



BODY WEIGHT PERCEPTION INFLUENCES WEIGHT LOSS BEHAVIOR IN SOUTH INDIAN CHILDREN ACROSS A WIDE BODY WEIGHT RANGE- A CROSS-SECTIONAL STUDY

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3 BODY WEIGHT PERCEPTION INFLUENCES WEIGHT LOSS BEHAVIOR IN SOUTH
4 INDIAN CHILDREN ACROSS A WIDE BODY WEIGHT RANGE– A CROSS-
5 SECTIONAL STUDY
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39 Short title: Body weight perception influences weight loss in South Indian children
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Abstract:

Objective: To examine the patterns of weight loss behaviour and the relationship between weight loss attempts with actual weight status and children's and parental perceptions of weight status.

Design: Cross sectional study

Setting: Karnataka, South India

Participants: 1907 girls and boys aged 8 to 14 years from 7 schools in Karnataka, South India

Main outcome measures: The association between weight loss attempts and socio-demographic factors, weight status and the child's or parent's perception of weight status.

Results: Approximately 73% of overweight and obese, 35% of normal weight and 22% of underweight children attempted to lose weight. Children of lower socio-economic groups studying in schools in the local vernacular and overweight/obese children were more likely to attempt to lose weight (AOR=1.57, 95% CI: 1.11 to 2.25; AOR= 4.38, 95% CI: 2.64 to 7.28, respectively). Perception of weight status was important in influencing weight loss attempts. Thus, children who were normal weight but perceived themselves to be overweight / obese were three times likely to attempt weight loss, while the odds of attempting weight loss were the highest for those who were overweight and perceived themselves to be so (AOR ~ 18).

Conclusions: Weight loss is attempted by children in India irrespective of their weight status, age and gender. Children who were actually overweight as well as those who were perceived by themselves or by their parents to be overweight were highly likely to try to lose weight. It is necessary to understand body weight perceptions in communities with a dual burden of overweight and under-nutrition, if intervention programmes for either are to be successful.

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ARTICLE FOCUS:

- Patterns of weight loss behaviour and the relationship between weight loss attempts with actual weight status and children's and parental perceptions of weight status.

KEY MESSAGES

- There are no data on body weight perceptions of children and the relation to weight loss in India where both overweight and underweight in children co-exist in the community. It is essential to understand body weight perceptions by both children and their parents to tailor intervention programmes that can work in communities with concurrent under- and over-nutrition.
- Weight loss is attempted by children irrespective of weight status, age and gender.. However, those who perceive that they are overweight have higher odds of trying to lose weight, even though they may be normal weight.

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STRENGTHS AND LIMITATIONS

- This is the first study to report perceptions of body weight in India in relation to weight loss attempts.
- With the cross-sectional study design used in this study, the changes in perception as the children grow cannot be accounted for.

INTRODUCTION:

Body image is a psycho-social dimension of body size that encompasses both perceptual and attitudinal factors¹ and has been associated with eating disorders. In recent years, its association with overweight and obesity has been described². It is recognised that individuals make decisions on lifestyle behaviours based on body weight perceptions (a dimension of body image)^{1 3}. A unique situation exists in India, where there is a large burden of under-nutrition alongside increasing overweight and obesity. For public health and clinical programmes to be more effective, body image of undernourished and overweight children should be understood in the context of the influence of culture on body weight perceptions and on weight management behaviours.

A large number of studies have indicated that children and adolescents misperceive their body weight status. Interventions that address socio-cultural attitudes towards appearance should ideally reduce body image dissatisfaction as well as overweight and obesity since studies have indicated a relationship between body image, unhealthy eating practices and obesity^{4 5}. Perceptions of body weight are, in part, influenced by external factors including cultural norms and social preferences. The disconnect between actual weight and perception of body size could stem from the extent to which individuals identify with the majority cultural standards of beauty⁶. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures⁷. Evidence also suggests associations of actual body weight, body weight perceptions and weight dissatisfaction with weight control practices; overweight children are more likely to try to lose weight compared to non-overweight children^{8 9}. Analysis of data from the National Health and Nutrition Examination Survey (NHANES)¹⁰ and the Youth Risk Behaviour Surveillance Survey (YRBSS)^{6 11} indicate that those overweight children who perceived their weight status correctly were more likely to exercise or eat less for weight control. Results from an analysis from Europe, Israel and North America as part of the Health Behaviour in School aged Children (HBSC) 2001/2002 survey indicated that weight status perception of weight and age were significant factors influencing current attempt to lose weight⁹.

For healthy weight management it is necessary for a person to perceive his or her weight status accurately as well as be aware of healthy methods to lose or gain weight. Most literature on body weight perceptions and weight control behaviours are related to studies done in developed countries^{6 8 10 12} with a few on ethnic minorities, including South Asians²

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3 13. The present analysis aims to examine the associations between the actual weight status,
4 body weight perceptions of both children and their parents, and body weight satisfaction with
5 weight loss intentions. The study sample included a wide range of body weights to reflect the
6 dual burden of under-nutrition and overweight/obesity that India currently faces.
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9 10 **METHODS:**

11 12 **Study population:**

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14 A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-economic
15 status located in rural areas, towns in Karnataka and urban Bangalore in South India, were
16 contacted at baseline out of which 1907 (91.6%) children participated in a longitudinal study
17 on body image perceptions and growth indices of school children, details of which are
18 published earlier ¹⁴. The sample recruited had adequate power (above 80 %) to identify the
19 significant socio-demographic predictors for perception of body image in the present study
20 and to estimate a difference of at least 10% over-estimation or under-estimation of body
21 weight at 5% level of significance. Ethical approval was obtained from the Institutional
22 Ethical Review Board. Principals of schools were contacted for permission to conduct the
23 study in their schools. Written parental consent and assent from the child was also obtained
24 and confidentiality. A questionnaire to assess body image perception was administered by an
25 investigator (MP) to all the consenting students in a class by reading aloud the questions in
26 either English or Kannada (the local language). Responses were marked on the questionnaire
27 by each child. A short questionnaire in English or the local language to be filled by one of the
28 parents was sent home after the children completed their questionnaires. Children whose
29 parents were illiterate (6.7% mothers, 5.9% fathers), elicited the answers from either of their
30 parents and filled up the questionnaire.
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33 34 **Measurements:**

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36 Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was
37 measured in school clothing but without shoes using a calibrated digital scale (Home Health,
38 Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were
39 made using a standardized protocol. Body mass index (BMI) was computed and the BMI-
40 for-age z score values were obtained using the World Health Organization Anthroplus
41 software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by
42 actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2
43 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI
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values of 25.4 kg/m² for boys and 25.0 kg/m² for girls and is equivalent to the overweight cut-off for adults (> 25.0 kg/m²), while the +2 SD value (29.7 kg/m² for both sexes) compares closely with the cut-off for obesity (> 30.0 kg/m²)¹⁵.

To assess current body weight perception, children were asked to mark whether they thought their body weight or appearance was “too thin” “a little thin”, “normal”, “a little fat”, or “very fat”. Response to a similar question about their child’s body weight or appearance with similar options was filled by parents in a questionnaire sent to their homes. For analysis, ‘very thin’ and ‘a little thin’ were combined for perceived ‘underweight’ and ‘a little fat’ and ‘very fat’ for perceived ‘overweight’.

In addition, children were asked whether they had ever tried to lose weight. If they replied in the affirmative (options: yes/no), the method used to try and lose weight was recorded as “skipping meals”, “stopped eating a certain kind of food”, reduced quantity of food eaten” and “exercise” as a multiple response. Weight loss methods recommended by parents were similarly recorded. The present analysis is restricted to children on whom anthropometric measurements were available and who responded to the question on weight loss and this corresponds to 1874 participants (871 boys, 1003 girls).

Statistical analysis:

Data are reported as number and percentages for all the categorical variables. For analysis, socio-demographic variables of age of children were categorized as 10 and below and above 10 years of age, language of instruction as Kannada and English medium (a surrogate of socio-economic status), location as city and non-city (village and small towns) and maternal and paternal education below 7th grade and above 7th grade.

Cross-tabulations were created of actual weight status of the child with the child’s perception and parent’s perception of their child’s current body weight. Using this, the following six groups were formed

U/U – underweight by actual measurements/perceived by child/parent to be underweight

U/N- underweight by actual measurements/perceived by child/parent to be normal

N/N- normal by actual measurements/perceived by child/parent to be normal

N/O- normal by actual measurements/perceived by child/parent to be overweight

O/N- overweight by actual measurements/perceived by child/parent to be normal

O/O- overweight by actual measurements/perceived by child/parent to be overweight

The referent group was the N/N group.

The association between attempting weight loss with various socio-demographic factors as well with the above six groups was evaluated using the Chi-square test and the unadjusted odds ratio reported. Binary logistic regression was performed to identify the factors associated with attempted weight loss adjusted for socio-demographic variables and actual and perceived weight status of the children. It was also performed to identify the factors associated with trying to lose weight based on groups created using the actual weight status of the child and child's or parent's perception of child's weight adjusted for age, gender and medium of instruction. A level of significance (two-sided) less than 5% was considered statistically significant.

RESULTS:

Of the 1907 study children, 1874 responded to the question on whether they had ever tried to lose weight. Of these, 65.5% of children were normal weight, 25.0 % underweight and 9.5% overweight. Thirty two percent of children perceived themselves to be underweight; this was 7% more than the actual prevalence of underweight. Similarly, 15.4% perceived themselves to be overweight (5.9% higher than the actual prevalence). In contrast, parents tended to under-estimate underweight (5% lower than the actual prevalence of under-weight).

A total of 35% of children had attempted to lose weight; this constituted 73% of overweight and obese, 35% of normal weight and 22% of underweight children. Sixty eight percent of those children who perceived themselves to be overweight, 32% of those who perceived themselves to be normal, and 23% of those who perceived themselves to be underweight attempted to lose weight. Similarly, 54 % of children whose parents perceived them to be overweight, 35% who perceived them to be normal, and 21% of those who were perceived them to be underweight attempted to lose weight.

Among the socio-demographic factors (Table 1), children in schools with Kannada as the medium of instruction were more likely to attempt to lose weight than those studying in schools with English as the medium of instruction (AOR= 1.57, 95% C.I: 1.11 to 2.25). Underweight children were less likely to try to lose weight (AOR=0.71, 95% C.I: 0.51 to 0.98), while overweight/obese children were more likely (AOR=4.38. 95% C.I: 2.64 to 7.28) to try and lose weight compared to normal weight children. Based on the child's perception of their weight status, those who perceived themselves to be overweight were

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3 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental
4 perception of weight status, however, did not have a significant impact on children
5 attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire
6 (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of
7 attempting to lose weight.
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12 Figure 1 represents the odds of a child attempting to lose weight based on the child's actual
13 weight status in combination with the child's/parent's perception of weight status After
14 adjusting for age, gender and medium of instruction, the odds of attempting to lose weight
15 (Figure 1) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight child who perceived
16 themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an overweight child who
17 perceived themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an overweight child who
18 perceived themselves to be overweight. A similar trend was observed when parental
19 perceptions were replaced with child's perception (Figure 1) with odds of attempting to lose
20 weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child perceived by a
21 parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child perceived by a
22 parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child perceived to be
23 overweight by a parent. None of the underweight children were perceived by themselves or
24 by their parents to be overweight. Among children who were underweight but perceived
25 either by the child or parent to be underweight or normal, the odds of attempting to lose
26 weight was reduced by approximately 60% to 40% respectively in relation to children of
27 normal weight status perceived to be normal by both children and parents. .
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40 The most commonly adopted practice to lose weight regardless of whether the children were
41 underweight, overweight or normal was exercise (~46%), followed by reducing the quantity
42 of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 2).
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45 **DISCUSSION:**

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48 In concurrence with the findings of our study, misperception of weight status among children
49 has been reported in other studies conducted in the United States of America, with
50 perceptions differing between various ethnic groups. Among African American adolescents,
51 one-third perceived their weight status inaccurately⁸. Racial or ethnic differences in weight
52 perception have been reported^{8 12 16}, where Caucasians were more likely than African
53 Americans to perceive themselves as overweight^{8 12 17}. Perceptions, however, also governed
54 their decision to attempt weight loss, notwithstanding their current weight status.
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3 In general, children who were actually overweight as well as those who were perceived by
4 themselves or by their parents to be overweight were highly likely to try to lose weight.
5 Clearly, perceptions influence their decision to try to lose weight. This finding is similar to
6 studies conducted in other countries^{8 16 18}. Unless individuals or their families perceive their
7 weight status correctly, their acceptance of programmes designed to encourage healthy
8 weight may be low¹¹. The child's or parent's desire for the child to be thinner also influenced
9 their decision to try to lose weight.
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15 The fact that there were reported weight loss attempts even in the underweight group suggests
16 that factors other than weight status and weight perception are operative. This is corroborated
17 by the higher odds of children from Kannada medium schools, who belong to a relatively
18 lower socio-economic status compared to children from English medium schools (higher
19 SES) trying to lose weight. Thus socio-cultural factors may also influence their decision to
20 lose weight. This could be linked to the continuous exposure to images and unrealistic body
21 shapes that encourage weight loss regardless of body weight¹⁶. These factors must be further
22 explored so that suitable programmes that encourage overweight children but not
23 underweight or normal children to lose weight are planned.
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31 Included in our sample were children as young as 8 years of age. However, body
32 dissatisfaction with increasing weight status was established even by the age of 5 in both
33 boys and girls of South Asian origin in UK². Irrespective of whether they were below or
34 above 10 years of age or whether they were boys or girls, children attempted to lose weight.
35 In our study sample, there were no gender differences in weight loss attempts. This is
36 contrary to the findings elsewhere, as for instance, the NHANES study¹⁰, which indicated
37 that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender
38 differences in our study may, in part, be due to the relatively low prevalence of overweight or
39 obesity.
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47 It is encouraging that 46 % children indicated exercise their preferred choice of weight loss.
48 Differences in the methods used to lose weight between overweight, normal and underweight
49 children were not apparent unlike other studies where unhealthier weight loss methods like
50 skipping meals are reported more in overweight or obese children compared to normal weight
51 children¹⁹. However, an effect of social desirability cannot be discounted, given that exercise
52 as a healthy lifestyle choice is promoted early in the school curriculum
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3 Body image must be taken into account when designing programmes to improve both body
4 image and reduce unhealthy behaviours like unhealthy eating and reduced or excessive
5 exercise ¹. Since public health programmes are generally targeted towards all, a general
6 programme that caters to all children irrespective of their weight status is required.
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10 **Strengths and limitations:** This is the first study to report perceptions of body weight in
11 India in relation to weight loss attempts. With the cross-sectional study design used in this
12 study, the changes in perception as the children grow cannot be accounted for.
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16 Overall, perceptions of weight status influenced the decision of children to lose weight.
17 However, regardless of weight status, many children did resort to weight loss. Public health
18 campaigns should emphasize healthy weight management rather than weight loss.
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Data sharing:

Raw data are available from the statistician, Sumithra Selvam on request.

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Table 1. Socio-economic and anthropometric associations of weight loss behaviour

	Attempted weight loss		Unadjusted OR	P value*	Adjusted † OR	P value‡	
	Yes	No	95% C.I.		95% C.I.		
Gender							
	Female	387 (39%)	616 (61%)	1.41 1.16 – 1.72	<0.001	1.16 0.89 – 1.51	0.27
	Male	268 (31%)	603 (69%)	1	1		
Age category (years)							
	<=10	245 (34%)	469 (66%)	0.96 0.78 – 1.17	0.65	1.04 0.79 – 1.36	0.76
	>10	410 (35%)	750 (65%)	1		1	
Location							
	City	408 (33%)	812 (67%)	0.83 0.68 – 1.01	0.06	1.03 0.78 – 1.36	0.81
	Non City	247 (38%)	407 (62%)	1		1	
Education of mother (Standard)							
	Up to 7 th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22
	> 7 th	400 (36%)	727 (65%)	1		1	
Education of father (Standard)							
	Up to 7 th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22
	> 7 th	437 (34%)	838 (66%)	1		1	
Medium of instruction							
	Kannada	198 (39%)	308 (61%)	1.28 1.03- 1.59	0.02	1.57 1.11 – 2.25	0.01
	English ¹	457(33%)	911 (67%)	1		1	

Actual weight status							
Underweight	98 (22%)	352 (78%)	0.52	<0.001	0.71	0.04	
			0.40 – 0.67		0.51 – 0.98		
Overweight	125 (73%)	47 (27%)	4.96	<0.001	4.38	<0.001	
			3.43 – 7.20		2.64 – 7.28		
Normal	412 (35%)	769 (65%)	1		1		
Child's perception of body image							
Too /A little Thin	133 (23%)	457 (77%)	0.61	<0.001	0.67	0.01	
			0.48 – 0.77		0.49 – 0.93		
A little /Too fat	195 (68%)	91 (32%)	4.48	<0.001	2.91	<0.001	
			3.35 – 6.00		1.95 – 4.34		
Normal	318 (32%)	665 (68%)	1		1		
Child's desire to be							
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76	0.03	0.84	0.35	
			0.58 – 0.98		0.59 – 1.20		
Slightly/Much thinner	260(52%)	237 (48%)	2.53	<0.001	1.56	0.006	
			2.00 – 3.19		1.14 – 2.15		
Same as at present	272 (30%)	627 (70%)	1		1		
Parent's perception of child's body image							
Too /A little Thin	66 (22%)	241 (79%)	0.52	<0.001	0.76	0.15	
			0.38 – 0.71		0.52 – 1.12		
A little /Too fat	95 (54%)	82 (46%)	2.20	<0.001	0.86	0.51	
			1.58 – 3.08		0.51 – 1.37		
Normal	364 (35%)	690 (66%)	1		1		
Parent's desire for child to be							
A lot /Slightly fatter	87 (21%)	331 (79%)	0.54	<0.001	0.75	0.11	
			0.41- 0.72		0.52 – 1.07		
Slightly /Much thinner	170 (56%)	134 (44%)	2.61	<0.001	1.79	0.002	
			1.98 – 3.46		1.25 – 2.58		
Same as at present	263 (33%)	542 (67%)	1		1		

Results are reported as Number (percentages); OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

† Adjusted for actual BMI status, child's and parents perception of body weight and socio-demographic factors

‡ Obtained by fitting binary logistic regression models

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8 **Figure Legends:**
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10 **Figure 1: Odds ratio of having tried to lose body weight in children classified by current**
11 **weight status and perception of body weight.** ■ Comparison of child's actual weight
12 status with child's perception of weight status □ Comparison of child's actual weight
13 status with parental perception of weight status. U/U: underweight by actual
14 measurements/child's or parent's perception of being underweight, U/N: underweight by
15 actual measurements/child's or parent's perception of being normal, N/N: normal by actual
16 measurements/child's or parent's perception of being normal, N/O: normal by actual
17 measurements/child's or parent's perception of being overweight, O/N: overweight by actual
18 measurements/child's or parent's perception of being normal, O/O: overweight by actual
19 measurements/child's or parent's perception of being overweight.
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24 **Figure 2: Actual weight status and weight loss practices of children**

25 ■ Exercise ■ Reduced quantity of food eaten □ Stopped eating certain kind of foods
26 □ Skipping meals
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Figure 1: Odds ratio of attempting to lose body weight in children classified by current weight status and children and parental perception of body weight

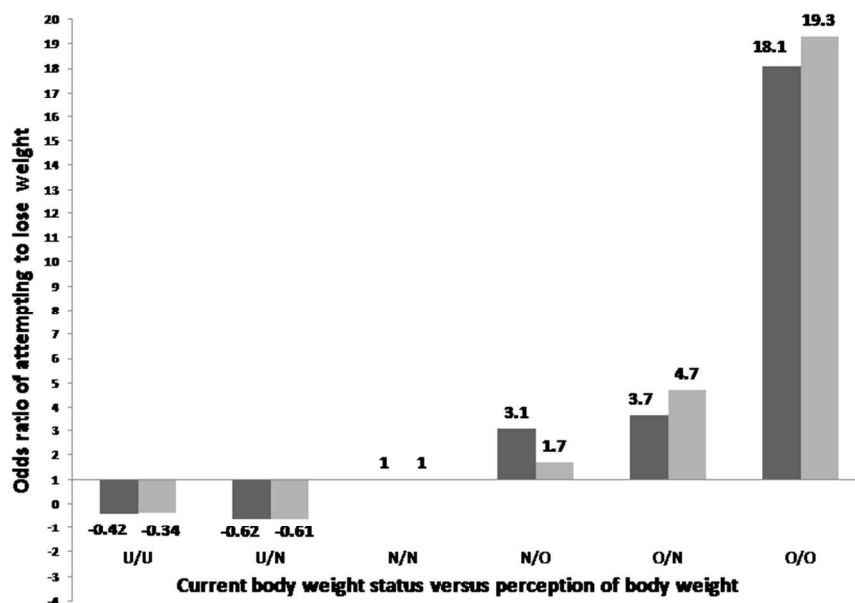


Figure 1: Odds ratio of having tried to lose body weight in children classified by current weight status and perception of body weight. Comparison of child's actual weight status with child's perception of weight status. Comparison of child's actual weight status with parental perception of weight status. U/U: underweight by actual measurements/child's or parent's perception of being underweight, U/N: underweight by actual measurements/child's or parent's perception of being normal, N/N: normal by actual measurements/child's or parent's perception of being normal, N/O: normal by actual measurements/child's or parent's perception of being overweight, O/N: overweight by actual measurements/child's or parent's perception of being normal, O/O: overweight by actual measurements/child's or parent's perception of being overweight.

254x190mm (96 x 96 DPI)

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Figure 2: Actual weight status and weight loss practices of children

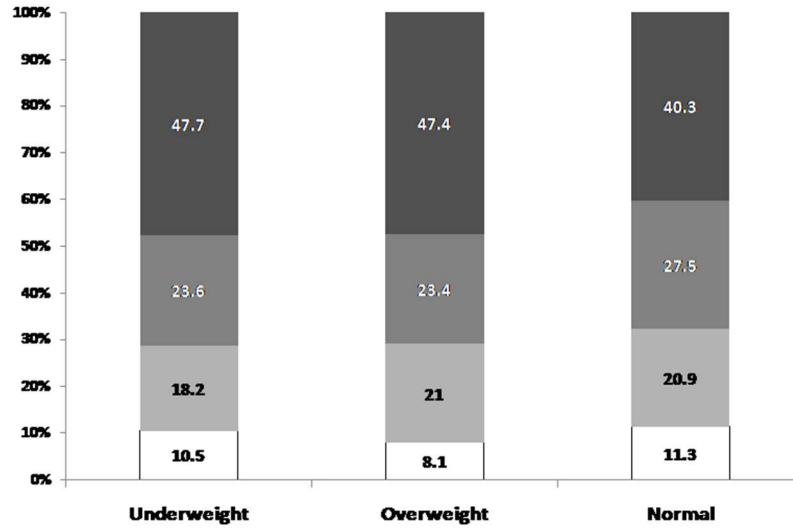


Figure 2: Actual weight status and weight loss practices of children

Exercise Reduced quantity of food eaten Stopped eating certain kind of foods meals Skipping

254x190mm (96 x 96 DPI)

For peer review only

(Supplementary) Table 2: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the child's perception of body weight

Actual BMI	Child's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted† OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	105	67	3.1 2.22 – 4.58	<0.001	3.1 2.2 -4.42	<0.001
Overweight/Obese	Overweight/Obese	74	9	16.7 7.93 – 36.54	<0.001	18.1 8.8 -36.9	<0.001
Overweight/Obese	Normal	43	25	3.5 2.03 – 6.08	<0.001	3.7 2.2 – 6.2	<0.001
Underweight	Underweight	19	95	0.41 0.23 – 0.70	<0.001	0.42 0.25-0.70	0.001
Underweight	Normal	67	226	0.60 0.43 – 0.84	0.001	0.62 0.45 – 0.86	0.004
Normal	Normal	219	446	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

†Adjusted for age, gender and medium of instruction

‡‡ Obtained by fitting binary logistic regression models

(Supplementary) Table 3: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the parent's perception of child's body weight

Actual BMI status of the children	Parent's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P Value*	Adjusted † OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	43	47	1.69 1.07 – 2.69	0.01	1.74 1.1 – 2.7	0.01
Overweight/Obese	Overweight/Obese	40	4	18.5 6.25 – 61.63	<0.001	19.3 6.8- 54.8	<0.001
Overweight/Obese	Normal	50	21	4.4 2.52 – 7.77	<0.001	4.7 2.7 – 8.0	<0.001
Underweight	Underweight	18	102	0.33 0.19 – 0.57	<0.001	0.34 0.20 – 0.57	<0.001
Underweight	Normal	58	181	0.59 0.42 – 0.84	0.001	0.61 0.44 – 0.86	0.004
Normal	Normal	257	476	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

* Fisher's Exact test or Chi square test

†Adjusted for age, gender and medium of instruction

‡‡ Obtained by fitting binary logistic regression models

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4 and 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4 and 5
Bias	9	Describe any efforts to address potential sources of bias	<i>Not applicable</i>
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5 and 6
		(b) Describe any methods used to examine subgroups and interactions	5 and 6
		(c) Explain how missing data were addressed	Not applicable
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	Not applicable
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	Not used
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	5 and 6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,12,13
		(b) Report category boundaries when continuous variables were categorized	5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	7 and 8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Not applicable
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7, 8 and 9
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.



BODY WEIGHT PERCEPTION INFLUENCES WEIGHT LOSS BEHAVIOR IN SOUTH INDIAN CHILDREN ACROSS A WIDE BODY WEIGHT RANGE– A CROSS-SECTIONAL STUDY

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Primary Subject Heading:	Public health
Secondary Subject Heading:	Nutrition and metabolism
Keywords:	Community child health < PAEDIATRICS, PUBLIC HEALTH, EPIDEMIOLOGY, Cross Sectional Study, INDIA

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Manuscripts

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3 1 BODY WEIGHT PERCEPTION INFLUENCES WEIGHT LOSS BEHAVIOR IN SOUTH
4 2 INDIAN CHILDREN ACROSS A WIDE BODY WEIGHT RANGE– A CROSS-
5 3 SECTIONAL STUDY
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7
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24 Short title: Body weight perception influences weight loss in South Indian children

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45 26 **Abstract:**

7 **Objective:** To examine the patterns of weight loss behaviour and the association between
8 weight loss attempts with actual weight status and children's and parental perceptions of
9 weight status.
10

11 **Design:** Cross sectional study
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13 **Setting:** Karnataka, South India
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15 **Participants:** 1874 girls and boys aged 8 to 14 years from 7 schools in Karnataka, South
16 India
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18 **Main outcome measures:** The association between weight loss attempts and socio-
19 demographic factors, weight status and the child or parent's perception of weight status.
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22 **Results:** Approximately 73% of overweight and obese, 35% of normal weight and 22% of
23 underweight children attempted to lose weight. Children of lower socio-economic groups
24 studying in schools in the local vernacular and overweight/obese children were more likely to
25 attempt to lose weight (Adjusted odds ratio or AOR=1.57, 95% CI: 1.11 to 2.25; AOR= 4.38,
26 95% CI: 2.64 to 7.28, respectively). Perception of weight status was important in influencing
27 weight loss attempts. Thus, children who were normal weight but perceived themselves to be
28 overweight / obese were three times more likely to attempt weight loss compared with those
29 who accurately perceived themselves as normal weight, while the odds of attempting weight
30 loss were the highest for those who were overweight and perceived themselves to be so
31 (AOR ~ 18).
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36 **Conclusions:** Children are likely to attempt weight loss in India irrespective of their weight
37 status, age and gender. Children who were actually overweight as well as those who were
38 perceived by themselves or by their parents to be overweight or obese were highly likely to
39 try to lose weight. It is necessary to understand body weight perceptions in communities with
40 a dual burden of overweight and under-nutrition, if intervention programmes for either are to
41 be successful.
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ARTICLE FOCUS:

- To explore weight loss behaviour patterns and association between weight loss attempts with socio-demographic factors, actual as well as children's and parental perceptions of child's weight status.

KEY MESSAGES

- In India, where both overweight and underweight in children co-exist, there are no data on the associations of body weight perceptions of children in relation to weight loss attempts. It is essential to understand this association in order to tailor suitable intervention programmes that can work in communities with concurrent under- and over-nutrition.
- Weight loss is attempted by children irrespective of weight status, age and gender. However, there are higher odds of attempting to lose weight among those who perceive themselves to be overweight, although their weight status may be normal.

STRENGTHS AND LIMITATIONS

- This is the first study to report perceptions of body weight in India in relation to weight loss attempts.
- The cross-sectional study design used in this study, allows only associations to be assessed.

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3 57 **INTRODUCTION:**
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6 58 Body image is a psycho-social dimension of body size that encompasses both perceptual and
7 59 attitudinal factors⁽¹⁾ and has been associated with eating disorders. In recent years, its
8 60 association with overweight and obesity has been described ⁽²⁾. It is recognised that
9 61 individuals make decisions on lifestyle behaviours based on body weight perceptions (a
10 62 dimension of body image) ^(1, 3). In India, there is a large burden of under-nutrition alongside
11 63 increasing overweight and obesity. For public health and clinical programmes to be more
12 64 effective, body image of undernourished and overweight children should be understood in the
13 65 context of the influence of culture on body weight perceptions and on weight management
14 66 behaviours.

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21 67 A large number of studies have indicated that children and adolescents misperceive their
22 68 body weight status. Interventions that address socio-cultural attitudes towards appearance
23 69 should ideally reduce body image dissatisfaction as well as overweight and obesity since
24 70 studies have indicated a relationship between body image, unhealthy eating practices and
25 71 obesity ^(4, 5). Perceptions of body weight are, in part, influenced by external factors including
26 72 cultural norms and social preferences as it has been observed that Asian women have less
27 73 body dissatisfaction than other ethnic groups⁽⁶⁾. In India, it is often believed that an
28 74 overweight person is wealthier and happier and reflects social mobility to a higher status
29 75 compared to an underweight person, although there are no studies to corroborate this. The
30 76 disconnect between actual weight and perception of body size could stem from the extent to
31 77 which individuals identify with the majority cultural standards of beauty⁽⁷⁾. There are also
32 78 reports that individuals in less socio-economically developed societies positively evaluate
33 79 overweight and obese figures ⁽⁸⁾. Evidence also suggests associations of actual body weight,
34 80 body weight perceptions and weight dissatisfaction with weight control practices; overweight
35 81 children are more likely to try to lose weight compared to non-overweight children ^{(9,}
36 82 ¹⁰⁾. Analysis of data from the National Health and Nutrition Examination Survey (NHANES)
37 83 ⁽¹¹⁾ and the Youth Risk Behaviour Surveillance Survey (YRBSS) ^(7, 12) indicate that those
38 84 overweight children who perceived their weight status correctly were more likely to exercise
39 85 or eat less for weight control. Results from an analysis from Europe, Israel and North
40 86 America as part of the Health Behaviour in School aged Children (HBSC) 2001/2002 survey
41 87 indicated that weight status perception of weight and age were significant factors influencing
42 88 current attempt to lose weight ⁽¹⁰⁾.

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3 89 For healthy weight management it is necessary for a person to perceive his or her weight
4 90 status accurately as well as be aware of healthy methods to lose or gain weight. Most
5 91 literature on body weight perceptions and weight control behaviours are related to studies
6 92 done in developed countries^(7, 9, 11, 13) with a few on ethnic minorities, including South Asians
7 93^(2, 14). The present analysis aims to examine the associations between the actual weight
8 94 status, body weight perceptions of both children and their parents, and body weight
9 95 satisfaction with weight loss intentions. The study sample included a wide range of body
10 96 weights to reflect the dual burden of under-nutrition and overweight/obesity that India
11 97 currently faces.

18 98 **METHODS:**

20 99 **Study population:**

21 100 A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-
22 101 economic status located in rural areas, towns in Karnataka and urban Bangalore in South
23 102 India, were contacted at baseline out of which 1907 (91.6%) children participated in a
24 103 longitudinal study on body image perceptions and growth indices of school children, details
25 104 of which are published earlier⁽¹⁵⁾. Convenience sampling of 7 city and non-city (rural and
26 105 small towns) co-educational, non-residential schools was employed, such that children
27 106 representing various socio-economic statuses (based on school fees linked to medium of
28 107 instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and
29 108 2 in Bangalore city. The schools in which Kannada, the regional state language, was the
30 109 language of instruction, received government support and had annual tuition fees of Rs.250 to
31 110 500 whereas English medium schools did not receive government support and had annual
32 111 tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an
33 112 indicator of socio-economic status (SES). Three schools (1 each in a village, small town and
34 113 city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small
35 114 towns and 1 in the city) had English as the medium of instruction.

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50 115 The sample recruited had adequate power (above 80 %) to identify the significant socio-
51 116 demographic predictors for perception of body image in the present study and to estimate a
52 117 difference of at least 10% over-estimation or under-estimation of body weight at 5% level of
53 118 significance. Ethical approval was obtained from the Institutional Ethical Review Board.

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3 119 Principals of schools were contacted for permission to conduct the study in their schools.
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5 120 Written parental consent and assent from the child was also obtained.. A questionnaire to
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7 121 assess body image perception was administered by an investigator (MP) to all the consenting
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9 122 students in a class by reading aloud the questions in either English or Kannada (the local
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11 123 language). Responses were marked on the questionnaire by each child. A short questionnaire
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13 124 in English or the local language to be filled by one of the parents was sent home after the
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15 125 children completed their questionnaires. Children whose parents were illiterate (6.7%
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17 126 mothers, 5.9% fathers), elicited the answers from either of their parents and filled up the
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19 127 questionnaire.

128 **Measurements:**

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21 129 Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was
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23 130 measured in school uniforms but without shoes using a calibrated digital scale (Home Health,
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25 131 Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were
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27 132 made using a standardized protocol. Body mass index (BMI) was computed and the BMI-
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29 133 for-age z score values were obtained using the World Health Organization Anthroplus
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31 134 software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by
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33 135 actual weight status as overweight ($>+1$ SD), normal (< -2 to $+1$) and underweight (< -2
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35 136 SD). These values at 19 years of age, at $+1$ standard deviation (SD) correspond to the BMI
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37 137 values of 25.4 kg/m^2 for boys and 25.0 kg/m^2 for girls and is equivalent to the overweight
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39 138 cut-off for adults ($> 25.0 \text{ kg/m}^2$), while the $+2$ SD value (29.7 kg/m^2 for both sexes) compares
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41 139 closely with the cut-off for obesity ($> 30.0 \text{ kg/m}^2$)⁽¹⁶⁾.

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43 140 To assess current body weight perception, children were asked to mark whether they
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45 141 thought their body weight or appearance was “too thin”, “a little thin”, “normal”, “a little
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47 142 fat”, or “very fat”. Response to a similar identical question about their child’s body weight or
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49 143 appearance with similar options was filled by parents in a questionnaire sent to their homes.
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51 144 For analysis, “very thin” and “a little thin” were combined as “too/little thin” and “a little fat”
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53 145 and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

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55 146 To assess perceptions on desired (ideal) body weight, children responded to the
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57 147 question “I want to be” with options “a lot fatter”, “slightly fatter”, “as I am at present”,
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59 148 “slightly thinner”, “much thinner”. The first 2 options were clubbed as “a lot/slightly fatter”,
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149 “as I am at present” as “same as at present” and the last 2 options clubbed as “slightly/much
150 thinner. Parents responded to a similar question on “I want my child to be” with an identical

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3 151 set of options. For analysis, clubbing of the options for parents desired body weight for their
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5 152 child was also done in a similar manner.
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7 153 The Stunkard's silhouettes⁽¹⁷⁾ were also used to assess body image perception in
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9 154 children and this was also administered in the classroom. In order to make comparisons with
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11 155 the body weight perception questions, the nine images were regrouped to reflect the 3
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13 156 categories of weight status as underweight, normal and overweight. The agreement between
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15 157 the perceived visual image and the body weight perception obtained by questions of current
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17 158 weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement
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19 159 between underweight/fat and normal, and a moderate agreement between both the extremes
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21 160 of weight (underweight versus overweight) was seen. There were no gender differences in
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23 161 agreement. Parental perceptions of the body weight were assessed using structured questions
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25 162 only, and since this was available both for the parent and the child, further analyses were
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27 163 done using the questions only.

28 164 In addition, children were asked whether they had ever tried to lose weight. If they
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30 165 replied in the affirmative (options: yes/no), the method used to try and lose weight was
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32 166 recorded as "skipping meals", "stopped eating a certain kind of food", reduced quantity of
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34 167 food eaten" and "exercise" as a multiple response. Weight loss methods recommended by
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36 168 parents were similarly recorded.

37 169 The present analysis is restricted to children on whom anthropometric measurements were
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39 170 available and who responded to the question on weight loss and this corresponds to 1874
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41 171 participants (871 boys, 1003 girls). The response rate (of a total of 1907 children) was 98.3%;
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43 172 socio-demographic (age, gender, medium of instruction) characteristics between the
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45 173 responders and non responders were comparable.
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48 175 **Statistical analysis:**

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50 176 Data are reported as number and percentages for all the categorical variables. For analysis,
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52 177 socio-demographic variables of age of children were categorized as 10 and below and above
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54 178 10 years of age (the adolescent period)⁽¹⁸⁾, language of instruction as Kannada and English
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56 179 medium (a surrogate of socio-economic status), location as city and non-city (village and
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58 180 small towns) and maternal and paternal education below 7th grade and above 7th grade.
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3 181 Cross-tabulations were created of actual weight status of the child with the child's perception
4 182 and parent's perception of their child's current body weight. Using this, the following eight
5 183 groups were formed. As there were no children who were underweight but were perceived
6 184 either by themselves or their parents to be overweight, this category was not considered.
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10 185 U/U – underweight by actual measurements/perceived by child/parent to be underweight

11 186 U/N- underweight by actual measurements/perceived by child/parent to be normal

12 187 N/U- normal by actual measurements/perceived by child/parent to be underweight

13 188 N/N- normal by actual measurements/perceived by child/parent to be normal

14 189 N/O- normal by actual measurements/perceived by child/parent to be overweight

15 190 O/N- overweight by actual measurements/perceived by child/parent to be normal

16 191 O/O- overweight by actual measurements/perceived by child/parent to be overweight

17 192 O/U- overweight by actual measurements/perceived by child/parent to be underweight

18 193 The referent group was the N/N group.

19 194 The association between attempting weight loss with various socio-demographic factors as
20 195 well with the above eight groups was evaluated using the Chi-square test and the unadjusted
21 196 odds ratio reported. Association between attempt to lose weight and child's actual weight
22 197 status, child's and parent's perception of child's weight status and the above mentioned eight
23 198 groups were done using Chi square test stratified by age and gender. Binary logistic
24 199 regression was performed to identify the factors associated with attempted weight loss
25 200 adjusted for socio-demographic variables of age, gender, medium of instruction, parent's
26 201 education and current actual body weight status, child's and parent's perceived and desired
27 202 weight status of the child as model 1. In addition, a model (model 2) adjusted only for age,
28 203 sex, medium of instruction, actual weight status and the child's weight perception was
29 204 performed. Binary logistic regression was also performed to identify the factors associated
30 205 with attempting to lose weight (Yes/No) based on the 8 groups (details above) created using
31 206 the actual weight status of the child and child's or parent's perception of child's weight,
32 207 adjusted for age, gender and medium of instruction. A level of significance (two-sided) less
33 208 than 5% was considered statistically significant.
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51 209 **RESULTS:**

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54 210 Of the 1907 study children, 1874 responded to the question on whether they had ever tried to
55 211 lose weight. Of these, 65.5% of children were normal weight, 25.0 % underweight and 9.5%
56 212 overweight. Thirty two percent of children perceived themselves to be underweight; this was
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3 213 7% more than the actual prevalence of underweight. Similarly, 15.4% perceived themselves
4 214 to be overweight (5.9% higher than the actual prevalence). In contrast, parents tended to
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6 215 under-estimate underweight (5% lower than the actual prevalence of under-weight).
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9 216 A total of 35% of children had attempted to lose weight; this constituted 73% of overweight
10 217 and obese, 35% of normal weight and 22% of underweight children. Sixty eight percent of
11 218 those children who perceived themselves to be overweight, 32% of those who perceived
12 219 themselves to be normal, and 23% of those who perceived themselves to be underweight
13 220 attempted to lose weight. Similarly, 54 % of children whose parents perceived them to be
14 221 overweight, 35% who perceived them to be normal, and 21% of those who perceived them to
15 222 be underweight attempted to lose weight. Correlations between actual weight status of the
16 223 child, child's or parent's perception of child's weight status, as well as child's and parent's
17 224 perceptions on desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$)
18 225 (Supplementary table 1) indicating a low to moderate correlation between these variables.
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22 226 Among the socio-demographic factors (Table 1, Model 1), children in schools with Kannada
23 227 as the medium of instruction were more likely to attempt to lose weight than those studying
24 228 in schools with English as the medium of instruction (AOR= 1.57, 95% C.I: 1.11 to
25 229 2.25). Underweight children were less likely to try to lose weight (AOR=0.71, 95% C.I: 0.51
26 230 to 0.98), while overweight/obese children were more likely (AOR=4.38. 95% C.I: 2.64 to
27 231 7.28) to try and lose weight compared to normal weight children. Based on the child's
28 232 perception of their weight status, those who perceived themselves to be overweight were
29 233 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental
30 234 perception of weight status, however, did not have a significant impact on children
31 235 attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire
32 236 (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of
33 237 attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to
34 238 lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys.
35 239 Otherwise, the findings were similar to Model 1.
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39 240 A stratified analysis based on age and gender (Supplementary table 2) was also done. While
40 241 the groups were largely similar in terms of attempting to lose weight, significant differences
41 242 were observed only among those children who were actually underweight as well as those
42 243 who perceived themselves to be underweight. In these children, the prevalence of attempting
43 244 to lose weight was significantly higher in older boys compared to older girls. Similarly, there
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245 was a significantly higher prevalence of younger girls attempting to lose weight compared to
246 older girls, but not between younger and older boys.

247 Figure 1 represents the odds of a child attempting to lose weight based on the child's actual
248 weight status in combination with the child's/parent's perception of weight status. After
249 adjusting for age, gender and medium of instruction, the odds of attempting to lose weight
250 (Figure 1, Supplementary table3) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight
251 child who perceive themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an
252 overweight child who perceive themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an
253 overweight child who perceive themselves to be overweight. A similar trend was observed
254 when parental perceptions were replaced with child's perception (Figure 1) with odds of
255 attempting to lose weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child
256 perceived by a parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child
257 perceived by a parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child
258 perceived to be overweight by a parent. None of the underweight children were perceived by
259 themselves or by their parents to be overweight. Among children who were underweight but
260 perceived either by the child or parent to be underweight or normal, the odds of attempting to
261 lose weight was reduced by approximately 60% to 40% respectively in relation to children of
262 normal weight status perceived to be normal by both children and parents. The same has been
263 done using prevalence of attempting to lose weight based on actual weight status, child's
264 perception and parent's perception of child's weight status stratified by age and gender
265 (Figure 2a and 2b),

266 The most commonly adopted practice to lose weight regardless of whether the children were
267 underweight, overweight or normal was exercise (~46%), followed by reducing the quantity
268 of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 3).

269 **DISCUSSION:**

270 In concurrence with the findings of our study, misperception of weight status among children
271 has been reported in other studies conducted in the United States of America, with
272 perceptions differing between various ethnic groups. Among African American adolescents,
273 one-third perceived their weight status inaccurately⁽⁹⁾. Racial or ethnic differences in weight
274 perception have been reported ^(9, 13, 19), where Caucasians were more likely than African
275 Americans to perceive themselves as overweight ^(9, 13, 20). However, this has not been a
276 universal finding, as for instance in multi-ethnic adolescents in the United Kingdom ⁽¹⁴⁾.

277 Perceptions, however, also governed their decision to attempt weight loss, notwithstanding
278 their current weight status.

279 In general, children who were actually overweight as well as those who were perceived by
280 themselves or by their parents to be overweight were highly likely to try to lose weight.
281 Clearly, perceptions influence their decision to try to lose weight. This finding is similar to
282 studies conducted in other countries^(9, 19, 21). Unless individuals or their families perceive
283 their weight status correctly, their acceptance of programmes designed to encourage healthy
284 weight may be low⁽¹²⁾.

285 The child's or parent's desire for the child to be thinner also influenced their decision to try to
286 lose weight. This desire was highest among those who perceived themselves to be
287 overweight, although about one-third of those who perceived themselves to be normal weight
288 and about one-fifth of those who perceived themselves to be underweight also attempted to
289 lose weight. In contrast, among children who were underweight and those of normal weight,
290 32% and 23% desired to gain weight respectively. This clearly indicates that in a country
291 where both underweight and overweight co-exist, care must be taken in developing
292 programmes at a community level such that those who require to put on weight and those
293 who need to lose weight are considered as for example in the school feeding programmes.

294
295 The fact that there were reported weight loss attempts even in the underweight group suggests
296 that factors other than weight status and weight perception are operative. This is corroborated
297 by the higher odds of children from Kannada medium schools, who belong to a relatively
298 lower socio-economic status compared to children from English medium schools (higher
299 SES) trying to lose weight. Thus socio-cultural factors may also influence their decision to
300 lose weight. This could be linked to the continuous exposure to images and unrealistic body
301 shapes that encourage weight loss regardless of body weight⁽¹⁹⁾. These factors must be
302 further explored so that suitable programmes that encourage overweight children but not
303 underweight or normal children to lose weight are planned.

304 Included in our sample were children as young as 8 years of age. However, body
305 dissatisfaction with increasing weight status was established even by the age of 5 in both
306 boys and girls of South Asian origin in UK⁽²⁾. Irrespective of whether they were below or
307 above 10 years of age or whether they were boys or girls, children attempted to lose weight.
308 In our study sample, there were no gender differences in weight loss attempts. This is

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3 309 contrary to the findings elsewhere, as for instance, the NHANES study ⁽¹¹⁾, which indicated
4 310 that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender
5 311 differences in our study may, in part, be due to the relatively low prevalence of overweight or
6 312 obesity.
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10 313 It is encouraging that 46 % children indicated exercise their preferred choice of weight loss.
11 314 Differences in the methods used to lose weight between overweight, normal and underweight
12 315 children were not apparent unlike other studies where unhealthier weight loss methods like
13 316 skipping meals are reported more in overweight or obese children compared to normal weight
14 317 children ⁽²²⁾. However, an effect of social desirability cannot be discounted, given that
15 318 exercise as a healthy lifestyle choice is promoted early in the school curriculum
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18 319 Body image must be taken into account when designing programmes to improve both body
19 320 image and reduce unhealthy behaviours like unhealthy eating and reduced or excessive
20 321 exercise⁽¹⁾. Since public health programmes are generally targeted towards all, a general
21 322 programme that caters to all children irrespective of their weight status is required.
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24 323 **Strengths and limitations:** This is the first study to report perceptions of body weight in
25 324 India in relation to weight loss attempts. A major strength of this study is that measured
26 325 heights and weights rather than self-reported, were used and the study sample encompassed
27 326 children of diverse socio-economic strata, from rural and urban areas and of a large body
28 327 weight range. However, with the cross-sectional study design used in this study, the changes
29 328 in perception as the children grow cannot be accounted for. Longitudinal evaluation of these
30 329 children will allow us to establish causal links between weight perception and weight loss
31 330 behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of
32 331 the questionnaire were limitations as information regarding the frequency, duration, and
33 332 intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or
34 333 past) at which such behaviours occurred could not be obtained. Data on the reliability and
35 334 validity of the questionnaire are not available for this population. With the question asked on
36 335 attempt to lose weight being dichotomous, there is a possibility that a child who is currently
37 336 normal weight may report weight loss behaviours because they were overweight in the past.
38 337 The small numbers of children in each category in the analysis stratified by actual and
39 338 perceived weight status necessitates further exploration with larger numbers of children in
40 339 each category. A further limitation is that we have not collected data on attempt to gain
41 340 weight.
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5 342 Overall, perceptions of weight status influenced the decision of children to lose weight. This
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7 343 needs to be further explored as a longitudinal study to establish causal links. However,
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9 344 regardless of weight status, many children did resort to weight loss. Public health campaigns
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11 345 should emphasize healthy weight management rather than weight loss.

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18
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20
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22
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24
25 352 All authors revised the manuscript critically for important intellectual content. SS is the
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Table 1. Socio-economic and anthropometric associations of weight loss behaviour

	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted † OR Model 1 95% C.I.	P value‡	Adjusted ¶ OR Model 2 95% C.I.	P value‡	
	Yes	No							
Gender									
	Girls	387 (39%)	616 (61%)	1.41 1.16 – 1.72	<0.001	1.16 0.89 – 1.51	0.27	1.37 1.11 – 1.70	0.01
	Boys	268 (31%)	603 (69%)	1		1	1		
Age category (years)									
	≤10	245 (34%)	469 (66%)	0.96 0.78 – 1.17	0.65	1.04 0.79 – 1.36	0.76	1.03 0.83 – 1.28	0.79
	>10	410 (35%)	750 (65%)	1		1	1		
Location									
	City	408 (33%)	812 (67%)	0.83 0.68 – 1.01	0.06	1.03 0.78 – 1.36	0.81	-	-
	Non City	247 (38%)	407 (62%)	1		1	1		
Education of mother (Standard)									
	Up to 7 th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7 th	400 (36%)	727 (65%)	1		1	1		
Education of father (Standard)									
	Up to 7 th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7 th	437 (34%)	838 (66%)	1		1	1		
Medium of instruction									
	Kannada	198 (39%)	308 (61%)	1.28 1.03- 1.59	0.02	1.57 1.11 – 2.25	0.01	1.52 1.20 – 1.92	<0.001
	English ¹	457(33%)	911 (67%)	1		1	1		

Actual weight status									
Underweight	98 (22%)	352 (78%)	0.52	<0.001	0.71	0.04	0.66		
			0.40 – 0.67		0.51 – 0.98		0.50 – 0.86	0.002	
Overweight	125 (73%)	47 (27%)	4.96	<0.001	4.38	<0.001	3.86		
			3.43 – 7.20		2.64 – 7.28		2.63 – 5.64	<0.001	
Normal	412 (35%)	769 (65%)	1		1				
Child's perception of body image									
Too /A little Thin	133 (23%)	457 (77%)	0.61	<0.001	0.67	0.01	0.64	<0.001	
			0.48 – 0.77		0.49 – 0.93		0.49 – 0.82		
A little /Too fat	195 (68%)	91 (32%)	4.48	<0.001	2.91	<0.001	3.48	<0.001	
			3.35 – 6.00		1.95 – 4.34		2.57 – 4.69		
Normal	318 (32%)	665 (68%)	1		1				
Child's desire to be									
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76	0.03	0.84	0.35			
			0.58 – 0.98		0.59 – 1.20				
Slightly/Much thinner	260(52%)	237 (48%)	2.53	<0.001	1.56	0.006	-	-	
			2.00 – 3.19		1.14 – 2.15				
Same as at present	272 (30%)	627 (70%)	1		1				
Parent's perception of child's body image									
Too /A little Thin	66 (22%)	241 (79%)	0.52	<0.001	0.76	0.15			
			0.38 – 0.71		0.52 – 1.12		-	-	
A little /Too fat	95 (54%)	82 (46%)	2.20	<0.001	0.86				
			1.58 – 3.08		0.51 – 1.37	0.51			
Normal	364 (35%)	690 (66%)	1		1				
Parent's desire for child to be									
A lot /Slightly fatter	87 (21%)	331 (79%)	0.54	<0.001	0.75	0.11			
			0.41- 0.72		0.52 – 1.07		-	-	
Slightly /Much thinner	170 (56%)	134 (44%)	2.61	<0.001	1.79				
			1.98 – 3.46		1.25 – 2.58	0.002			
Same as at present	263 (33%)	542 (67%)	1		1				

Results are reported as Number (percentages); OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

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5 † Adjusted for actual BMI status, child's and parents perception of body weight and socio-demographic factors

6 ‡ Obtained by fitting binary logistic regression model. Model 1: Adjusted for socio-demographic variables and actual and perceived weight

7 ¶ Obtained by fitting binary logistic regression model. Model 2: Adjusted for age, gender, medium of instruction, actual weight status and child's perception of
8 body weight.
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8 **Figure Legends:**
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10 **Figure 1: Odds ratio of having tried to lose body weight in children classified by current**
11 **weight status and perception of body weight.** ■ Comparison of child's actual weight

12 status with child's perception of weight status □ Comparison of child's actual weight
13 status with parental perception of weight status. U/U: underweight by actual
14 measurements/child's or parent's perception of being underweight, U/N: underweight by
15 actual measurements/child's or parent's perception of being normal, N/U- normal by actual
16 measurements/perceived by child/parent to be underweight, N/N: normal by actual
17 measurements/child's or parent's perception of being normal, N/O: normal by actual
18 measurements/child's or parent's perception of being overweight, O/N: overweight by actual
19 measurements/child's or parent's perception of being normal, O/O: overweight by actual
20 measurements/child's or parent's perception of being overweight, O/U: overweight by actual
21 measurements/child's or parent's perception of being underweight.
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34 **Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category**
35 **based on actual weight status and children and parent's perception of child's body**
36 **weight. UW – Underweight, OW – Overweight**
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40 **Figure 3: Actual weight status and weight loss practices of children**

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42 ■ Exercise ■ Reduced quantity of food eaten ■ Stopped eating certain kind of foods
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3 1 BODY WEIGHT PERCEPTION INFLUENCES WEIGHT LOSS BEHAVIOR IN SOUTH
4 2 INDIAN CHILDREN ACROSS A WIDE BODY WEIGHT RANGE– A CROSS-
5 3 SECTIONAL STUDY
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24 Short title: Body weight perception influences weight loss in South Indian children

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Abstract:

Objective: To examine the patterns of weight loss behaviour and the association between weight loss attempts with actual weight status and children's and parental perceptions of weight status.

Design: Cross sectional study

Setting: Karnataka, South India

Participants: 1874 girls and boys aged 8 to 14 years from 7 schools in Karnataka, South India

Main outcome measures: The association between weight loss attempts and socio-demographic factors, weight status and the child or parent's perception of weight status.

Results: Approximately 73% of overweight and obese, 35% of normal weight and 22% of underweight children attempted to lose weight. Children of lower socio-economic groups studying in schools in the local vernacular and overweight/obese children were more likely to attempt to lose weight (Adjusted odds ratio or AOR=1.57, 95% CI: 1.11 to 2.25; AOR= 4.38, 95% CI: 2.64 to 7.28, respectively). Perception of weight status was important in influencing weight loss attempts. Thus, children who were normal weight but perceived themselves to be overweight / obese were three times more likely to attempt weight loss compared with those who accurately perceived themselves as normal weight, while the odds of attempting weight loss were the highest for those who were overweight and perceived themselves to be so (AOR ~ 18).

Conclusions: Children are likely to attempt weight loss in India irrespective of their weight status, age and gender. Children who were actually overweight as well as those who were perceived by themselves or by their parents to be overweight or obese were highly likely to try to lose weight. It is necessary to understand body weight perceptions in communities with a dual burden of overweight and under-nutrition, if intervention programmes for either are to be successful.

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ARTICLE FOCUS:

- To explore weight loss behaviour patterns and association between weight loss attempts with socio-demographic factors, actual as well as children's and parental perceptions of child's weight status.

KEY MESSAGES

- In India, where both overweight and underweight in children co-exist, there are no data on the associations of body weight perceptions of children in relation to weight loss attempts. It is essential to understand this association in order to tailor suitable intervention programmes that can work in communities with concurrent under- and over-nutrition.
- Weight loss is attempted by children irrespective of weight status, age and gender. However, there are higher odds of attempting to lose weight among those who perceive themselves to be overweight, although their weight status may be normal.

STRENGTHS AND LIMITATIONS

- This is the first study to report perceptions of body weight in India in relation to weight loss attempts.
- The cross-sectional study design used in this study, allows only associations to be assessed.

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57 INTRODUCTION:

58 Body image is a psycho-social dimension of body size that encompasses both perceptual and
59 attitudinal factors⁽¹⁾ and has been associated with eating disorders. In recent years, its
60 association with overweight and obesity has been described⁽²⁾. It is recognised that
61 individuals make decisions on lifestyle behaviours based on body weight perceptions (a
62 dimension of body image)^(1, 3). **In India, there is a large burden of under-nutrition alongside
63 increasing overweight and obesity.** For public health and clinical programmes to be more
64 effective, body image of undernourished and overweight children should be understood in the
65 context of the influence of culture on body weight perceptions and on weight management
66 behaviours.

67 A large number of studies have indicated that children and adolescents misperceive their
68 body weight status. Interventions that address socio-cultural attitudes towards appearance
69 should ideally reduce body image dissatisfaction as well as overweight and obesity since
70 studies have indicated a relationship between body image, unhealthy eating practices and
71 obesity^(4, 5). Perceptions of body weight are, in part, influenced by external factors including
72 cultural norms and social preferences **as it has been observed that Asian women have less
73 body dissatisfaction than other ethnic groups⁽⁶⁾.** In India, it is often believed that an
74 **overweight person is wealthier and happier and reflects social mobility to a higher status
75 compared to an underweight person, although there are no studies to corroborate this.** The
76 disconnect between actual weight and perception of body size could stem from the extent to
77 which individuals identify with the majority cultural standards of beauty⁽⁷⁾. There are also
78 reports that individuals in less socio-economically developed societies positively evaluate
79 overweight and obese figures⁽⁸⁾. Evidence also suggests associations of actual body weight,
80 body weight perceptions and weight dissatisfaction with weight control practices; overweight
81 children are more likely to try to lose weight compared to non-overweight children^{(9,}
82 ¹⁰⁾. Analysis of data from the National Health and Nutrition Examination Survey (NHANES)
83 ⁽¹¹⁾ and the Youth Risk Behaviour Surveillance Survey (YRBSS)^(7, 12) indicate that those
84 overweight children who perceived their weight status correctly were more likely to exercise
85 or eat less for weight control. Results from an analysis from Europe, Israel and North
86 America as part of the Health Behaviour in School aged Children (HBSC) 2001/2002 survey
87 indicated that weight status perception of weight and age were significant factors influencing
88 current attempt to lose weight⁽¹⁰⁾.

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3 89 For healthy weight management it is necessary for a person to perceive his or her weight
4 90 status accurately as well as be aware of healthy methods to lose or gain weight. Most
5 91 literature on body weight perceptions and weight control behaviours are related to studies
6 92 done in developed countries^(7, 9, 11, 13) with a few on ethnic minorities, including South Asians
7 93^(2, 14). The present analysis aims to examine the associations between the actual weight
8 94 status, body weight perceptions of both children and their parents, and body weight
9 95 satisfaction with weight loss intentions. The study sample included a wide range of body
10 96 weights to reflect the dual burden of under-nutrition and overweight/obesity that India
11 97 currently faces.

18 98 **METHODS:**

20 99 **Study population:**

21 100 A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-
22 101 economic status located in rural areas, towns in Karnataka and urban Bangalore in South
23 102 India, were contacted at baseline out of which 1907 (91.6%) children participated in a
24 103 longitudinal study on body image perceptions and growth indices of school children, details
25 104 of which are published earlier⁽¹⁵⁾. Convenience sampling of 7 city and non-city (rural and
26 105 small towns) co-educational, non-residential schools was employed, such that children
27 106 representing various socio-economic statuses (based on school fees linked to medium of
28 107 instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and
29 108 2 in Bangalore city. The schools in which Kannada, the regional state language, was the
30 109 language of instruction, received government support and had annual tuition fees of Rs.250 to
31 110 500 whereas English medium schools did not receive government support and had annual
32 111 tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an
33 112 indicator of socio-economic status (SES). Three schools (1 each in a village, small town and
34 113 city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small
35 114 towns and 1 in the city) had English as the medium of instruction.

36 115 The sample recruited had adequate power (above 80 %) to identify the significant socio-
37 116 demographic predictors for perception of body image in the present study and to estimate a
38 117 difference of at least 10% over-estimation or under-estimation of body weight at 5% level of
39 118 significance. Ethical approval was obtained from the Institutional Ethical Review Board.

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3 119 Principals of schools were contacted for permission to conduct the study in their schools.
4 120 Written parental consent and assent from the child was also obtained. A questionnaire to
5 assess body image perception was administered by an investigator (MP) to all the consenting
6 students in a class by reading aloud the questions in either English or Kannada (the local
7 language). Responses were marked on the questionnaire by each child. A short questionnaire
8 in English or the local language to be filled by one of the parents was sent home after the
9 children completed their questionnaires. Children whose parents were illiterate (6.7%
10 mothers, 5.9% fathers), elicited the answers from either of their parents and filled up the
11 questionnaire.
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128 **Measurements:**

129 Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was
130 measured in school uniforms but without shoes using a calibrated digital scale (Home Health,
131 Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were
132 made using a standardized protocol. Body mass index (BMI) was computed and the BMI-
133 for-age z score values were obtained using the World Health Organization Anthroplus
134 software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by
135 actual weight status as overweight ($>+1$ SD), normal (< -2 to $+1$) and underweight (< -2
136 SD). These values at 19 years of age, at $+1$ standard deviation (SD) correspond to the BMI
137 values of 25.4 kg/m^2 for boys and 25.0 kg/m^2 for girls and is equivalent to the overweight
138 cut-off for adults ($> 25.0 \text{ kg/m}^2$), while the $+2$ SD value (29.7 kg/m^2 for both sexes) compares
139 closely with the cut-off for obesity ($> 30.0 \text{ kg/m}^2$)⁽¹⁶⁾.

140 To assess current body weight perception, children were asked to mark whether they
141 thought their body weight or appearance was “too thin”, “a little thin”, “normal”, “a little
142 fat”, or “very fat”. Response to a similar identical question about their child’s body weight or
143 appearance with similar options was filled by parents in a questionnaire sent to their homes.
144 For analysis, “very thin” and “a little thin” were combined as “too/little thin” and “a little fat”
145 and “very fat” were combined as “a little/too fat” and “normal” remained “normal”.

146 To assess perceptions on desired (ideal) body weight, children responded to the
147 question “I want to be” with options “a lot fatter”, “slightly fatter”, “as I am at present”,
148 “slightly thinner”, “much thinner”. The first 2 options were clubbed as “a lot/slightly fatter”,
149 “as I am at present” as “same as at present” and the last 2 options clubbed as “slightly/much
150 thinner. Parents responded to a similar question on “I want my child to be” with an identical

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3 151 set of options. For analysis, clubbing of the options for parents desired body weight for their
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5 152 child was also done in a similar manner.

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7 153 The Stunkard's silhouettes⁽¹⁷⁾ were also used to assess body image perception in
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9 154 children and this was also administered in the classroom. In order to make comparisons with
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11 155 the body weight perception questions, the nine images were regrouped to reflect the 3
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13 156 categories of weight status as underweight, normal and overweight. The agreement between
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15 157 the perceived visual image and the body weight perception obtained by questions of current
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17 158 weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement
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19 159 between underweight/fat and normal, and a moderate agreement between both the extremes
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21 160 of weight (underweight versus overweight) was seen. There were no gender differences in
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23 161 agreement. Parental perceptions of the body weight were assessed using structured questions
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25 162 only, and since this was available both for the parent and the child, further analyses were
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27 163 done using the questions only.

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29 164 In addition, children were asked whether they had ever tried to lose weight. If they
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31 165 replied in the affirmative (options: yes/no), the method used to try and lose weight was
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33 166 recorded as "skipping meals", "stopped eating a certain kind of food", reduced quantity of
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35 167 food eaten" and "exercise" as a multiple response. Weight loss methods recommended by
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37 168 parents were similarly recorded.

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39 169 The present analysis is restricted to children on whom anthropometric measurements were
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41 170 available and who responded to the question on weight loss and this corresponds to 1874
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43 171 participants (871 boys, 1003 girls). The response rate (of a total of 1907 children) was 98.3%;
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45 172 socio-demographic (age, gender, medium of instruction) characteristics between the
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47 173 responders and non responders were comparable.

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175 **Statistical analysis:**

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51 176 Data are reported as number and percentages for all the categorical variables. For analysis,
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53 177 socio-demographic variables of age of children were categorized as 10 and below and above
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55 178 10 years of age (the adolescent period)⁽¹⁸⁾, language of instruction as Kannada and English
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57 179 medium (a surrogate of socio-economic status), location as city and non-city (village and
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59 180 small towns) and maternal and paternal education below 7th grade and above 7th grade.

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3 181 Cross-tabulations were created of actual weight status of the child with the child's perception
4 182 and parent's perception of their child's current body weight. Using this, the following **eight**
5 183 groups were formed. **As there were no children who were underweight but were perceived**
6 184 **either by themselves or their parents to be overweight, this category was not considered.**

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10 185 U/U – underweight by actual measurements/perceived by child/parent to be underweight

11 186 U/N- underweight by actual measurements/perceived by child/parent to be normal

12 187 **N/U- normal by actual measurements/perceived by child/parent to be underweight**

13 188 N/N- normal by actual measurements/perceived by child/parent to be normal

14 189 N/O- normal by actual measurements/perceived by child/parent to be overweight

15 190 O/N- overweight by actual measurements/perceived by child/parent to be normal

16 191 O/O- overweight by actual measurements/perceived by child/parent to be overweight

17 192 **O/U- overweight by actual measurements/perceived by child/parent to be underweight**

18 193 The referent group was the N/N group.

19 194 The association between attempting weight loss with various socio-demographic factors as
20 195 well with the above eight groups was evaluated using the Chi-square test and the unadjusted
21 196 odds ratio reported. **Association between attempt to lose weight and child's actual weight**
22 197 **status, child's and parent's perception of child's weight status and the above mentioned eight**
23 198 **groups were done using Chi square test stratified by age and gender.** Binary logistic
24 199 regression was performed to identify the factors associated with attempted weight loss
25 200 adjusted for socio-demographic variables **of age, gender, medium of instruction, parent's**
26 201 **education and current actual body weight status, child's and parent's perceived and desired**
27 202 **weight status of the child as model 1. In addition, a model (model 2) adjusted only for age,**
28 203 **sex, medium of instruction, actual weight status and the child's weight perception was**
29 204 **performed.** Binary logistic regression was also performed to identify the factors associated
30 205 with attempting to lose weight (**Yes/No**) based on the 8 groups (details above) created using
31 206 the actual weight status of the child and child's or parent's perception of child's weight,
32 207 adjusted for age, gender and medium of instruction. A level of significance (two-sided) less
33 208 than 5% was considered statistically significant.

34 209 **RESULTS:**

35 210 Of the 1907 study children, 1874 responded to the question on whether they had ever tried to
36 211 lose weight. Of these, 65.5% of children were normal weight, 25.0 % underweight and 9.5%
37 212 overweight. Thirty two percent of children perceived themselves to be underweight; this was

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3 213 7% more than the actual prevalence of underweight. Similarly, 15.4% perceived themselves
4 214 to be overweight (5.9% higher than the actual prevalence). In contrast, parents tended to
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6 215 under-estimate underweight (5% lower than the actual prevalence of under-weight).
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9 216 A total of 35% of children had attempted to lose weight; this constituted 73% of overweight
10 217 and obese, 35% of normal weight and 22% of underweight children. Sixty eight percent of
11 218 those children who perceived themselves to be overweight, 32% of those who perceived
12 219 themselves to be normal, and 23% of those who perceived themselves to be underweight
13 220 attempted to lose weight. Similarly, 54 % of children whose parents perceived them to be
14 221 overweight, 35% who perceived them to be normal, and 21% of those who perceived them to
15 222 be underweight attempted to lose weight. **Correlations between actual weight status of the**
16 223 **child, child's or parent's perception of child's weight status, as well as child's and parent's**
17 224 **perceptions on desired (ideal) body weight ranged from 0.12 to 0.31 (p<0.01)**
18 225 **(Supplementary table 1) indicating a low to moderate correlation between these variables.**
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26 226 Among the socio-demographic factors (Table 1, Model 1), children in schools with Kannada
27 227 as the medium of instruction were more likely to attempt to lose weight than those studying
28 228 in schools with English as the medium of instruction (AOR= 1.57, 95% C.I: 1.11 to
29 229 2.25). Underweight children were less likely to try to lose weight (AOR=0.71, 95% C.I: 0.51
30 230 to 0.98), while overweight/obese children were more likely (AOR=4.38. 95% C.I: 2.64 to
31 231 7.28) to try and lose weight compared to normal weight children. Based on the child's
32 232 perception of their weight status, those who perceived themselves to be overweight were
33 233 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental
34 234 perception of weight status, however, did not have a significant impact on children
35 235 attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire
36 236 (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of
37 237 attempting to lose weight. **Based on a simpler model (Model 2) the odds of attempting to**
38 238 **lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys.**
39 239 **Otherwise, the findings were similar to Model 1.**
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50 240 **A stratified analysis based on age and gender (Supplementary table 2) was also done. While**
51 241 **the groups were largely similar in terms of attempting to lose weight, significant differences**
52 242 **were observed only among those children who were actually underweight as well as those**
53 243 **who perceived themselves to be underweight. In these children, the prevalence of attempting**
54 244 **to lose weight was significantly higher in older boys compared to older girls. Similarly, there**
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3 245 was a significantly higher prevalence of younger girls attempting to lose weight compared to
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5 246 older girls, but not between younger and older boys.

7 247 Figure 1 represents the odds of a child attempting to lose weight based on the child's actual
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9 248 weight status in combination with the child's/parent's perception of weight status. After
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11 249 adjusting for age, gender and medium of instruction, the odds of attempting to lose weight
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13 250 (Figure 1, Supplementary table3) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight
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15 251 child who perceive themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an
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17 252 overweight child who perceive themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an
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19 253 overweight child who perceive themselves to be overweight. A similar trend was observed
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21 254 when parental perceptions were replaced with child's perception (Figure 1) with odds of
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23 255 attempting to lose weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child
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25 256 perceived by a parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child
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27 257 perceived by a parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child
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29 258 perceived to be overweight by a parent. None of the underweight children were perceived by
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31 259 themselves or by their parents to be overweight. Among children who were underweight but
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33 260 perceived either by the child or parent to be underweight or normal, the odds of attempting to
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35 261 lose weight was reduced by approximately 60% to 40% respectively in relation to children of
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37 262 normal weight status perceived to be normal by both children and parents. **The same has been
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39 263 done using prevalence of attempting to lose weight based on actual weight status, child's
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41 264 perception and parent's perception of child's weight status stratified by age and gender
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43 265 (Figure 2a and 2b),**

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45 266 The most commonly adopted practice to lose weight regardless of whether the children were
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47 267 underweight, overweight or normal was exercise (~46%), followed by reducing the quantity
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49 268 of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 3).

45 269 **DISCUSSION:**

48 270 In concurrence with the findings of our study, misperception of weight status among children
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50 271 has been reported in other studies conducted in the United States of America, with
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52 272 perceptions differing between various ethnic groups. Among African American adolescents,
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54 273 one-third perceived their weight status inaccurately⁽⁹⁾. Racial or ethnic differences in weight
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56 274 perception have been reported^(9, 13, 19), where Caucasians were more likely than African
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58 275 Americans to perceive themselves as overweight^(9, 13, 20). **However, this has not been a
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60 276 universal finding, as for instance in multi-ethnic adolescents in the United Kingdom⁽¹⁴⁾.**

277 Perceptions, however, also governed their decision to attempt weight loss, notwithstanding
278 their current weight status.

279 In general, children who were actually overweight as well as those who were perceived by
280 themselves or by their parents to be overweight were highly likely to try to lose weight.
281 Clearly, perceptions influence their decision to try to lose weight. This finding is similar to
282 studies conducted in other countries^(9, 19, 21). Unless individuals or their families perceive
283 their weight status correctly, their acceptance of programmes designed to encourage healthy
284 weight may be low⁽¹²⁾.

285 The child's or parent's desire for the child to be thinner also influenced their decision to try to
286 lose weight. **This desire was highest among those who perceived themselves to be
287 overweight, although about one-third of those who perceived themselves to be normal weight
288 and about one-fifth of those who perceived themselves to be underweight also attempted to
289 lose weight. In contrast, among children who were underweight and those of normal weight,
290 32% and 23% desired to gain weight respectively. This clearly indicates that in a country
291 where both underweight and overweight co-exist, care must be taken in developing
292 programmes at a community level such that those who require to put on weight and those
293 who need to lose weight are considered as for example in the school feeding programmes.**

294
295 The fact that there were reported weight loss attempts even in the underweight group suggests
296 that factors other than weight status and weight perception are operative. This is corroborated
297 by the higher odds of children from Kannada medium schools, who belong to a relatively
298 lower socio-economic status compared to children from English medium schools (higher
299 SES) trying to lose weight. Thus socio-cultural factors may also influence their decision to
300 lose weight. This could be linked to the continuous exposure to images and unrealistic body
301 shapes that encourage weight loss regardless of body weight⁽¹⁹⁾. These factors must be
302 further explored so that suitable programmes that encourage overweight children but not
303 underweight or normal children to lose weight are planned.

304 Included in our sample were children as young as 8 years of age. However, body
305 dissatisfaction with increasing weight status was established even by the age of 5 in both
306 boys and girls of South Asian origin in UK⁽²⁾. Irrespective of whether they were below or
307 above 10 years of age or whether they were boys or girls, children attempted to lose weight.
308 In our study sample, there were no gender differences in weight loss attempts. This is

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3 309 contrary to the findings elsewhere, as for instance, the NHANES study ⁽¹¹⁾, which indicated
4 310 that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender
5 311 differences in our study may, in part, be due to the relatively low prevalence of overweight or
6 312 obesity.
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10 313 It is encouraging that 46 % children indicated exercise their preferred choice of weight loss.
11 314 Differences in the methods used to lose weight between overweight, normal and underweight
12 315 children were not apparent unlike other studies where unhealthier weight loss methods like
13 316 skipping meals are reported more in overweight or obese children compared to normal weight
14 317 children ⁽²²⁾. However, an effect of social desirability cannot be discounted, given that
15 318 exercise as a healthy lifestyle choice is promoted early in the school curriculum
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18 319 Body image must be taken into account when designing programmes to improve both body
19 320 image and reduce unhealthy behaviours like unhealthy eating and reduced or excessive
20 321 exercise⁽¹⁾. Since public health programmes are generally targeted towards all, a general
21 322 programme that caters to all children irrespective of their weight status is required.
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24 323 **Strengths and limitations:** This is the first study to report perceptions of body weight in
25 324 India in relation to weight loss attempts. A major strength of this study is that measured
26 325 heights and weights rather than self-reported, were used and the study sample encompassed
27 326 children of diverse socio-economic strata, from rural and urban areas and of a large body
28 327 weight range. However, with the cross-sectional study design used in this study, the changes
29 328 in perception as the children grow cannot be accounted for. Longitudinal evaluation of these
30 329 children will allow us to establish causal links between weight perception and weight loss
31 330 behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of
32 331 the questionnaire were limitations as information regarding the frequency, duration, and
33 332 intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or
34 333 past) at which such behaviours occurred could not be obtained. Data on the reliability and
35 334 validity of the questionnaire are not available for this population. With the question asked on
36 335 attempt to lose weight being dichotomous, there is a possibility that a child who is currently
37 336 normal weight may report weight loss behaviours because they were overweight in the past.
38 337 The small numbers of children in each category in the analysis stratified by actual and
39 338 perceived weight status necessitates further exploration with larger numbers of children in
40 339 each category. A further limitation is that we have not collected data on attempt to gain
41 340 weight.
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4 342 Overall, perceptions of weight status influenced the decision of children to lose weight. **This**
5 343 **needs to be further explored as a longitudinal study to establish causal links.** However,
6 344 regardless of weight status, many children did resort to weight loss. Public health campaigns
7 345 should emphasize healthy weight management rather than weight loss.
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18

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36 360 years/ no other relationships or activities that could appear to have influence the submitted
37 361 work.
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Table 1. Socio-economic and anthropometric associations of weight loss behaviour

	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted † OR Model 1 95% C.I.	P value‡	Adjusted ¶ OR Model 2 95% C.I.	P value‡	
	Yes	No							
Gender	Girls	387 (39%)	616 (61%)	1.41 1.16 – 1.72	<0.001	1.16 0.89 – 1.51	0.27	1.37 1.11 – 1.70	0.01
	Boys	268 (31%)	603 (69%)	1		1			
Age category (years)	<=10	245 (34%)	469 (66%)	0.96 0.78 – 1.17	0.65	1.04 0.79 – 1.36	0.76	1.03 0.83 – 1.28	0.79
	>10	410 (35%)	750 (65%)	1		1			
Location	City	408 (33%)	812 (67%)	0.83 0.68 – 1.01	0.06	1.03 0.78 – 1.36	0.81	-	-
	Non City	247 (38%)	407 (62%)	1		1			
Education of mother (Standard)	Up to 7 th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7 th	400 (36%)	727 (65%)	1		1			
Education of father (Standard)	Up to 7 th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7 th	437 (34%)	838 (66%)	1		1			
Medium of instruction	Kannada	198 (39%)	308 (61%)	1.28 1.03- 1.59	0.02	1.57 1.11 – 2.25	0.01	1.52 1.20 – 1.92	<0.001
	English ¹	457(33%)	911 (67%)	1		1			

Actual weight status									
Underweight	98 (22%)	352 (78%)	0.52	<0.001	0.71	0.04	0.66		
			0.40 – 0.67		0.51 – 0.98		0.50 – 0.86	0.002	
Overweight	125 (73%)	47 (27%)	4.96	<0.001	4.38	<0.001	3.86		
			3.43 – 7.20		2.64 – 7.28		2.63 – 5.64	<0.001	
Normal	412 (35%)	769 (65%)	1		1				
Child's perception of body image									
Too /A little Thin	133 (23%)	457 (77%)	0.61	<0.001	0.67	0.01	0.64	<0.001	
			0.48 – 0.77		0.49 – 0.93		0.49 – 0.82		
A little /Too fat	195 (68%)	91 (32%)	4.48	<0.001	2.91	<0.001	3.48	<0.001	
			3.35 – 6.00		1.95 – 4.34		2.57 – 4.69		
Normal	318 (32%)	665 (68%)	1		1				
Child's desire to be									
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76	0.03	0.84	0.35			
			0.58 – 0.98		0.59 – 1.20				
Slightly/Much thinner	260(52%)	237 (48%)	2.53	<0.001	1.56	0.006	-	-	
			2.00 – 3.19		1.14 – 2.15				
Same as at present	272 (30%)	627 (70%)	1		1				
Parent's perception of child's body image									
Too /A little Thin	66 (22%)	241 (79%)	0.52	<0.001	0.76	0.15			
			0.38 – 0.71		0.52 – 1.12		-	-	
A little /Too fat	95 (54%)	82 (46%)	2.20	<0.001	0.86				
			1.58 – 3.08		0.51 – 1.37	0.51			
Normal	364 (35%)	690 (66%)	1		1				
Parent's desire for child to be									
A lot /Slightly fatter	87 (21%)	331 (79%)	0.54	<0.001	0.75	0.11			
			0.41- 0.72		0.52 – 1.07		-	-	
Slightly /Much thinner	170 (56%)	134 (44%)	2.61	<0.001	1.79				
			1.98 – 3.46		1.25 – 2.58	0.002			
Same as at present	263 (33%)	542 (67%)	1		1				

Results are reported as Number (percentages); OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

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† Adjusted for actual BMI status, child’s and parents perception of body weight and socio-demographic factors
‡ Obtained by fitting binary logistic regression model. Model 1: Adjusted for socio-demographic variables and actual and perceived weight
¶ Obtained by fitting binary logistic regression model. Model 2: Adjusted for age, gender, medium of instruction, actual weight status and child’s perception of body weight.

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8 **Figure Legends:**
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10 **Figure 1: Odds ratio of having tried to lose body weight in children classified by current**
11 **weight status and perception of body weight.** ■ Comparison of child's actual weight

12 status with child's perception of weight status □ Comparison of child's actual weight
13 status with parental perception of weight status. U/U: underweight by actual
14 measurements/child's or parent's perception of being underweight, U/N: underweight by
15 actual measurements/child's or parent's perception of being normal, N/U- normal by actual
16 measurements/perceived by child/parent to be underweight, N/N: normal by actual
17 measurements/child's or parent's perception of being normal, N/O: normal by actual
18 measurements/child's or parent's perception of being overweight, O/N: overweight by actual
19 measurements/child's or parent's perception of being normal, O/O: overweight by actual
20 measurements/child's or parent's perception of being overweight, O/U: overweight by actual
21 measurements/child's or parent's perception of being underweight.
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33 **Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category**
34 **based on actual weight status and children and parent's perception of child's body**
35 **weight. UW – Underweight, OW – Overweight**
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40 **Figure 3: Actual weight status and weight loss practices of children**

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4 and 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4 and 5
Bias	9	Describe any efforts to address potential sources of bias	<i>Not applicable</i>
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5 and 6
		(b) Describe any methods used to examine subgroups and interactions	5 and 6
		(c) Explain how missing data were addressed	Not applicable
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	Not applicable
Results			

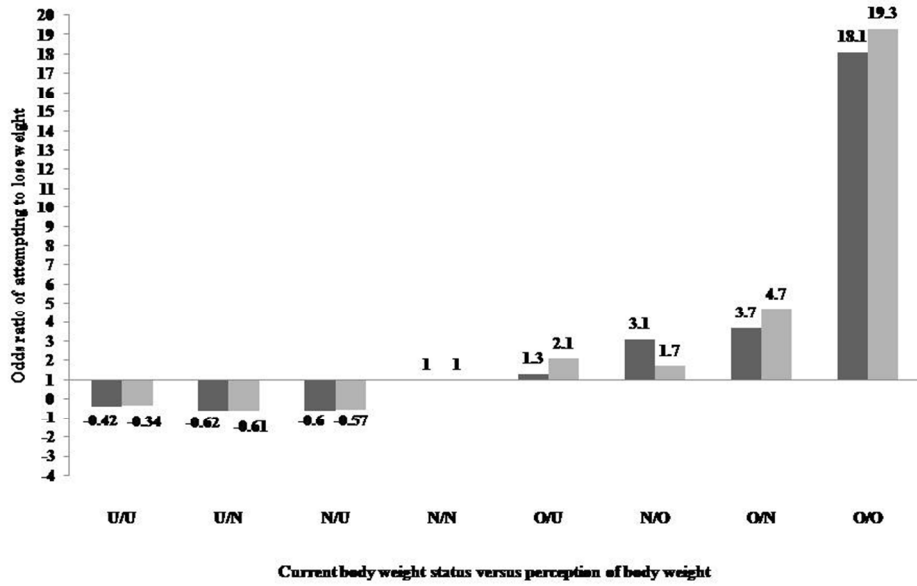
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	Not used
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	5 and 6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,12,13
		(b) Report category boundaries when continuous variables were categorized	5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	7 and 8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Not applicable
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7, 8 and 9
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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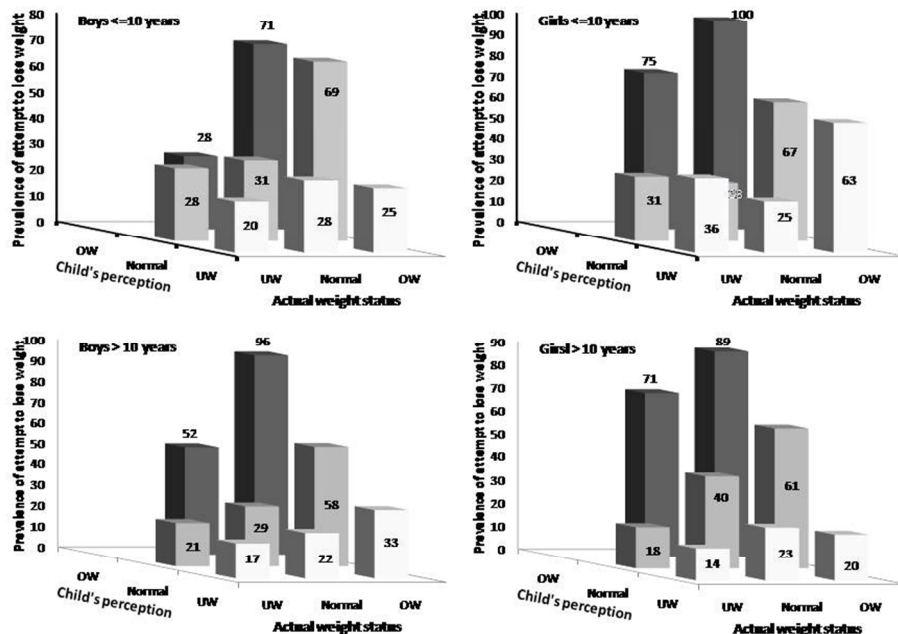
FIGURE 1: ODDS RATIO OF ATTEMPTING TO LOSE WEIGHT IN CHILDREN CLASSIFIED BY CURRENT WEIGHT STATUS OF CHILDREN WITH CHILD'S AND PARENT'S PERCEPTION OF CHILD'S BODY WEIGHT



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FIGURE 2A: PREVALENCE OF ATTEMPTING TO LOSE WEIGHT BY GENDER AND AGE CATEGORY BASED ON ACTUAL WEIGHT STATUS AND CHILD'S PERCEPTION OF BODY WEIGHT

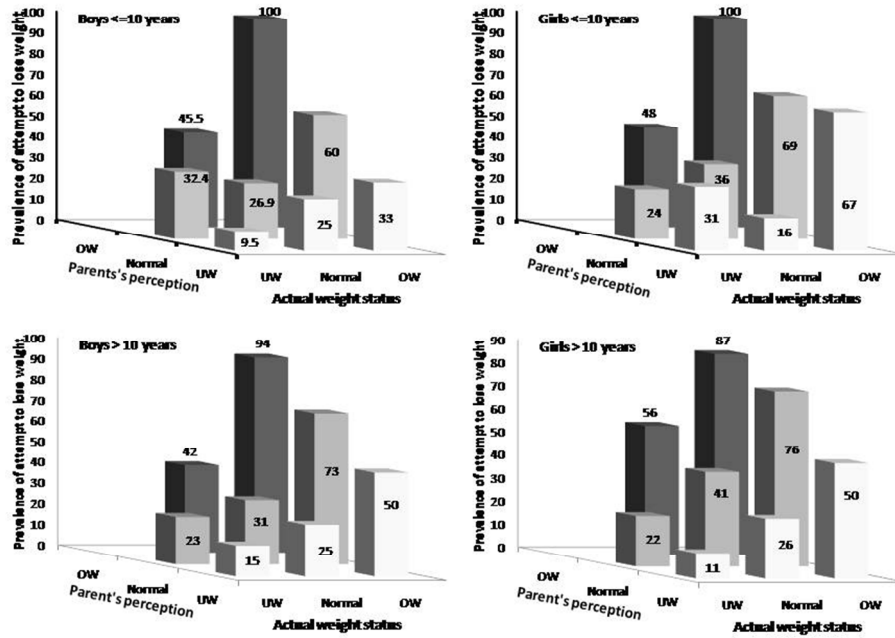


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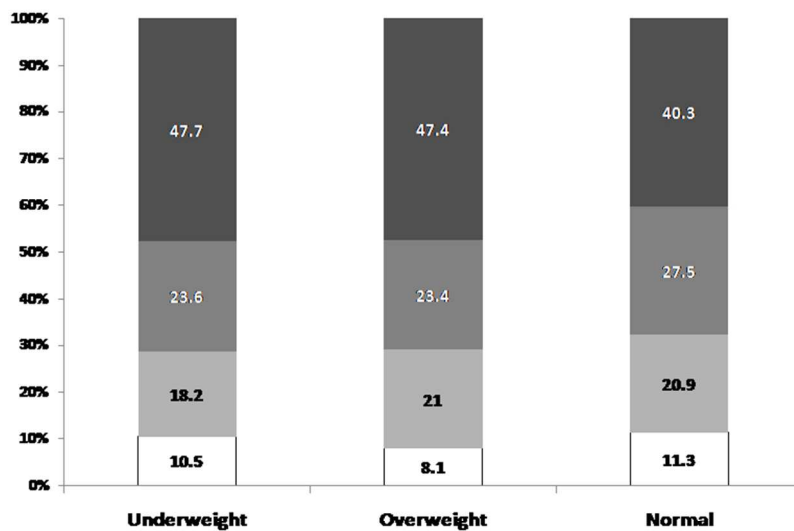
FIGURE 2B: PREVALENCE OF ATTEMPTING TO LOSE WEIGHT BY GENDER AND AGE CATEGORY BASED ON ACTUAL WEIGHT STATUS AND PARENT'S PERCEPTION OF BODY WEIGHT



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Figure 2: Actual weight status and weight loss practices of children



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Supplementary Table 1: Correlation matrix of actual weight status, child's and parent's perception of child's present weight and desired weight status

	Actual weight status	Child's perception of body weight	Child's desired weight status	Parent's perception of child's body weight	Parents desired for child's weight status
Actual weight status	1				
Child's perception of body weight	0.26	1			
Child's desired weight status	0.15	0.21	1		
Parent's perception of child's body weight	0.17	0.30	0.12	1	
Parents desired for child's weight status	0.18	0.19	0.31	0.28	1

Supplementary Table 2: Prevalence of attempt to lose weight by gender and age category:

	Attempt to lose weight				P value*
	Boys		Girls		
	<=10	>10	<=10	>10	
Actual weight status					
Underweight	19 (25.0)	36 (20.2)†	23 (32.4)‡	20 (16.0)	0.002
Overweight	20 (64.5)	30 (78.9)	24 (72.7)	51 (72.9)	0.89
Normal	60 (29.3)	96 (30.7)	92 (34.3)	164 (41.5)	-
Child's perception of body weight					
Too thin/Little thin	24 (23.5)	38 (20.4) †	40 (29.0) :	31 (18.9)	0.006
Too fat/little fat	21 (46.7)	49 (63.6)	41 (78.8)	84 (75.0)	0.25
Normal	55 (30.9)	76 (27.5)	62 (32.1)	125 (37.2)	-
Parent's perception of body weight					
Too thin/Little thin	9 (18.0)	21(21.0)	14 (25.5)	22 (21.6)	0.60
Too fat/little fat	10 (47.6)	32 (48.5)	15 (48.4)	38 (64.4)	0.17
Normal	51 (29.1)	88 (30.4)	82 (36.0)	143 (39.5)	-

Reported as number and within parenthesis percentages; *Fisher's Exact test or Chi square test;
 †Among older/younger age group children significant difference between boys and girls
 ‡ Among girls significant difference between the younger and older age group children
 p values for O/U not reported due to small numbers.

(Supplementary) Table 3: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the child's perception of body weight

Actual BMI	Child's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted† OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	105	67	3.1 2.22 – 4.58	<0.001	3.1 2.2 -4.42	<0.001
Overweight/Obese	Overweight/Obese	74	9	16.7 7.93 – 36.54	<0.001	18.1 8.8 -36.9	<0.001
Overweight/Obese	Normal	43	25	3.5 2.03 – 6.08	<0.001	3.7 2.2 – 6.2	<0.001
Overweight/Obese	Underweight	8	12	1.36 0.50 – 3.62	0.50	1.37 0.55 – 3.4	0.50
Underweight	Underweight	30	123	0.50 0.32 – 0.78	<0.001	0.49 0.32-0.77	0.001
Underweight	Normal	67	226	0.60 0.43 – 0.84	0.001	0.62 0.45 – 0.86	0.004
Normal	Underweight	81	254	0.65 0.48 – 0.88	0.004	0.60 0.45 – 0.82	0.001
Normal	Normal	219	446	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

†Adjusted for age, gender and medium of instruction

‡‡ Obtained by fitting binary logistic regression models

(Supplementary) Table 4: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the parent's perception of child's body weight

Actual BMI status of the children	Parent's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P Value*	Adjusted † OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	43	47	1.69 1.07 – 2.69	0.01	1.74 1.1 – 2.7	0.01
Overweight/Obese	Overweight/Obese	40	4	18.5 6.25 – 61.63	<0.001	19.3 6.8- 54.8	<0.001
Overweight/Obese	Normal	50	21	4.4 2.52 – 7.77	<0.001	4.7 2.7 – 8.0	<0.001
Overweight/Obese	Underweight	10	9	2.06 0.76 – 5.58	0.11	2.17 0.87 – 5.4	0.10
Underweight	Underweight	18	102	0.33 0.19 – 0.57	<0.001	0.34 0.20 – 0.57	<0.001
Underweight	Normal	58	181	0.59 0.42 – 0.84	0.001	0.61 0.44 – 0.86	0.004
Normal	Underweight	37	121	0.57 0.37 – 0.86	0.004	0.57 0.38 – 0.84	0.005
Normal	Normal	257	476	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

* Fisher's Exact test or Chi square test

† Adjusted for age, gender and medium of instruction

‡ Obtained by fitting binary logistic regression models



**ASSOCIATIONS BETWEEN BODY WEIGHT PERCEPTIONS
AND WEIGHT CONTROL BEHAVIORS IN SOUTH INDIAN
CHILDREN– A CROSS-SECTIONAL STUDY**

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-002239.R2
Article Type:	Research
Date Submitted by the Author:	01-Feb-2013
Complete List of Authors:	Swaminathan, Sumathi; St John's Research Institute, Division of Nutrition Selvam, Sumithra; St John's Research Institute, Department of Epidemiology and Biostatistics Maria, Pauline; St John's Medical College and Hospital, Department of Physiology Vaz, Mario; St John's Medical College and Hospital, Department of Physiology; St John's Research Institute, Division of Humanities and Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Nutrition and metabolism, Paediatrics
Keywords:	Community child health < PAEDIATRICS, PUBLIC HEALTH, EPIDEMIOLOGY, Cross Sectional Study, INDIA

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3 1 ASSOCIATIONS BETWEEN BODY WEIGHT PERCEPTION AND WEIGHT CONTROL
4 2 BEHAVIOR IN SOUTH INDIAN CHILDREN– A CROSS-SECTIONAL STUDY
5

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23 23 Short title: Body weight perception influences weight loss in South Indian children
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25 **Abstract:**

26 **Objective:** To examine the patterns of weight loss behaviour, and the association between
27 weight loss attempts with actual weight status, and children's and parental perceptions of
28 weight status.

29 **Design:** Cross sectional study

30 **Setting:** Karnataka, South India

31 **Participants:** 1874 girls and boys aged 8 to 14 years from 7 schools in Karnataka, South
32 India

33 **Main outcome measures:** The association between weight loss attempts and socio-
34 demographic factors, weight status and the child or parent's perception of weight status.

35 **Results:** Approximately 73% of overweight and obese, 35% of normal weight and 22% of
36 underweight children attempted to lose weight. Children of lower socio-economic groups
37 studying in schools in the local vernacular and overweight/obese children were more likely to
38 attempt to lose weight (Adjusted odds ratio or AOR=1.57, 95% CI: 1.11 to 2.25; AOR= 4.38,
39 95% CI: 2.64 to 7.28, respectively). Perception of weight status was associated with weight
40 loss attempts. Thus, children who were normal weight but perceived themselves to be
41 overweight / obese were three times more likely to attempt weight loss compared with those
42 who accurately perceived themselves as normal weight, while the odds of attempting weight
43 loss were the highest for those who were overweight and perceived themselves to be so
44 (AOR ~ 18).

45 **Conclusions:** Children are likely to attempt weight loss in India irrespective of their weight
46 status, age and gender. Children who were actually overweight as well as those who were
47 perceived by themselves or by their parents to be overweight or obese were highly likely to
48 try to lose weight. It is necessary to understand body weight perceptions in communities with
49 a dual burden of overweight and under-nutrition, if intervention programmes for either are to
50 be successful.

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ARTICLE FOCUS:

- To explore weight loss behaviour patterns and association between weight loss attempts with socio-demographic factors, actual as well as children's and parental perceptions of child's weight status.

KEY MESSAGES

- In India, where both overweight and underweight in children co-exist; there are no data on the associations of body weight perceptions of children in relation to weight loss attempts. It is essential to understand this association in order to tailor suitable intervention programmes that can work in communities with concurrent under- and over-nutrition.
- Weight loss is attempted by children irrespective of weight status, age and gender. However, there are higher odds of attempting to lose weight among those who perceive themselves to be overweight, although their weight status may be normal.

STRENGTHS AND LIMITATIONS

- This is the first study to report perceptions of body weight in India in relation to weight loss attempts.
- The cross-sectional study design used in this study, allows only associations to be assessed.

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3 56 **INTRODUCTION:**
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6 57 Body image is a psycho-social dimension of body size that encompasses both perceptual and
7 58 attitudinal factors ⁽¹⁾ and has been associated with eating disorders^(1, 2). In recent years, its
8 59 association with overweight and obesity has been described ⁽³⁾. It is recognised that
9 60 individuals make decisions on lifestyle behaviours based on body weight perceptions (a
10 61 dimension of body image) ^(1, 4). In India, there is a large burden of under-nutrition alongside
11 62 increasing overweight and obesity ⁽⁴⁾. For public health and clinical programmes to be more
12 63 effective, body image of undernourished and overweight children should be understood in the
13 64 context of the influence of culture on body weight perceptions and on weight management
14 65 behaviours.

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22 66 A large number of studies have indicated that children and adolescents misperceive their
23 67 body weight status ⁽⁵⁻¹⁰⁾. Interventions that address socio-cultural attitudes towards
24 68 appearance should ideally reduce body image dissatisfaction as well as overweight and
25 69 obesity since studies have indicated a relationship between body image, unhealthy eating
26 70 practices and obesity ^(11, 12). Perceptions of body weight are, in part, influenced by external
27 71 factors including cultural norms and social preferences as it has been observed that Asian
28 72 women have less body dissatisfaction than other ethnic groups ⁽¹³⁾. In India, it is often
29 73 believed that an overweight person is wealthier and happier and reflects social mobility to a
30 74 higher status compared to an underweight person, although there are no studies to corroborate
31 75 this. The disconnect between actual weight and perception of body size could stem from the
32 76 extent to which individuals identify with the majority cultural standards of beauty⁽¹⁴⁾. There
33 77 are also reports that individuals in less socio-economically developed societies positively
34 78 evaluate overweight and obese figures ⁽⁶⁾. Evidence also suggests associations of actual body
35 79 weight, body weight perceptions and weight dissatisfaction with weight control practices;
36 80 overweight children are more likely to try to lose weight compared to non-overweight
37 81 children ^(7, 15). Analysis of data from the National Health and Nutrition Examination Survey
38 82 (NHANES) ⁽¹⁶⁾ and the Youth Risk Behaviour Surveillance Survey (YRBSS) ^(14, 17) indicate
39 83 that those overweight children who perceived their weight status correctly were more likely
40 84 to exercise or eat less for weight control. Results from an analysis from Europe, Israel and
41 85 North America as part of the Health Behaviour in School aged Children (HBSC) 2001/2002
42 86 survey indicated that weight and age were significant factors associated with current attempts
43 87 to lose weight ⁽¹⁵⁾.

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3 88 For healthy weight management it is necessary for a person to perceive his or her weight
4 89 status accurately as well as be aware of healthy methods to lose or gain weight. Most
5 90 literature on body weight perceptions and weight control behaviours are related to studies
6 91 done in developed countries^(5, 7, 14, 16) with a few on ethnic minorities, including South Asians
7 92^(3, 10). The present analysis aims to examine the associations between the actual weight
8 93 status, body weight perceptions of both children and their parents, and body weight
9 94 satisfaction with weight loss intentions. The study sample included a wide range of body
10 95 weights to reflect the dual burden of under-nutrition and overweight/obesity that India
11 96 currently faces.

19 **METHODS:**

21 **Study population:**

23 99 A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-
24 100 economic status located in rural areas, towns in Karnataka and urban Bangalore in South
25 101 India, were contacted at baseline out of which 1907 (91.6%) children participated in a
26 102 longitudinal study on body image perceptions and growth indices of school children, details
27 103 of which are published earlier⁽¹⁸⁾. Convenience sampling of 7 city and non-city (rural and
28 104 small towns) co-educational, non-residential schools was employed, such that children
29 105 representing various socio-economic statuses (based on school fees linked to medium of
30 106 instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and
31 107 2 in Bangalore city. The schools in which Kannada, the regional state language, was the
32 108 language of instruction, received government support and had annual tuition fees of Rs.250 to
33 109 500 whereas English medium schools did not receive government support and had annual
34 110 tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an
35 111 indicator of socio-economic status (SES). Three schools (1 each in a village, small town and
36 112 city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small
37 113 towns and 1 in the city) had English as the medium of instruction.

38 114 The sample recruited had adequate power (above 80 %) to identify the significant socio-
39 115 demographic predictors for perception of body image in the present study and to estimate a
40 116 difference of at least 10% over-estimation or under-estimation of body weight at 5% level of
41 117 significance. Ethical approval was obtained from the Institutional Ethical Review Board.

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3 118 Principals of schools were contacted for permission to conduct the study in their schools.
4 119 Written parental consent and assent from the child was also obtained. A questionnaire to
5 120 assess body image perception was administered by an investigator (MP) to all the consenting
6 121 students in a class by reading aloud the questions in either English or Kannada (the local
7 122 language). Responses were marked on the questionnaire by each child. A short questionnaire
8 123 in English or the local language to be filled by one of the parents was sent home after the
9 124 children completed their questionnaires. Children whose parents were illiterate (6.7%
10 125 mothers, 5.9% fathers), elicited the answers from either of their parents and filled up the
11 126 questionnaire.

127 **Measurements:**

128 Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was
129 measured in school uniforms but without shoes using a calibrated digital scale (Home Health,
130 Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were
131 made using a standardized protocol. Body mass index (BMI) was computed and the BMI-
132 for-age Z score values were obtained using the World Health Organization Anthroplus
133 software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by
134 actual weight status as overweight ($>+1$ SD), normal (< -2 to $+1$) and underweight (< -2
135 SD). These values at 19 years of age, at $+1$ standard deviation (SD) correspond to the BMI
136 values of 25.4 kg/m^2 for boys and 25.0 kg/m^2 for girls and is equivalent to the overweight
137 cut-off for adults ($> 25.0 \text{ kg/m}^2$), while the $+2$ SD value (29.7 kg/m^2 for both sexes) compares
138 closely with the cut-off for obesity ($> 30.0 \text{ kg/m}^2$)⁽¹⁹⁾.

139 To assess current body weight perception, children were asked to mark whether they
140 thought their body weight or appearance was “too thin”, “a little thin”, “normal”, “a little
141 fat”, or “very fat”. Response to a similar identical question about their child’s body weight or
142 appearance with similar options was filled by parents in a questionnaire sent to their homes.
143 For analysis, “very thin” and “a little thin” were combined as “too/little thin” and “a little fat”
144 and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

145 To assess perceptions on desired (ideal) body weight, children responded to the
146 question “I want to be” with options “a lot fatter”, “slightly fatter”, “as I am at present”,
147 “slightly thinner”, “much thinner”. The first 2 options were clubbed as “a lot/slightly fatter”,
148 “as I am at present” as “same as at present” and the last 2 options clubbed as “slightly/much
149 thinner. Parents responded to a similar question on “I want my child to be” with an identical

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3 150 set of options. For analysis, clubbing of the options for parents desired body weight for their
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5 151 child was also done in a similar manner.

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7 152 The Stunkard's silhouettes ⁽²⁰⁾ were also used to assess body image perception in
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9 153 children and this was also administered in the classroom. In order to make comparisons with
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11 154 the body weight perception questions, the nine images were regrouped to reflect 3 categories
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13 155 of weight status: underweight, normal and overweight. The agreement between the perceived
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15 156 visual image and the body weight perception obtained by questions of current weight status,
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17 157 evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement between
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19 158 underweight/fat and normal, and a moderate agreement between both the extremes of weight
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21 159 (underweight versus overweight) was seen. There were no gender differences in agreement.
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23 160 Parental perceptions of the body weight were assessed using structured questions, and since
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25 161 this was available for both parent child; further analyses was done using only the questions.

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27 162 In addition, children were asked whether they had ever tried to lose weight. If they
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29 163 replied in the affirmative (options: yes/no), the method used to try and lose weight was
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31 164 recorded as "skipping meals", "stopped eating a certain kind of food", reduced quantity of
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33 165 food eaten" and "exercise" as a multiple response. Weight loss methods recommended by
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35 166 parents were similarly recorded.

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37 167 The present analysis is restricted to children on whom anthropometric measurements were
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39 168 available and who responded to the question on weight loss and this corresponds to 1874
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41 169 participants (871 boys, 1003 girls). The response rate (of a total of 1907 children) was 98.3%;
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43 170 socio-demographic (age, gender, medium of instruction) characteristics between the
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45 171 responders and non responders were comparable.

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48 173 **Statistical analysis:**

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50 174 Data are reported as number and percentages for all the categorical variables. For analysis,
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52 175 socio-demographic variables of age of children were categorized as 10 and below and above
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54 176 10 years of age (the adolescent period)⁽²¹⁾, language of instruction as Kannada and English
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56 177 medium (a surrogate of socio-economic status), location as city and non-city (village and
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58 178 small towns) and maternal and paternal education below 7th grade and above 7th grade.

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3 179 Cross-tabulations were created of actual weight status of the child with the child's perception
4 180 and parent's perception of their child's current body weight. Using this, the following eight
5 181 groups were formed. As there were no children who were underweight but were perceived by
6 182 either themselves or their parents to be overweight, this category was not considered.
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10 183 U/U – underweight by actual measurements/perceived by child/parent to be underweight

11 184 U/N- underweight by actual measurements/perceived by child/parent to be normal

12 185 N/U- normal by actual measurements/perceived by child/parent to be underweight

13 186 N/N- normal by actual measurements/perceived by child/parent to be normal

14 187 N/O- normal by actual measurements/perceived by child/parent to be overweight

15 188 O/N- overweight by actual measurements/perceived by child/parent to be normal

16 189 O/O- overweight by actual measurements/perceived by child/parent to be overweight

17 190 O/U- overweight by actual measurements/perceived by child/parent to be underweight

18 191 The referent group was the N/N group.

19 192 The association between the various socio-demographic factors as well with the above eight
20 193 groups and attempt to lose weight was evaluated using the Chi-square test and the unadjusted
21 194 odds ratio are reported. Association between attempt to lose weight and child's actual weight
22 195 status, child's and parent's perception of child's weight status and the above mentioned eight
23 196 groups were done using Chi square test stratified by age and gender. Binary logistic
24 197 regression was performed to identify the factors associated with attempted weight loss
25 198 adjusted for socio-demographic variables of age, gender, medium of instruction, parent's
26 199 education and current actual body weight status, child's and parent's perceived and desired
27 200 weight status of the child as model 1. In addition, a model (model 2) adjusted only for age,
28 201 sex, medium of instruction, actual weight status and the child's weight perception was
29 202 performed. Binary logistic regression was also performed to identify the factors associated
30 203 with attempting to lose weight (Yes/No) based on the 8 groups (detailed above) created using
31 204 the actual weight status of the child and child's or parent's perception of child's weight,
32 205 adjusted for age, gender and medium of instruction. A level of significance (two-sided) less
33 206 than 5% was considered statistically significant.

34 207 **RESULTS:**

35 208 Of the 1907 study children, 1874 responded to the question on whether they had ever tried to
36 209 lose weight. Of these, 65.5% of children were normal weight, 25.0 % underweight and 9.5%
37 210 overweight. Thirty two percent of children perceived themselves to be underweight; this was

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3 211 7% more than the actual prevalence of underweight. Similarly, 15.4% perceived themselves
4 212 to be overweight (5.9% higher than the actual prevalence). In contrast, parents tended to
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6 213 under-estimate underweight (5% lower than the actual prevalence of under-weight).
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9 214 A total of 35% of children had attempted to lose weight; this constituted 73% of overweight
10 215 and obese, 35% of normal weight and 22% of underweight children. Sixty eight percent of
11 216 those children who perceived themselves to be overweight, 32% of those who perceived
12 217 themselves to be normal, and 23% of those who perceived themselves to be underweight
13 218 attempted to lose weight. Similarly, 54 % of children whose parents perceived them to be
14 219 overweight, 35% who perceived them to be normal, and 21% of those who perceived them to
15 220 be underweight attempted to lose weight. Correlations between actual weight status of the
16 221 child and the child's or parent's perception of the child's weight status, as well as the child's
17 222 and parent's perceptions of desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$)
18 223 (Supplementary table 1) indicating a low to moderate correlation between these variables.
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26 224 Among the socio-demographic factors (Table 1, Model 1), children in schools with Kannada
27 225 as the medium of instruction were more likely to attempt to lose weight than those studying
28 226 in schools with English as the medium of instruction (AOR= 1.57, 95% C.I: 1.11 to
29 227 2.25). Underweight children were less likely to try to lose weight (AOR=0.71, 95% C.I: 0.51
30 228 to 0.98), while overweight/obese children were more likely (AOR=4.38. 95% C.I: 2.64 to
31 229 7.28) to try and lose weight compared to normal weight children. Based on the child's
32 230 perception of their weight status, those who perceived themselves to be overweight were
33 231 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental
34 232 perception of weight status, however, did not have a significant impact on children
35 233 attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire
36 234 (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of
37 235 attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to
38 236 lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys.
39 237 Otherwise, the findings were similar to Model 1.
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50 238 A stratified analysis based on age and gender (Supplementary table 2) was also done. While
51 239 the groups were largely similar in terms of attempting to lose weight, significant differences
52 240 were observed only among those children who were actually underweight as well as those
53 241 who perceived themselves to be underweight. In these children, the prevalence of attempting
54 242 to lose weight was significantly higher in older boys compared to older girls. Similarly, there
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3 243 was a significantly higher prevalence of younger girls attempting to lose weight compared to
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5 244 older girls, but not between younger and older boys.

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7 245 Figure 1 represents the odds of a child attempting to lose weight based on the child's actual
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9 246 weight status in combination with the child's/parent's perception of weight status. After
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11 247 adjusting for age, gender and medium of instruction, the odds of attempting to lose weight
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13 248 (Figure 1, Supplementary table3) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight
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15 249 child who perceive themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an
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17 250 overweight child who perceive themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an
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19 251 overweight child who perceive themselves to be overweight. A similar trend was observed
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21 252 when parental perceptions were replaced with child's perception (Figure 1) with odds of
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23 253 attempting to lose weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child
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25 254 perceived by a parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child
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27 255 perceived by a parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child
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29 256 perceived to be overweight by a parent. None of the underweight children were perceived by
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31 257 themselves or by their parents to be overweight. Among children who were underweight but
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33 258 perceived either by the child or parent to be underweight or normal, the odds of attempting to
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35 259 lose weight was reduced by approximately 60% to 40% respectively in relation to children of
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37 260 normal weight status perceived to be normal by both children and parents. The same analyses
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39 261 were done using prevalence of attempting to lose weight based on actual weight status,
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41 262 child's perception and parent's perception of child's weight status stratified by age and
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43 263 gender (Figure 2a and 2b).

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45 264 The most commonly adopted practice to lose weight regardless of whether children were
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47 265 underweight, overweight or normal was exercise (~46%), followed by reducing the quantity
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49 266 of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 3).

45 267 **DISCUSSION:**

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47 268 In concurrence with the findings of our study, misperception of weight status among children
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49 269 has been reported in other studies conducted in the United States of America, with
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51 270 perceptions differing between various ethnic groups. Among African American adolescents,
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53 271 one-third perceived their weight status inaccurately⁽⁷⁾. Racial or ethnic differences in weight
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55 272 perception have been reported^(5, 7, 8), where Caucasians were more likely than African
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57 273 Americans to perceive themselves as overweight^(5, 7, 9). However, this has not been a
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59 274 universal finding, as for instance in multi-ethnic adolescents in the United Kingdom⁽¹⁴⁾.

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3 275 Perceptions, however, were also associated with their decision to attempt weight loss,
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5 276 notwithstanding their current weight status.
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7 277 In general, children who were actually overweight as well as those who were perceived by
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9 278 themselves or by their parents to be overweight were highly likely to try to lose weight.. This
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11 279 finding is similar to studies conducted in other countries ^(7, 8, 22). Unless individuals or their
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13 280 families perceive their weight status correctly, their acceptance of programmes designed to
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15 281 encourage healthy weight may be low ⁽¹⁷⁾.
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17 282 The child's or parent's desire for the child to be thinner was also associated with their
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19 283 decision to attempt to lose weight. This desire was highest among those who perceived
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21 284 themselves to be overweight, although about one-third of those who perceived themselves to
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23 285 be normal weight and about one-fifth of those who perceived themselves to be underweight
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25 286 also attempted to lose weight. In contrast, among children who were underweight and those
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27 287 of normal weight, 32% and 23% desired to gain weight respectively. This clearly indicates
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29 288 that in a country where both underweight and overweight co-exist, care must be taken in
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31 289 developing programmes at a community level such that those who require to put on weight
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33 290 and those who need to lose weight are considered, as for example in the school feeding
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35 291 programmes.
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38 293 The fact that there were reported weight loss attempts even in the underweight group suggests
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40 294 that factors other than weight status and weight perception are operative. This is corroborated
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42 295 by the higher odds of children from Kannada medium schools, who belong to a relatively
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44 296 lower socio-economic status compared to children from English medium schools (higher
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46 297 SES) trying to lose weight. Thus socio-cultural factors may be associated with their decision
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48 298 to lose weight. This could be linked to the continuous exposure to images and unrealistic
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50 299 body shapes that encourage weight loss regardless of body weight⁽⁸⁾. These factors must be
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52 300 further explored so that suitable programmes that encourage overweight children but not
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54 301 underweight or normal children to lose weight are planned.
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56 302 Included in our sample were children as young as 8 years of age. However, body
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58 303 dissatisfaction with increasing weight status was established even by the age of 5 in both
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60 304 boys and girls of South Asian origin in UK⁽³⁾. Irrespective of whether they were below or
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306 305 above 10 years of age or whether they were boys or girls, children attempted to lose weight.
In our study sample, there were no gender differences in weight loss attempts. This is

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3 307 contrary to the findings elsewhere, as for instance, the NHANES study ⁽¹⁶⁾, which indicated
4 308 that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender
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6 309 differences in our study may, in part, be due to the relatively low prevalence of overweight or
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8 310 obesity.

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10 311 It is encouraging that 46 % children indicated exercise their preferred choice of weight loss.
11 312 Differences in the methods used to lose weight between overweight, normal and underweight
12 313 children were not apparent unlike other studies where unhealthier weight loss methods like
13 314 skipping meals are reported more in overweight or obese children compared to normal weight
14 315 children ⁽²³⁾. However, an effect of social desirability cannot be discounted, given that
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16 316 exercise as a healthy lifestyle choice is promoted early in the school curriculum

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18 317 Body image must be taken into account when designing programmes to improve both body
19 318 image and reduce unhealthy behaviours like unhealthy eating and reduced or excessive
20 319 exercise ⁽¹⁾. Since public health programmes are generally targeted towards all, a general
21 320 programme that caters to all children irrespective of their weight status is required.

22
23 321 **Strengths and limitations:** This is the first study to report perceptions of body weight in
24 322 India in relation to weight loss attempts. A major strength of this study is that measured
25 323 heights and weights rather than self-reported, were used and the study sample encompassed
26 324 children of diverse socio-economic strata, from rural and urban areas and of a large body
27 325 weight range. However, with the cross-sectional study design used in this study, the changes
28 326 in perception as the children grow cannot be accounted for. Longitudinal evaluation of these
29 327 children will allow us to establish causal links between weight perception and weight loss
30 328 behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of
31 329 the questionnaire were limitations as information regarding the frequency, duration, and
32 330 intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or
33 331 past) at which such behaviours occurred could not be obtained. Data on the reliability and
34 332 validity of the questionnaire are not available for this population. With the question asked on
35 333 attempt to lose weight being dichotomous, there is a possibility that a child who is currently
36 334 normal weight may report weight loss behaviours because they were overweight in the past.
37 335 The small numbers of children in each category in the analysis stratified by actual and
38 336 perceived weight status necessitates further exploration with larger numbers of children in
39 337 each category. A further limitation is that we have not collected data on attempt to gain
40 338 weight.

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340 Overall, perception of weight status was associated with the decision of children to lose
341 weight. This needs to be further explored as a longitudinal study to establish causal links.
342 However, regardless of weight status, many children did resort to weight loss. Public health
343 campaigns should emphasize healthy weight management rather than weight loss.

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347 drafted and the manuscript. MP acquired the data. Sumithra Selvam (SRS) performed the
348 statistical analysis and interpreted the data. MV conceived the study and interpreted the data.
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365 *Data Sharing:* Raw data are available from the statistician, Sumithra Selvam on request at
366 sumithrars@sjri.res.in.

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Table 1. Socio-economic and anthropometric associations of weight loss behaviour

	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted † OR Model 1 95% C.I.	P value‡	Adjusted ¶ OR Model 2 95% C.I.	P value‡	
	Yes	No							
Gender									
	Girls	387 (39%)	616 (61%)	1.41 1.16 – 1.72	<0.001	1.16 0.89 – 1.51	0.27	1.37 1.11 – 1.70	0.01
	Boys	268 (31%)	603 (69%)	1		1		1	
Age category (years)									
	<=10	245 (34%)	469 (66%)	0.96 0.78 – 1.17	0.65	1.04 0.79 – 1.36	0.76	1.03 0.83 – 1.28	0.79
	>10	410 (35%)	750 (65%)	1		1		1	
Location									
	City	408 (33%)	812 (67%)	0.83 0.68 – 1.01	0.06	1.03 0.78 – 1.36	0.81	-	-
	Non City	247 (38%)	407 (62%)	1		1		1	
Education of mother (Standard)									
	Up to 7 th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7 th	400 (36%)	727 (65%)	1		1		1	
Education of father (Standard)									
	Up to 7 th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7 th	437 (34%)	838 (66%)	1		1		1	
Medium of instruction									
	Kannada	198 (39%)	308 (61%)	1.28 1.03- 1.59	0.02	1.57 1.11 – 2.25	0.01	1.52 1.20 – 1.92	<0.001
	English ¹	457(33%)	911 (67%)	1		1		1	

Actual weight status									
Underweight	98 (22%)	352 (78%)	0.52	<0.001	0.71	0.04	0.66		
			0.40 – 0.67		0.51 – 0.98		0.50 – 0.86	0.002	
Overweight	125 (73%)	47 (27%)	4.96	<0.001	4.38	<0.001	3.86		
			3.43 – 7.20		2.64 – 7.28		2.63 – 5.64	<0.001	
Normal	412 (35%)	769 (65%)	1		1				
Child's perception of body image									
Too /A little Thin	133 (23%)	457 (77%)	0.61	<0.001	0.67	0.01	0.64	<0.001	
			0.48 – 0.77		0.49 – 0.93		0.49 – 0.82		
A little /Too fat	195 (68%)	91 (32%)	4.48	<0.001	2.91	<0.001	3.48	<0.001	
			3.35 – 6.00		1.95 – 4.34		2.57 – 4.69		
Normal	318 (32%)	665 (68%)	1		1				
Child's desire to be									
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76	0.03	0.84	0.35			
			0.58 – 0.98		0.59 – 1.20				
Slightly/Much thinner	260(52%)	237 (48%)	2.53	<0.001	1.56	0.006	-	-	
			2.00 – 3.19		1.14 – 2.15				
Same as at present	272 (30%)	627 (70%)	1		1				
Parent's perception of child's body image									
Too /A little Thin	66 (22%)	241 (79%)	0.52	<0.001	0.76	0.15			
			0.38 – 0.71		0.52 – 1.12		-	-	
A little /Too fat	95 (54%)	82 (46%)	2.20	<0.001	0.86				
			1.58 – 3.08		0.51 – 1.37	0.51			
Normal	364 (35%)	690 (66%)	1		1				
Parent's desire for child to be									
A lot /Slightly fatter	87 (21%)	331 (79%)	0.54	<0.001	0.75	0.11			
			0.41- 0.72		0.52 – 1.07		-	-	
Slightly /Much thinner	170 (56%)	134 (44%)	2.61	<0.001	1.79				
			1.98 – 3.46		1.25 – 2.58	0.002			
Same as at present	263 (33%)	542 (67%)	1		1				

Results are reported as Number (percentages); OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

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5 † Adjusted for actual BMI status, child's and parents perception of body weight and socio-demographic factors

6 ‡ Obtained by fitting binary logistic regression model. Model 1: Adjusted for socio-demographic variables and actual and perceived weight

7 ¶ Obtained by fitting binary logistic regression model. Model 2: Adjusted for age, gender, medium of instruction, actual weight status and child's perception of
8 body weight.
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8 **Figure Legends:**
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10 **Figure 1: Odds ratio of having tried to lose body weight in children classified by current**
11 **weight status and perception of body weight.** ■ Comparison of child's actual weight

12 status with child's perception of weight status □ Comparison of child's actual weight
13 status with parental perception of weight status. U/U: underweight by actual
14 measurements/child's or parent's perception of being underweight, U/N: underweight by
15 actual measurements/child's or parent's perception of being normal, N/U- normal by actual
16 measurements/perceived by child/parent to be underweight, N/N: normal by actual
17 measurements/child's or parent's perception of being normal, N/O: normal by actual
18 measurements/child's or parent's perception of being overweight, O/N: overweight by actual
19 measurements/child's or parent's perception of being normal, O/O: overweight by actual
20 measurements/child's or parent's perception of being overweight, O/U: overweight by actual
21 measurements/child's or parent's perception of being underweight.
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34 **Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category**
35 **based on actual weight status and children and parent's perception of child's body**
36 **weight. UW – Underweight, OW – Overweight**
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40 **Figure 3: Actual weight status and weight loss practices of children**

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42 ■ Exercise ■ Reduced quantity of food eaten ■ Stopped eating certain kind of foods
43 □ Skipping meals
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3 | **ASSOCIATIONS** BETWEEN BODY WEIGHT PERCEPTIONS AND WEIGHT
4 | CONTROL BEHAVIORS IN SOUTH INDIAN CHILDREN– A CROSS-SECTIONAL
5 |
6 | STUDY
7 |

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39 | Short title: Body weight perception influences weight loss in South Indian children
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Abstract:

Objective: To examine the patterns of weight loss behaviour, and the association between weight loss attempts with actual weight status, and children's and parental perceptions of weight status.

Design: Cross sectional study

Setting: Karnataka, South India

Participants: 1874 girls and boys aged 8 to 14 years from 7 schools in Karnataka, South India

Main outcome measures: The association between weight loss attempts and socio-demographic factors, weight status and the child or parent's perception of weight status.

Results: Approximately 73% of overweight and obese, 35% of normal weight and 22% of underweight children attempted to lose weight. Children of lower socio-economic groups studying in schools in the local vernacular and overweight/obese children were more likely to attempt to lose weight (Adjusted odds ratio or AOR=1.57, 95% CI: 1.11 to 2.25; AOR= 4.38, 95% CI: 2.64 to 7.28, respectively). Perception of weight status was [important in influencing associated with](#) weight loss attempts. Thus, children who were normal weight but perceived themselves to be overweight / obese were three times more likely to attempt weight loss compared with those who accurately perceived themselves as normal weight, while the odds of attempting weight loss were the highest for those who were overweight and perceived themselves to be so (AOR ~ 18).

Conclusions: Children are likely to attempt weight loss in India irrespective of their weight status, age and gender. Children who were actually overweight as well as those who were perceived by themselves or by their parents to be overweight or obese were highly likely to try to lose weight. It is necessary to understand body weight perceptions in communities with a dual burden of overweight and under-nutrition, if intervention programmes for either are to be successful.

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ARTICLE FOCUS:

- To explore weight loss behaviour patterns and association between weight loss attempts with socio-demographic factors, actual as well as children's and parental perceptions of child's weight status.

KEY MESSAGES

- In India, where both overweight and underweight in children co-exist, there are no data on the associations of body weight perceptions of children in relation to weight loss attempts. It is essential to understand this association in order to tailor suitable intervention programmes that can work in communities with concurrent under- and over-nutrition.
- Weight loss is attempted by children irrespective of weight status, age and gender. However, there are higher odds of attempting to lose weight among those who perceive themselves to be overweight, although their weight status may be normal.

STRENGTHS AND LIMITATIONS

- This is the first study to report perceptions of body weight in India in relation to weight loss attempts.
- The cross-sectional study design used in this study, allows only associations to be assessed.

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57 INTRODUCTION:

58 Body image is a psycho-social dimension of body size that encompasses both perceptual and
59 attitudinal factors ⁽¹⁾ and has been associated with eating disorders ^(1, 2). In recent years, its
60 association with overweight and obesity has been described ⁽³⁾. It is recognised that
61 individuals make decisions on lifestyle behaviours based on body weight perceptions (a
62 dimension of body image) ^(1, 4). In India, there is a large burden of under-nutrition alongside
63 increasing overweight and obesity ⁽⁴⁾. For public health and clinical programmes to be more
64 effective, body image of undernourished and overweight children should be understood in the
65 context of the influence of culture on body weight perceptions and on weight management
66 behaviours.

67 A large number of studies have indicated that children and adolescents misperceive their
68 body weight status ⁽⁵⁻¹⁰⁾. Interventions that address socio-cultural attitudes towards
69 appearance should ideally reduce body image dissatisfaction as well as overweight and
70 obesity since studies have indicated a relationship between body image, unhealthy eating
71 practices and obesity ^(11, 12). Perceptions of body weight are, in part, influenced by external
72 factors including cultural norms and social preferences as it has been observed that Asian
73 women have less body dissatisfaction than other ethnic groups ⁽¹³⁾. In India, it is often
74 believed that an overweight person is wealthier and happier and reflects social mobility to a
75 higher status compared to an underweight person, although there are no studies to corroborate
76 this. The disconnect between actual weight and perception of body size could stem from the
77 extent to which individuals identify with the majority cultural standards of beauty ⁽¹⁴⁾. There
78 are also reports that individuals in less socio-economically developed societies positively
79 evaluate overweight and obese figures ⁽⁶⁾. Evidence also suggests associations of actual body
80 weight, body weight perceptions and weight dissatisfaction with weight control practices;
81 overweight children are more likely to try to lose weight compared to non-overweight
82 children ^(7, 15). Analysis of data from the National Health and Nutrition Examination Survey
83 (NHANES) ⁽¹⁶⁾ and the Youth Risk Behaviour Surveillance Survey (YRBSS) ^(14, 17) indicate
84 that those overweight children who perceived their weight status correctly were more likely
85 to exercise or eat less for weight control. Results from an analysis from Europe, Israel and
86 North America as part of the Health Behaviour in School aged Children (HBSC) 2001/2002
87 survey indicated that weight and age were significant factors influencing associated with
88 currents attempts to lose weight ⁽¹⁵⁾.

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3 89 For healthy weight management it is necessary for a person to perceive his or her weight
4 90 status accurately as well as be aware of healthy methods to lose or gain weight. Most
5 91 literature on body weight perceptions and weight control behaviours are related to studies
6 92 done in developed countries^(5, 7, 14, 16) with a few on ethnic minorities, including South Asians
7 93^(3, 10). The present analysis aims to examine the associations between the actual weight
8 94 status, body weight perceptions of both children and their parents, and body weight
9 95 satisfaction with weight loss intentions. The study sample included a wide range of body
10 96 weights to reflect the dual burden of under-nutrition and overweight/obesity that India
11 97 currently faces.

18 98 **METHODS:**

20 99 **Study population:**

21 100 A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-
22 101 economic status located in rural areas, towns in Karnataka and urban Bangalore in South
23 102 India, were contacted at baseline out of which 1907 (91.6%) children participated in a
24 103 longitudinal study on body image perceptions and growth indices of school children, details
25 104 of which are published earlier⁽¹⁸⁾. Convenience sampling of 7 city and non-city (rural and
26 105 small towns) co-educational, non-residential schools was employed, such that children
27 106 representing various socio-economic statuses (based on school fees linked to medium of
28 107 instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and
29 108 2 in Bangalore city. The schools in which Kannada, the regional state language, was the
30 109 language of instruction, received government support and had annual tuition fees of Rs.250 to
31 110 500 whereas English medium schools did not receive government support and had annual
32 111 tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an
33 112 indicator of socio-economic status (SES). Three schools (1 each in a village, small town and
34 113 city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small
35 114 towns and 1 in the city) had English as the medium of instruction.

36 115 The sample recruited had adequate power (above 80 %) to identify the significant socio-
37 116 demographic predictors for perception of body image in the present study and to estimate a
38 117 difference of at least 10% over-estimation or under-estimation of body weight at 5% level of
39 118 significance. Ethical approval was obtained from the Institutional Ethical Review Board.

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3 119 Principals of schools were contacted for permission to conduct the study in their schools.
4 120 Written parental consent and assent from the child was also obtained. A questionnaire to
5 assess body image perception was administered by an investigator (MP) to all the consenting
6 students in a class by reading aloud the questions in either English or Kannada (the local
7 language). Responses were marked on the questionnaire by each child. A short questionnaire
8 in English or the local language to be filled by one of the parents was sent home after the
9 children completed their questionnaires. Children whose parents were illiterate (6.7%
10 mothers, 5.9% fathers), elicited the answers from either of their parents and filled up the
11 questionnaire.
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128 **Measurements:**

129 Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was
130 measured in school uniforms but without shoes using a calibrated digital scale (Home Health,
131 Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were
132 made using a standardized protocol. Body mass index (BMI) was computed and the BMI-
133 for-age Z score values were obtained using the World Health Organization Anthroplus
134 software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by
135 actual weight status as overweight ($>+1$ SD), normal (< -2 to $+1$) and underweight (< -2
136 SD). These values at 19 years of age, at $+1$ standard deviation (SD) correspond to the BMI
137 values of 25.4 kg/m^2 for boys and 25.0 kg/m^2 for girls and is equivalent to the overweight
138 cut-off for adults ($> 25.0 \text{ kg/m}^2$), while the $+2$ SD value (29.7 kg/m^2 for both sexes) compares
139 closely with the cut-off for obesity ($> 30.0 \text{ kg/m}^2$)⁽¹⁹⁾.

140 To assess current body weight perception, children were asked to mark whether they
141 thought their body weight or appearance was “too thin”, “a little thin”, “normal”, “a little
142 fat”, or “very fat”. Response to a similar identical question about their child’s body weight or
143 appearance with similar options was filled by parents in a questionnaire sent to their homes.
144 For analysis, “very thin” and “a little thin” were combined as “too/little thin” and “a little fat”
145 and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

146 To assess perceptions on desired (ideal) body weight, children responded to the
147 question “I want to be” with options “a lot fatter”, “slightly fatter”, “as I am at present”,
148 “slightly thinner”, “much thinner”. The first 2 options were clubbed as “a lot/slightly fatter”,
149 “as I am at present” as “same as at present” and the last 2 options clubbed as “slightly/much
150 thinner. Parents responded to a similar question on “I want my child to be” with an identical

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3 151 set of options. For analysis, clubbing of the options for parents desired body weight for their
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5 152 child was also done in a similar manner.

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7 153 The Stunkard's silhouettes ⁽²⁰⁾ were also used to assess body image perception in
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9 154 children and this was also administered in the classroom. In order to make comparisons with
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11 155 the body weight perception questions, the nine images were regrouped to reflect ~~the~~ 3
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13 156 categories of weight status: ~~as~~ underweight, normal and overweight. The agreement between
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15 157 the perceived visual image and the body weight perception obtained by questions of current
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17 158 weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement
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19 159 between underweight/fat and normal, and a moderate agreement between both the extremes
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21 160 of weight (underweight versus overweight) was seen. There were no gender differences in
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23 161 agreement. Parental perceptions of the body weight were assessed using structured questions
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25 162 ~~only~~, and since this was available ~~both for both the parent and the child~~; further analyses ~~were~~
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27 163 ~~was done using only the questions only.~~

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29 164 In addition, children were asked whether they had ever tried to lose weight. If they
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31 165 replied in the affirmative (options: yes/no), the method used to try and lose weight was
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33 166 recorded as "skipping meals", "stopped eating a certain kind of food", reduced quantity of
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35 167 food eaten" and "exercise" as a multiple response. Weight loss methods recommended by
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37 168 parents were similarly recorded.

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39 169 The present analysis is restricted to children on whom anthropometric measurements were
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41 170 available and who responded to the question on weight loss and this corresponds to 1874
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43 171 participants (871 boys, 1003 girls). The response rate (of a total of 1907 children) was 98.3%;
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45 172 socio-demographic (age, gender, medium of instruction) characteristics between the
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47 173 responders and non responders were comparable.

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175 **Statistical analysis:**

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51 176 Data are reported as number and percentages for all the categorical variables. For analysis,
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53 177 socio-demographic variables of age of children were categorized as 10 and below and above
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55 178 10 years of age (the adolescent period)⁽²¹⁾, language of instruction as Kannada and English
56
57 179 medium (a surrogate of socio-economic status), location as city and non-city (village and
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59 180 small towns) and maternal and paternal education below 7th grade and above 7th grade.

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3 181 Cross-tabulations were created of actual weight status of the child with the child's perception
4 182 and parent's perception of their child's current body weight. Using this, the following eight
5 183 groups were formed. As there were no children who were underweight but were perceived
6 184 ~~either~~ by either themselves or their parents to be overweight, this category was not
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9 185 considered.

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12 186 U/U – underweight by actual measurements/perceived by child/parent to be underweight

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14 187 U/N- underweight by actual measurements/perceived by child/parent to be normal

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16 188 N/U- normal by actual measurements/perceived by child/parent to be underweight

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18 189 N/N- normal by actual measurements/perceived by child/parent to be normal

19
20 190 N/O- normal by actual measurements/perceived by child/parent to be overweight

21
22 191 O/N- overweight by actual measurements/perceived by child/parent to be normal

23
24 192 O/O- overweight by actual measurements/perceived by child/parent to be overweight

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26 193 O/U- overweight by actual measurements/perceived by child/parent to be underweight

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28 194 The referent group was the N/N group.

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30 195 The association between the various socio-demographic factors as well with the above eight
31 196 groups **and attempt to lose weight** was evaluated using the Chi-square test and the unadjusted
32 197 odds ratio **are** reported. Association between attempt to lose weight and child's actual weight
33 198 status, child's and parent's perception of child's weight status and the above mentioned eight
34 199 groups were done using Chi square test stratified by age and gender. Binary logistic
35 200 regression was performed to identify the factors associated with attempted weight loss
36 201 adjusted for socio-demographic variables of age, gender, medium of instruction, parent's
37 202 education and current actual body weight status, child's and parent's perceived and desired
38 203 weight status of the child as model 1. In addition, a model (model 2) adjusted only for age,
39 204 sex, medium of instruction, actual weight status and the child's weight perception was
40 205 performed. Binary logistic regression was also performed to identify the factors associated
41 206 with attempting to lose weight (Yes/No) based on the 8 groups (detailed above) created using
42 207 the actual weight status of the child and child's or parent's perception of child's weight,
43 208 adjusted for age, gender and medium of instruction. A level of significance (two-sided) less
44 209 than 5% was considered statistically significant.

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53 210 **RESULTS:**

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56 211 Of the 1907 study children, 1874 responded to the question on whether they had ever tried to
57 212 lose weight. Of these, 65.5% of children were normal weight, 25.0 % underweight and 9.5%

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3 213 overweight. Thirty two percent of children perceived themselves to be underweight; this was
4 214 7% more than the actual prevalence of underweight. Similarly, 15.4% perceived themselves
5 215 to be overweight (5.9% higher than the actual prevalence). In contrast, parents tended to
6 216 under-estimate underweight (5% lower than the actual prevalence of under-weight).
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10 217 A total of 35% of children had attempted to lose weight; this constituted 73% of overweight
11 218 and obese, 35% of normal weight and 22% of underweight children. Sixty eight percent of
12 219 those children who perceived themselves to be overweight, 32% of those who perceived
13 220 themselves to be normal, and 23% of those who perceived themselves to be underweight
14 221 attempted to lose weight. Similarly, 54 % of children whose parents perceived them to be
15 222 overweight, 35% who perceived them to be normal, and 21% of those who perceived them to
16 223 be underweight attempted to lose weight. Correlations between actual weight status of the
17 224 child and the child's or parent's perception of the child's weight status, as well as the child's
18 225 and parent's perceptions on of desired (ideal) body weight ranged from 0.12 to 0.31 ($p < 0.01$)
19 226 (Supplementary table 1) indicating a low to moderate correlation between these variables.
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28 227 Among the socio-demographic factors (Table 1, Model 1), children in schools with Kannada
29 228 as the medium of instruction were more likely to attempt to lose weight than those studying
30 229 in schools with English as the medium of instruction (AOR= 1.57, 95% C.I: 1.11 to
31 230 2.25). Underweight children were less likely to try to lose weight (AOR=0.71, 95% C.I: 0.51
32 231 to 0.98), while overweight/obese children were more likely (AOR=4.38. 95% C.I: 2.64 to
33 232 7.28) to try and lose weight compared to normal weight children. Based on the child's
34 233 perception of their weight status, those who perceived themselves to be overweight were
35 234 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental
36 235 perception of weight status, however, did not have a significant impact on children
37 236 attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire
38 237 (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of
39 238 attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to
40 239 lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys.
41 240 Otherwise, the findings were similar to Model 1.
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52 241 A stratified analysis based on age and gender (Supplementary table 2) was also done. While
53 242 the groups were largely similar in terms of attempting to lose weight, significant differences
54 243 were observed only among those children who were actually underweight as well as those
55 244 who perceived themselves to be underweight. In these children, the prevalence of attempting
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245 to lose weight was significantly higher in older boys compared to older girls. Similarly, there
246 was a significantly higher prevalence of younger girls attempting to lose weight compared to
247 older girls, but not between younger and older boys.

248 Figure 1 represents the odds of a child attempting to lose weight based on the child's actual
249 weight status in combination with the child's/parent's perception of weight status. After
250 adjusting for age, gender and medium of instruction, the odds of attempting to lose weight
251 (Figure 1, Supplementary table3) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight
252 child who perceive themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an
253 overweight child who perceive themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an
254 overweight child who perceive themselves to be overweight. A similar trend was observed
255 when parental perceptions were replaced with child's perception (Figure 1) with odds of
256 attempting to lose weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child
257 perceived by a parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child
258 perceived by a parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child
259 perceived to be overweight by a parent. None of the underweight children were perceived by
260 themselves or by their parents to be overweight. Among children who were underweight but
261 perceived either by the child or parent to be underweight or normal, the odds of attempting to
262 lose weight was reduced by approximately 60% to 40% respectively in relation to children of
263 normal weight status perceived to be normal by both children and parents. The same ~~has~~
264 ~~been analyses were was~~ done using prevalence of attempting to lose weight based on actual
265 weight status, child's perception and parent's perception of child's weight status stratified by
266 age and gender (Figure 2a and 2b).

267 The most commonly adopted practice to lose weight regardless of whether ~~the~~ children were
268 underweight, overweight or normal was exercise (~46%), followed by reducing the quantity
269 of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 3).

270 **DISCUSSION:**

271 In concurrence with the findings of our study, misperception of weight status among children
272 has been reported in other studies conducted in the United States of America, with
273 perceptions differing between various ethnic groups. Among African American adolescents,
274 one-third perceived their weight status inaccurately⁽⁷⁾. Racial or ethnic differences in weight
275 perception have been reported^(5, 7, 8), where Caucasians were more likely than African
276 Americans to perceive themselves as overweight^(5, 7, 9). However, this has not been a

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3 277 universal finding, as for instance in multi-ethnic adolescents in the United Kingdom ⁽¹⁴⁾.
4 278 Perceptions, however, ~~also governed~~ were also associated with their decision to attempt
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6 279 weight loss, notwithstanding their current weight status.

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9 280 In general, children who were actually overweight as well as those who were perceived by
10 281 themselves or by their parents to be overweight were highly likely to try to lose weight.
11 282 ~~Perceptions were associated with their decision to try to lose weight~~. This finding is similar to
12 283 studies conducted in other countries ^(7, 8, 22). Unless individuals or their families perceive their
13 284 weight status correctly, their acceptance of programmes designed to encourage healthy
14 285 weight may be low ⁽¹⁷⁾.

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19 286 The child's or parent's desire for the child to be thinner was **also associated with** their
20 287 decision to try-attempt to lose weight. This desire was highest among those who perceived
21 288 themselves to be overweight, although about one-third of those who perceived themselves to
22 289 be normal weight and about one-fifth of those who perceived themselves to be underweight
23 290 also attempted to lose weight. In contrast, among children who were underweight and those
24 291 of normal weight, 32% and 23% desired to gain weight respectively. This clearly indicates
25 292 that in a country where both underweight and overweight co-exist, care must be taken in
26 293 developing programmes at a community level such that those who require to put on weight
27 294 and those who need to lose weight are considered, as for example in the school feeding
28 295 programmes.

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38 297 The fact that there were reported weight loss attempts even in the underweight group suggests
39 298 that factors other than weight status and weight perception are operative. This is corroborated
40 299 by the higher odds of children from Kannada medium schools, who belong to a relatively
41 300 lower socio-economic status compared to children from English medium schools (higher
42 301 SES) trying to lose weight. Thus socio-cultural factors may ~~also influence~~ be associated with
43 302 their decision to lose weight. This could be linked to the continuous exposure to images and
44 303 unrealistic body shapes that encourage weight loss regardless of body weight⁽⁸⁾. These
45 304 factors must be further explored so that suitable programmes that encourage overweight
46 305 children but not underweight or normal children to lose weight are planned.

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54 306 Included in our sample were children as young as 8 years of age. However, body
55 307 dissatisfaction with increasing weight status was established even by the age of 5 in both
56 308 boys and girls of South Asian origin in UK⁽³⁾. Irrespective of whether they were below or

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3 309 above 10 years of age or whether they were boys or girls, children attempted to lose weight.
4 310 In our study sample, there were no gender differences in weight loss attempts. This is
5 311 contrary to the findings elsewhere, as for instance, the NHANES study ⁽¹⁶⁾, which indicated
6 312 that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender
7 313 differences in our study may, in part, be due to the relatively low prevalence of overweight or
8 314 obesity.

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14 315 It is encouraging that 46 % children indicated exercise their preferred choice of weight loss.
15 316 Differences in the methods used to lose weight between overweight, normal and underweight
16 317 children were not apparent unlike other studies where unhealthier weight loss methods like
17 318 skipping meals are reported more in overweight or obese children compared to normal weight
18 319 children ⁽²³⁾. However, an effect of social desirability cannot be discounted, given that
19 320 exercise as a healthy lifestyle choice is promoted early in the school curriculum

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25 321 Body image must be taken into account when designing programmes to improve both body
26 322 image and reduce unhealthy behaviours like unhealthy eating and reduced or excessive
27 323 exercise ⁽¹⁾. Since public health programmes are generally targeted towards all, a general
28 324 programme that caters to all children irrespective of their weight status is required.

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32 325 **Strengths and limitations:** This is the first study to report perceptions of body weight in
33 326 India in relation to weight loss attempts. A major strength of this study is that measured
34 327 heights and weights rather than self-reported, were used and the study sample encompassed
35 328 children of diverse socio-economic strata, from rural and urban areas and of a large body
36 329 weight range. However, with the cross-sectional study design used in this study, the changes
37 330 in perception as the children grow cannot be accounted for. Longitudinal evaluation of these
38 331 children will allow us to establish causal links between weight perception and weight loss
39 332 behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of
40 333 the questionnaire were limitations as information regarding the frequency, duration, and
41 334 intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or
42 335 past) at which such behaviours occurred could not be obtained. Data on the reliability and
43 336 validity of the questionnaire are not available for this population. With the question asked on
44 337 attempt to lose weight being dichotomous, there is a possibility that a child who is currently
45 338 normal weight may report weight loss behaviours because they were overweight in the past.
46 339 The small numbers of children in each category in the analysis stratified by actual and
47 340 perceived weight status necessitates further exploration with larger numbers of children in

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3 341 each category. A further limitation is that we have not collected data on attempt to gain
4 342 weight.

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8 344 Overall, perceptions of weight status **was associated with** the decision of children to lose
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10 345 weight. This needs to be further explored as a longitudinal study to establish causal links.
11 346 However, regardless of weight status, many children did resort to weight loss. Public health
12 347 campaigns should emphasize healthy weight management rather than weight loss.

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19 350 of part of the data.

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23 351 *Contributors:* MP, SS and MV were responsible for the concept and design of the study. SS
24 352 drafted and the manuscript. MP acquired the data. Sumithra Selvam (SRS) performed the
25 353 statistical analysis and interpreted the data. MV conceived the study and interpreted the data.
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37 360 declare no support from any organisation for the submitted work; no financial relationships
38 361 with any organisations that might have an interest in the submitted work in the previous 3
39 362 years/ no other relationships or activities that could appear to have influence the submitted
40 363 work.

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Table 1. Socio-economic and anthropometric associations of weight loss behaviour

	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted † OR Model 1 95% C.I.		Adjusted ‡ OR Model 2 95% C.I.	P value‡	
	Yes	No			P value‡	P value‡			
Gender									
	Girls	387 (39%)	616 (61%)	1.41 1.16 – 1.72	<0.001	1.16 0.89 – 1.51	0.27	1.37 1.11 – 1.70	0.01
	Boys	268 (31%)	603 (69%)	1		1		1	
Age category (years)									
	<=10	245 (34%)	469 (66%)	0.96 0.78 – 1.17	0.65	1.04 0.79 – 1.36	0.76	1.03 0.83 – 1.28	0.79
	>10	410 (35%)	750 (65%)	1		1		1	
Location									
	City	408 (33%)	812 (67%)	0.83 0.68 – 1.01	0.06	1.03 0.78 – 1.36	0.81	-	-
	Non City	247 (38%)	407 (62%)	1		1		-	-
Education of mother (Standard)									
	Up to 7 th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7 th	400 (36%)	727 (65%)	1		1		-	-
Education of father (Standard)									
	Up to 7 th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7 th	437 (34%)	838 (66%)	1		1		-	-
Medium of instruction									
	Kannada	198 (39%)	308 (61%)	1.28 1.03- 1.59	0.02	1.57 1.11 – 2.25	0.01	1.52 1.20 – 1.92	<0.001
	English ¹	457(33%)	911 (67%)	1		1		1	

Actual weight status									
Underweight	98 (22%)	352 (78%)	0.52	<0.001	0.71	0.04	0.66		
			0.40 – 0.67		0.51 – 0.98		0.50 – 0.86	0.002	
Overweight	125 (73%)	47 (27%)	4.96	<0.001	4.38	<0.001	3.86		
			3.43 – 7.20		2.64 – 7.28		2.63 – 5.64	<0.001	
Normal	412 (35%)	769 (65%)	1		1				
Child's perception of body image									
Too /A little Thin	133 (23%)	457 (77%)	0.61	<0.001	0.67	0.01	0.64	<0.001	
			0.48 – 0.77		0.49 – 0.93		0.49 – 0.82		
A little /Too fat	195 (68%)	91 (32%)	4.48	<0.001	2.91	<0.001	3.48	<0.001	
			3.35 – 6.00		1.95 – 4.34		2.57 – 4.69		
Normal	318 (32%)	665 (68%)	1		1				
Child's desire to be									
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76	0.03	0.84	0.35			
			0.58 – 0.98		0.59 – 1.20				
Slightly/Much thinner	260(52%)	237 (48%)	2.53	<0.001	1.56	0.006	-	-	
			2.00 – 3.19		1.14 – 2.15				
Same as at present	272 (30%)	627 (70%)	1		1				
Parent's perception of child's body image									
Too /A little Thin	66 (22%)	241 (79%)	0.52	<0.001	0.76	0.15			
			0.38 – 0.71		0.52 – 1.12		-	-	
A little /Too fat	95 (54%)	82 (46%)	2.20	<0.001	0.86				
			1.58 – 3.08		0.51 – 1.37	0.51			
Normal	364 (35%)	690 (66%)	1		1				
Parent's desire for child to be									
A lot /Slightly fatter	87 (21%)	331 (79%)	0.54	<0.001	0.75	0.11			
			0.41- 0.72		0.52 – 1.07		-	-	
Slightly /Much thinner	170 (56%)	134 (44%)	2.61	<0.001	1.79				
			1.98 – 3.46		1.25 – 2.58	0.002			
Same as at present	263 (33%)	542 (67%)	1		1				

Results are reported as Number (percentages); OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

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- † Adjusted for actual BMI status, child’s and parents perception of body weight and socio-demographic factors
- ‡ Obtained by fitting binary logistic regression model. Model 1: Adjusted for socio-demographic variables and actual and perceived weight
- ¶ Obtained by fitting binary logistic regression model. Model 2: Adjusted for age, gender, medium of instruction, actual weight status and child’s perception of body weight.

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8 **Figure Legends:**
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10 **Figure 1: Odds ratio of having tried to lose body weight in children classified by current**
11 **weight status and perception of body weight.**

12 ■ Comparison of child's actual weight
13 status with child's perception of weight status □ Comparison of child's actual weight
14 status with parental perception of weight status. U/U: underweight by actual
15 measurements/child's or parent's perception of being underweight, U/N: underweight by
16 actual measurements/child's or parent's perception of being normal, N/U- normal by actual
17 measurements/perceived by child/parent to be underweight, N/N: normal by actual
18 measurements/child's or parent's perception of being normal, N/O: normal by actual
19 measurements/child's or parent's perception of being overweight, O/N: overweight by actual
20 measurements/child's or parent's perception of being normal, O/O: overweight by actual
21 measurements/child's or parent's perception of being overweight, O/U: overweight by actual
22 measurements/child's or parent's perception of being underweight.
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34 **Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category**
35 **based on actual weight status and children and parent's perception of child's body**
36 **weight. UW – Underweight, OW – Overweight**
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40 **Figure 3: Actual weight status and weight loss practices of children**

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42 ■ Exercise ■ Reduced quantity of food eaten ■ Stopped eating certain kind of foods
43 □ Skipping meals
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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4 and 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4 and 5
Bias	9	Describe any efforts to address potential sources of bias	<i>Not applicable</i>
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5 and 6
		(b) Describe any methods used to examine subgroups and interactions	5 and 6
		(c) Explain how missing data were addressed	Not applicable
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	Not applicable
Results			

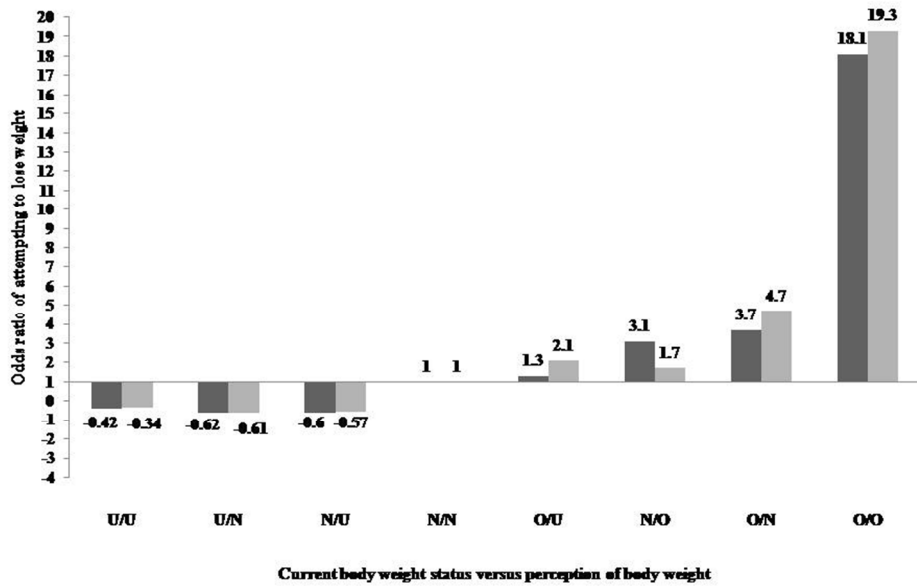
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	Not used
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5
Outcome data	15*	Report numbers of outcome events or summary measures	5 and 6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,12,13
		(b) Report category boundaries when continuous variables were categorized	5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	7 and 8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Not applicable
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7, 8 and 9
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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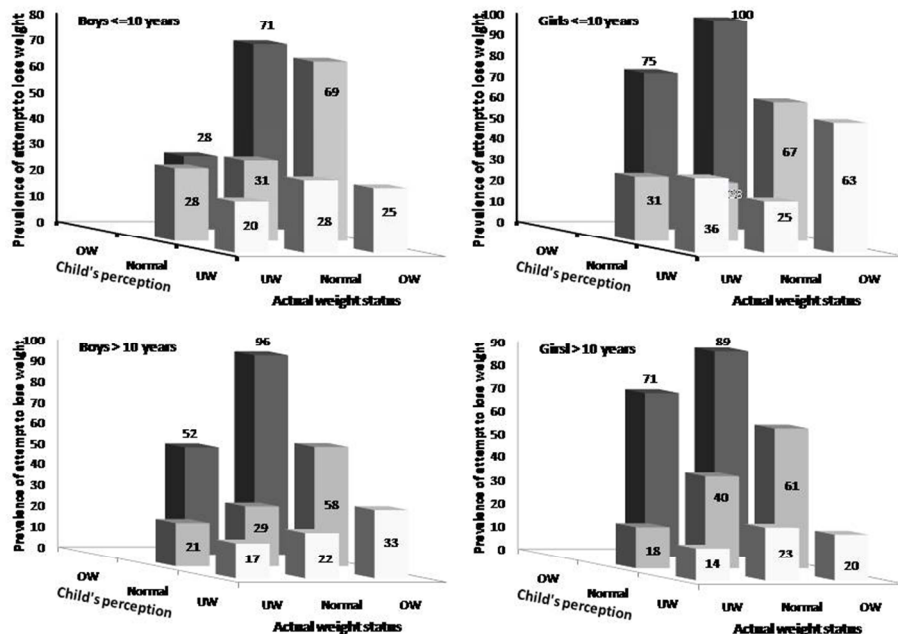
FIGURE 1: ODDS RATIO OF ATTEMPTING TO LOSE WEIGHT IN CHILDREN CLASSIFIED BY CURRENT WEIGHT STATUS OF CHILDREN WITH CHILD'S AND PARENT'S PERCEPTION OF CHILD'S BODY WEIGHT



254x190mm (96 x 96 DPI)

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FIGURE 2A: PREVALENCE OF ATTEMPTING TO LOSE WEIGHT BY GENDER AND AGE CATEGORY BASED ON ACTUAL WEIGHT STATUS AND CHILD'S PERCEPTION OF BODY WEIGHT

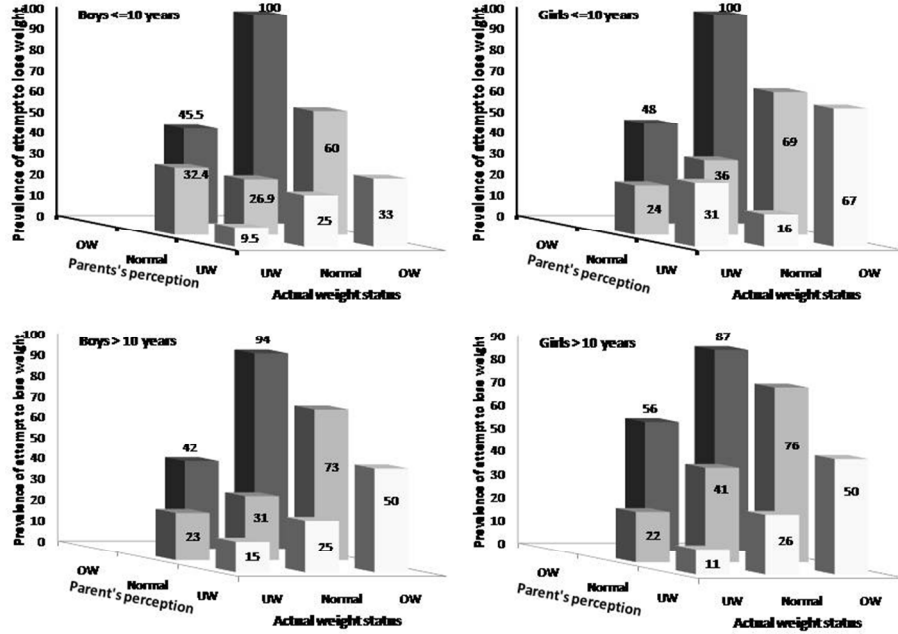


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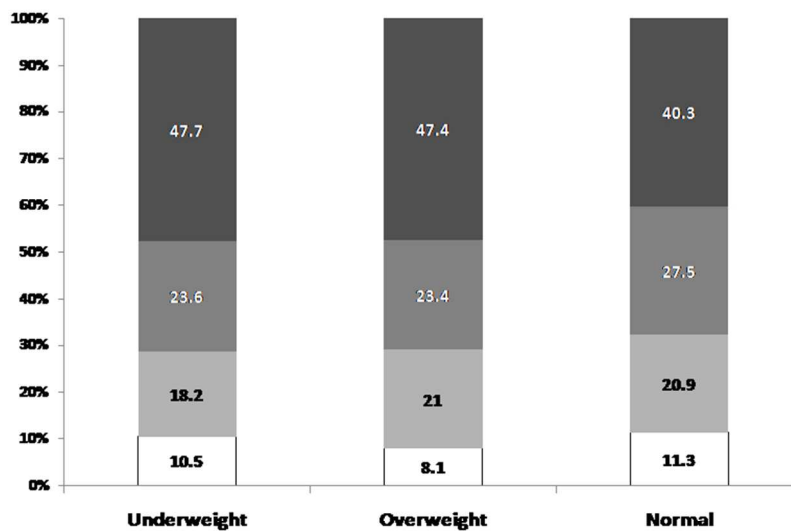
FIGURE 2B: PREVALENCE OF ATTEMPTING TO LOSE WEIGHT BY GENDER AND AGE CATEGORY BASED ON ACTUAL WEIGHT STATUS AND PARENT'S PERCEPTION OF BODY WEIGHT



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Figure 2: Actual weight status and weight loss practices of children



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Supplementary Table 1: Correlation matrix of actual weight status, child's and parent's perception of child's present weight and desired weight status

	Actual weight status	Child's perception of body weight	Child's desired weight status	Parent's perception of child's body weight	Parents desired for child's weight status
Actual weight status	1				
Child's perception of body weight	0.26	1			
Child's desired weight status	0.15	0.21	1		
Parent's perception of child's body weight	0.17	0.30	0.12	1	
Parents desired for child's weight status	0.18	0.19	0.31	0.28	1

Supplementary Table 2: Prevalence of attempt to lose weight by gender and age category:

	Attempt to lose weight				P value*
	Boys		Girls		
	<=10	>10	<=10	>10	
Actual weight status					
Underweight	19 (25.0)	36 (20.2)†	23 (32.4)‡	20 (16.0)	0.002
Overweight	20 (64.5)	30 (78.9)	24 (72.7)	51 (72.9)	0.89
Normal	60 (29.3)	96 (30.7)	92 (34.3)	164 (41.5)	-
Child's perception of body weight					
Too thin/Little thin	24 (23.5)	38 (20.4) †	40 (29.0) :	31 (18.9)	0.006
Too fat/little fat	21 (46.7)	49 (63.6)	41 (78.8)	84 (75.0)	0.25
Normal	55 (30.9)	76 (27.5)	62 (32.1)	125 (37.2)	-
Parent's perception of body weight					
Too thin/Little thin	9 (18.0)	21(21.0)	14 (25.5)	22 (21.6)	0.60
Too fat/little fat	10 (47.6)	32 (48.5)	15 (48.4)	38 (64.4)	0.17
Normal	51 (29.1)	88 (30.4)	82 (36.0)	143 (39.5)	-

Reported as number and within parenthesis percentages; *Fisher's Exact test or Chi square test;
 † Among older/younger age group children significant difference between boys and girls
 ‡ Among girls significant difference between the younger and older age group children
 p values for O/U not reported due to small numbers.

(Supplementary) Table 3: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the child's perception of body weight

Actual BMI	Child's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P value*	Adjusted† OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	105	67	3.1 2.22 – 4.58	<0.001	3.1 2.2 -4.42	<0.001
Overweight/Obese	Overweight/Obese	74	9	16.7 7.93 – 36.54	<0.001	18.1 8.8 -36.9	<0.001
Overweight/Obese	Normal	43	25	3.5 2.03 – 6.08	<0.001	3.7 2.2 – 6.2	<0.001
Overweight/Obese	Underweight	8	12	1.36 0.50 – 3.62	0.50	1.37 0.55 – 3.4	0.50
Underweight	Underweight	30	123	0.50 0.32 – 0.78	<0.001	0.49 0.32-0.77	0.001
Underweight	Normal	67	226	0.60 0.43 – 0.84	0.001	0.62 0.45 – 0.86	0.004
Normal	Underweight	81	254	0.65 0.48 – 0.88	0.004	0.60 0.45 – 0.82	0.001
Normal	Normal	219	446	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

*Fisher's Exact test or Chi square test

†Adjusted for age, gender and medium of instruction

‡‡ Obtained by fitting binary logistic regression models

(Supplementary) Table 4: Odds ratio of attempting to lose weight in comparison to actual weight status of the children and the parent's perception of child's body weight

Actual BMI status of the children	Parent's Perception of body weight	Attempted weight loss		Unadjusted OR 95% C.I.	P Value*	Adjusted † OR 95% C.I.	P value‡
		Yes	No				
Normal	Overweight/Obese	43	47	1.69 1.07 – 2.69	0.01	1.74 1.1 – 2.7	0.01
Overweight/Obese	Overweight/Obese	40	4	18.5 6.25 – 61.63	<0.001	19.3 6.8- 54.8	<0.001
Overweight/Obese	Normal	50	21	4.4 2.52 – 7.77	<0.001	4.7 2.7 – 8.0	<0.001
Overweight/Obese	Underweight	10	9	2.06 0.76 – 5.58	0.11	2.17 0.87 – 5.4	0.10
Underweight	Underweight	18	102	0.33 0.19 – 0.57	<0.001	0.34 0.20 – 0.57	<0.001
Underweight	Normal	58	181	0.59 0.42 – 0.84	0.001	0.61 0.44 – 0.86	0.004
Normal	Underweight	37	121	0.57 0.37 – 0.86	0.004	0.57 0.38 – 0.84	0.005
Normal	Normal	257	476	1		1	

Results are reported as Number and %; OR – Odds Ratio; 95% C.I. – 95% Confidence Interval

* Fisher's Exact test or Chi square test

†Adjusted for age, gender and medium of instruction

‡‡ Obtained by fitting binary logistic regression models