AT and BES-WE scores than their daughters, whilst IBS scores were similar between mothers and their daughters. However, without the control of maternal BMI, we observed a significant difference between mothers and their daughters for IBS:  $4.1\pm1.0$  (in mothers) versus  $3.8\pm1.3$  (in daughters) ( $p<0.001$ ).

## **Table 3**

## *Similarities between mothers and daughters*

In addition, BMI ( $r=0.29$ ,  $p<0.001$ ), EAT-26 ( $r=0.10$ ,  $p<0.05$ ), BES-AP ( $r=0.19$ ,  $p<0.001$ ), BES-WE ( $r=0.15$ ,  $p<0.001$ ) and FID ( $r=0.15$ ,  $p<0.01$ ) were significantly correlated between mothers and daughters. Using Cohen's Kappa to accurately match the response modalities from all psychometric variables between mothers and their daughters, we observed significant agreement for BMI categories ( $k=0.06$ ,  $p<0.001$ ;  $wk=0.14$ ,  $p<0.001$ ), WCA ( $k=0.13$ ,  $p<0.01$ ), BES-AP ( $k=0.03$ , not significant;  $wk=0.12$ ,  $p<0.01$ ), BES-WE ( $k=0.06$ ,  $p<0.05$ ;  $wk=0.13$ ,  $p<0.01$ ) and FID ( $k=0.08$ ,  $p<0.01$ ;  $wk=0.15$ ,  $p<0.001$ ). Then, we found a significant positive association between mothers and daughters on the *valorisation of fatness index* ( $p<0.01$ ). This index was also associated with overweight and obesity in both groups ( $p<0.05$ ;  $p<0.001$ ).

## ***Prediction of daughters' Weight Change Attempt and BMI***

The results of the binary logistic regression model (Table 4) showed an independent association between mothers' and their daughters' desire to lose weight. Further, an independent association between overweight daughters and their desire to lose weight was demonstrated. Univariate analyses showed an association between overweight mothers' and their daughters' desire to lose weight.

### **Table 4**

The multivariable linear regression model (Table 5) showed an independent positive association between mothers' and daughters' BMI. Univariate analyses showed a positive association between mothers' desire to lose weight and daughters' BMI and a positive association between black ethnicity and daughters' BMI.

### **Table 5**

## Discussion

This study analysed the relationship between African mothers' and their daughters' body weight perceptions and management in a poor-urban obesogenic environment. As demonstrated in studies from various SSA countries, body image perceptions differs across the age spectrum.<sup>9,25,50</sup> In the present study, we observed that mothers' and daughters' had contrasting and contradictory body weight perceptions. The majority of mothers were overweight or obese whilst most of the daughters were normal-weight, however the mothers valued fatness more than their daughters. This paradoxical trend between mothers and their daughters has also been observed in other African countries such as Nigeria.<sup>15,51</sup>

In the current study, mothers had better body esteem and eating attitudes than their daughters, despite most having a larger body weight. Overweight and obese mothers had higher BES scores compared with their daughters, and most of them underestimated their actual body weight.<sup>52,53</sup> Mothers seemed to value larger body size due to the overweight/obese category having a significantly higher BES than the normal-weight category. In addition, the BES, WCA and FID scores for the mothers were positively associated with BMI. Mothers who were overweight/obese had a greater desire to lose weight and tended to develop poorer body esteem and higher risk of eating disorders than those who were lean.<sup>27,54</sup> However, this trend was only observed with a higher BMI level (around obesity), which could be explained by their better body weight status awareness when diagnosed with cardiometabolic diseases, as observed in urban Ghana.<sup>21</sup>

In comparison, daughters showed poorer body esteem than their mothers and were more exposed to eating disorders risk despite most were in normal or underweight BMI categories, a trend in South African young women commented recently by Mchiza.<sup>55</sup> Then, the second highest BES mean in daughters was in the underweight category after normal-weight. In addition, underweight and normal-weight daughters tended overestimate their actual weight

more than their mothers, and overweight daughters were more exposed to eating disorders risk, as observed in another South African study.<sup>56</sup> In addition, WCA and FID scores show that daughters desire to be underweight or normal-weight whilst their mothers expected to be normal-weight or overweight, an intergeneration contrast already observed in South Africa,<sup>57,58</sup> as already identified in other African countries.<sup>20,59</sup> Unlike their mothers, daughters seemed to reject fatness for aesthetic reasons since most of them did not present with excess body weight, as also identified in other South African and Nigerian studies.<sup>15,19</sup> Indeed, studies of African populations suggest that younger people are more influenced and acculturated by Western media, which promotes thinness and could explain this young women depreciation towards fatness.<sup>60</sup> Conversely, older people are more influenced by their traditional African culture valuing stoutness, which is perceived as a symbol of health, fertility, peaceful and prosperity, especially in married women.<sup>22,28</sup> In this perspective, the prevalence of overweight and obesity in mothers were similar to those found in other South African studies, and therefore strongly higher compared with the prevalence found in many other African and Western countries.<sup>61–63</sup> For daughters, we observed that the prevalence of overweight was lower than the national prevalence in adolescent females but the prevalence of obesity was slightly higher.<sup>42</sup> Concerning eating disorders risk, we observed that its prevalence in daughters was between those showed by Le Grange et al.<sup>64</sup> and Gitau et al.<sup>24</sup> The prevalence of eating disorders risk in both mothers and daughters were slightly higher than those found in the rest of the continent and some Western countries,<sup>65,66</sup> and slightly lower than that found in Nigeria.<sup>15</sup>

A relationship between mothers and their daughters regarding body weight perceptions and BMI was also observed. Firstly, after controlling for BMI, IBS of both groups were similar, situated in the normal-weight category, even though without BMI adjustment, mothers had an IBS significantly higher than their daughters. We observed a positive correlation between

BMI and IBS in both groups. This could be explained by a tendency in mothers and daughters to unconsciously ‘adjust’ their IBS to their BMI.<sup>59</sup> Since mothers were more overweight and obese than their daughters, this propensity had a strong effect on IBS mean difference. We also found significant correlations and/or agreements between mothers and daughters for EAT-26 and body image variables (WCA, FID, BES-AP and BES-WE), which could be an accidental convergence caused by two different behavioural patterns.

Indeed, since the BMI of mothers and daughters were significantly different, most normal-weight daughters are living with mothers who are particularly overweight or obese, and a large proportion of them would like to lose weight. Therefore, daughters faced with the reality of their mothers’ morbid BMI status,<sup>67</sup> could reject being overweight as a self-protective strategy to prevent their potential future weight gain caused by the influence of their mothers’ lifestyle choices, as highlighted in a South African study.<sup>40</sup> This preventive reaction at home could also be exacerbated by norms conveyed by media and peers promoting thinness.<sup>68</sup> In this specific context, an agreement between mothers and daughters on psychometric variables is understandable, as identified in the binary logistic regression model. It seems that most of mothers don’t want to be fat anymore while most of daughters don’t want to become like them. This may be illustrated by the BES-AT disagreement between mothers and daughters demonstrating contrasted social attributions of the body, whilst we found agreements for BES-AP and BES-WE.

The correlations and inter-rater agreements expressed by Kappa values on BMI were also significant between mothers and daughters. A plausible explanation is the partial influence of mothers’ eating attitudes, body weight perceptions and possibly also genetic inheritance on BMI of some daughters, already identified in previous studies,<sup>31,34,69</sup> and probably expressed in the multivariable linear regression model. Since mothers’ BMI is a predictor of daughter’s BMI, the univariate association between mothers’ desire to lose weight and daughters’ BMI,

322 already identified in a previous study,<sup>70</sup> could be explained by the association between  
323 mothers' desire to lose weight and their own BMI. Mothers would transmit their own body  
324 weight appreciation to their daughters with consequences on their BMI. Beyond these BMI  
325 associations, we observed that inter-rater agreements were weak for BMI as well as  
326 psychometric variables. The correlation analyses cannot avoid a potential shift between  
327 variables which does not affect the coefficient values, whilst Kappa statistics, more accurate  
328 than correlations, allow matching variable modalities with each other.

329 The relative concordance between mothers and daughters for BMI and psychometric  
330 variables, besides the strong differences between both groups on these dimensions, might not  
331 be paradoxical but ambivalent, as explained by the possible double-reaction of daughters  
332 towards their maternal environment. Some of the daughters (*scenario 1*) could be influenced  
333 by obesogenic mothers' lifestyle as their relative tolerance for overweight and obesity,<sup>71</sup>  
334 whereas other daughters (*scenario 2*), not particularly overweight, try to prevent this  
335 influence, exacerbated by an external societal pressure, and develop a poorer body esteem  
336 associated with the phobia of fatness, as already observed in HICs.<sup>33,72,73</sup> At this stage, our  
337 study suggests that many daughters experience the second scenario because they are more  
338 exposed to eating disorders risk than overweight and obesity.

339 However, the exposure to overweight/obesity in daughters is confirmed, supported by a BMI  
340 relationship between mothers and daughters which could be exacerbated with older age of  
341 young women, especially by the decrease of peer and media pressures and the beginning of  
342 conjugal life. Therefore, we recommend that public health policies focus on the mother-  
343 daughter relationship towards body image and obesity to prevent eating disorders risk and  
344 obesity in adolescents and young adults. These policies should also consider the delayed  
345 influence of maternal environment on the BMI of daughters as they age and transition into  
346 marriage. Finally, future South African studies should integrate simultaneously parental,



media and peer effects on adolescents and young adults to assess their respective influence on body image and eating attitudes.<sup>74</sup>

## **Conclusions**

The findings of this study demonstrate that despite the variation in body weight perception models between mothers and their daughters, the daughters show lower body fatness appreciation than their mothers; overweight/obese mothers seem to exacerbate their daughters' desire to become thinner. The particularly high prevalence of cardiometabolic risk factors in the mothers and their relative tolerance for overweight and obesity could on one hand overexposed daughters to obesity, and on the other hand motivate many of them to excessive lower weight by exposing them to distorted body images of themselves and increased risk of eating disorders. The public health policies should take into account this interaction between obese mothers and their daughters to prevent eating disorders and obesity in this age group.

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