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

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 weighting 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.

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.

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 factors[1] and has been associated with eating disorders. In recent years, its association with overweight and obesity has been described[2]. 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 beauty[6]. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures[7]. 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 currents attempt to lose weight[9].

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 Asians [2]

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

METHODS:

Study population:

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

Measurements:

Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was measured in school clothing but without shoes using a calibrated digital scale (Home Health, Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were made using a standardized protocol. Body mass index (BMI) was computed and the BMI-for-age z score values were obtained using the World Health Organization Anthroplus software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI

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

about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental perception of weight status, however, did not have a significant impact on children attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of attempting to lose weight.

Figure 1 represents the odds of a child attempting to lose weight based on the child's actual weight status in combination with the child's/parent's perception of weight status After adjusting for age, gender and medium of instruction, the odds of attempting to lose weight (Figure 1) increased from 3.1 (95% CI: 2.2 to 4.4) for a normal weight child who perceived themselves to be overweight/obese, 3.7(95% CI: 2.2 to 6.2) for an overweight child who perceived themselves to be normal to 18.1 (95% CI: 8.8 to 36.9) for an overweight child who perceived themselves to be overweight. A similar trend was observed when parental perceptions were replaced with child's perception (Figure 1) with odds of attempting to lose weight increasing from 1.7 (95% CI: 1.1 to 2.7) for normal weight child perceived by a parent to be overweight, 4.7 (95% CI: 2.7 to 8.0) for an overweight child perceived by a parent to be normal to 19.3(95% CI: 6.8 to 54.8) for an overweight child perceived to be overweight by a parent. None of the underweight children were perceived by themselves or by their parents to be overweight. Among children who were underweight but perceived either by the child or parent to be underweight or normal, the odds of attempting to lose weight was reduced by approximately 60% to 40% respectively in relation to children of normal weight status perceived to be normal by both children and parents. .

The most commonly adopted practice to lose weight regardless of whether the children were underweight, overweight or normal was exercise (~46%), followed by reducing the quantity of food intake, ceasing to eat certain kinds of foods and skipping meals (Figure 2).

DISCUSSION:

In concurrence with the findings of our study, misperception of weight status among children has been reported in other studies conducted in the United States of America, with perceptions differing between various ethnic groups. Among African American adolescents, one-third perceived their weight status inaccurately[8]. Racial or ethnic differences in weight perception have been reported[8 12 16], where Caucasians were more likely than African Americans to perceive themselves as overweight[8 12 17]. Perceptions, however, also governed their decision to attempt weight loss, notwithstanding their current weight status.

In general, 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. Clearly, perceptions influence their decision to try to lose weight. This finding is similar to studies conducted in other countries[8 16 18]. Unless individuals or their families perceive their weight status correctly, their acceptance of programmes designed to encourage healthy weight may be low [11]. The child's or parent's desire for the child to be thinner also influenced their decision to try to lose weight.

The fact that there were reported weight loss attempts even in the underweight group suggests that factors other than weight status and weight perception are operative. This is corroborated by the higher odds of children from Kannada medium schools, who belong to a relatively lower socio-economic status compared to children from English medium schools (higher SES) trying to lose weight. Thus socio-cultural factors may also influence their decision to lose weight. This could be linked to the continuous exposure to images and unrealistic body shapes that encourage weight loss regardless of body weight [16]. These factors must be further explored so that suitable programmes that encourage overweight children but not underweight or normal children to lose weight are planned.

Included in our sample were children as young as 8 years of age. However, body dissatisfaction with increasing weight status was established even by the age of 5 in both boys and girls of South Asian origin in UK[2] . Irrespective of whether they were below or 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 contrary to the findings elsewhere, as for instance, the NHANES study [10], which indicated that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender differences in our study may, in part, be due to the relatively low prevalence of overweight or obesity.

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

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

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.

Overall, perceptions of weight status influenced the decision of children to lose weight. However, regardless of weight status, many children did resort to weight loss. Public health campaigns should emphasize healthy weight management rather than weight loss.

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Contributors: MP, SS and MV were responsible for the concept and design of the study. SS drafted and the manuscript. MP acquired the data. Sumithra Selvam (SRS) performed the statistical analysis and interpreted the data. MV conceived the study and interpreted the data. All authors revised the manuscript critically for important intellectual content. SS is the guarantor.

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Competing interests: All authors have completed the Unified Competing Interest from at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years/ no other relationships or activities that could appear to have influence the submitted work.

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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 95% C.I.	P value*	Adjusted † OR 95% C.I.	P value‡
		Yes	No				
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 7th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22
	> 7th	400 (36%)	727 (65%)	1		1	
Education of father (Standard)							
	Up to 7th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22
	> 7th	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 (0.40 – 0.67)	<0.001	0.71 (0.51 – 0.98)	0.04
Overweight	125 (73%)	47 (27%)	4.96 (3.43 – 7.20)	<0.001	4.38 (2.64 – 7.28)	<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 (0.48 – 0.77)	<0.001	0.67 (0.49 – 0.93)	0.01
A little /Too fat	195 (68%)	91 (32%)	4.48 (3.35 – 6.00)	<0.001	2.91 (1.95 – 4.34)	<0.001
Normal	318 (32%)	665 (68%)	1		1	
Child's desire to be						
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76 (0.58 – 0.98)	0.03	0.84 (0.59 – 1.20)	0.35
Slightly/Much thinner	260(52%)	237 (48%)	2.53 (2.00 – 3.19)	<0.001	1.56 (1.14 – 2.15)	0.006
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 (0.38 – 0.71)	<0.001	0.76 (0.52 – 1.12)	0.15
A little /Too fat	95 (54%)	82 (46%)	2.20 (1.58 – 3.08)	<0.001	0.86 (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 (0.41- 0.72)	<0.001	0.75 (0.52 – 1.07)	0.11
Slightly /Much thinner	170 (56%)	134 (44%)	2.61 (1.98 – 3.46)	<0.001	1.79 (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

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

‡ Obtained by fitting binary logistic regression models

Figure Legends:

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.

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

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

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

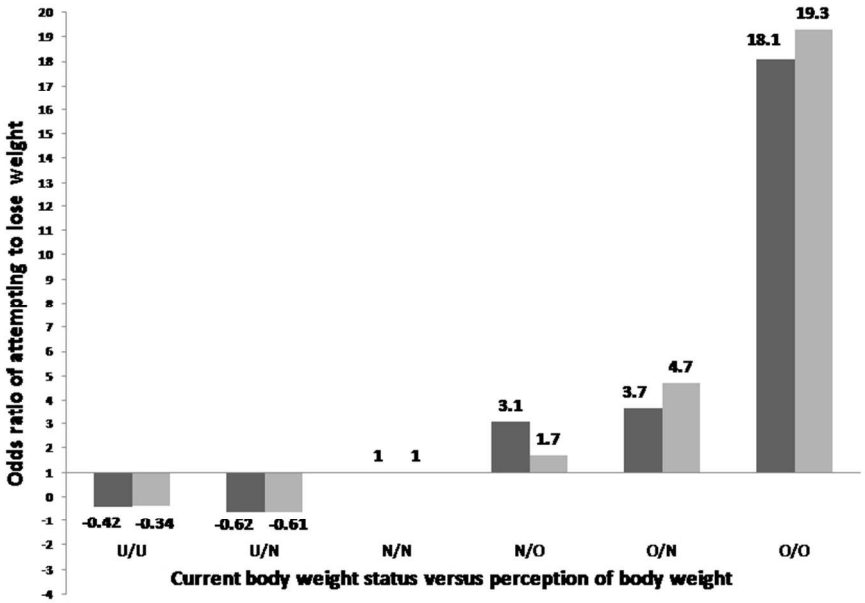

Figure 1: Odds ratio of having tried to lose body weight in children classified by current weight status and perception of body weight. Comparison of child's actual weight status with child's perception of weight status Comparison of child's actual weight status with parental perception of weight status. 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)

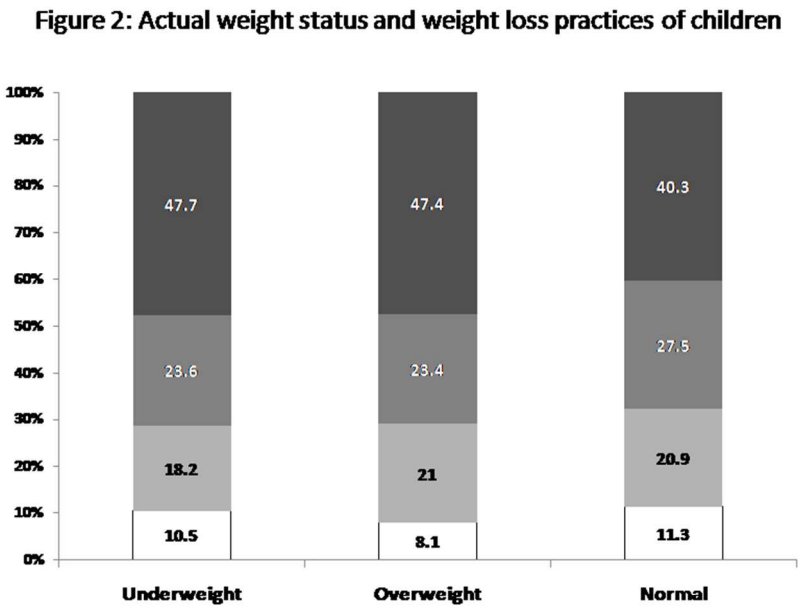

Figure 2: Actual weight status and weight loss practices of children

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

254x190mm (96 x 96 DPI)

(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	*Not applicable*
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.

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

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.

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.

INTRODUCTION:

Body image is a psycho-social dimension of body size that encompasses both perceptual and attitudinal factors[1] and has been associated with eating disorders. In recent years, its association with overweight and obesity has been described [2]. It is recognised that individuals make decisions on lifestyle behaviours based on body weight perceptions (a dimension of body image) [1, 3]. In India, 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 as it has been observed that Asian women have less body dissatisfaction than other ethnic groups[6]. In India, it is often believed that an overweight person is wealthier and happier and reflects social mobility to a higher status compared to an underweight person, although there are no studies to corroborate this. 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 beauty[7]. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures [8]. 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 [9, 10].Analysis of data from the National Health and Nutrition Examination Survey (NHANES) [11] and the Youth Risk Behaviour Surveillance Survey (YRBSS) [7, 12] 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 currents attempt to lose weight [10].

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 [7, 9, 11, 13] with a few on ethnic minorities, including South Asians [2, 14]. The present analysis aims to examine the associations between the actual weight status, body weight perceptions of both children and their parents, and body weight satisfaction with weight loss intentions. The study sample included a wide range of body weights to reflect the dual burden of under-nutrition and overweight/obesity that India currently faces.

METHODS:

Study population:

A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-economic status located in rural areas, towns in Karnataka and urban Bangalore in South India, were contacted at baseline out of which 1907 (91.6%) children participated in a longitudinal study on body image perceptions and growth indices of school children, details of which are published earlier [15]. Convenience sampling of 7 city and non-city (rural and small towns) co-educational, non-residential schools was employed, such that children representing various socio-economic statuses (based on school fees linked to medium of instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and 2 in Bangalore city. The schools in which Kannada, the regional state language, was the language of instruction, received government support and had annual tuition fees of Rs.250 to 500 whereas English medium schools did not receive government support and had annual tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an indicator of socio-economic status (SES). Three schools (1 each in a village, small town and city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small towns and 1 in the city) had English as the medium of instruction.

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

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

Measurements:

Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was measured in school uniforms but without shoes using a calibrated digital scale (Home Health, Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were made using a standardized protocol. Body mass index (BMI) was computed and the BMI-for-age z score values were obtained using the World Health Organization Anthroplus software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI 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) [16].

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 identical 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 as “too/little thin” and “a little fat” and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

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

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

The Stunkard's silhouettes [17] were also used to assess body image perception in children and this was also administered in the classroom. In order to make comparisons with the body weight perception questions, the nine images were regrouped to reflect the 3 categories of weight status as underweight, normal and overweight. The agreement between the perceived visual image and the body weight perception obtained by questions of current weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement between underweight/fat and normal, and a moderate agreement between both the extremes of weight (underweight versus overweight) was seen. There were no gender differences in agreement. Parental perceptions of the body weight were assessed using structured questions only, and since this was available both for the parent and the child, further analyses were done using the questions only.

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). The response rate (of a total of 1907 children) was 98.3%; socio-demographic (age, gender, medium of instruction) characteristics between the responders and non responders were comparable.

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 (the adolescent period)[18], 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 7^{th} grade and above 7^{th} 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 eight groups were formed. As there were no children who were underweight but were perceived either by themselves or their parents to be overweight, this category was not considered.

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

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

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

The referent group was the N/N group.

The association between attempting weight loss with various socio-demographic factors as well with the above eight groups was evaluated using the Chi-square test and the unadjusted odds ratio reported. Association between attempt to lose weight and child's actual weight status, child's and parent's perception of child's weight status and the above mentioned eight groups were done using Chi square test stratified by age and gender. Binary logistic regression was performed to identify the factors associated with attempted weight loss adjusted for socio-demographic variables of age, gender, medium of instruction, parent's education and current actual body weight status, child's and parent's perceived and desired weight status of the child as model 1. In addition, a model (model 2) adjusted only for age, sex, medium of instruction, actual weight status and the child's weight perception was performed. Binary logistic regression was also performed to identify the factors associated with attempting to lose weight (Yes/No) based on the 8 groups (details above) 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 perceived them to be underweight attempted to lose weight. Correlations between actual weight status of the child, child's or parent's perception of child's weight status, as well as child's and parent's perceptions on desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$) (Supplementary table 1) indicating a low to moderate correlation between these variables.

Among the socio-demographic factors (Table 1, Model 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 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental perception of weight status, however, did not have a significant impact on children attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys. Otherwise, the findings were similar to Model 1.

A stratified analysis based on age and gender (Supplementary table 2) was also done. While the groups were largely similar in terms of attempting to lose weight, significant differences were observed only among those children who were actually underweight as well as those who perceived themselves to be underweight. In these children, the prevalence of attempting to lose weight was significantly higher in older boys compared to older girls. Similarly, there

was a significantly higher prevalence of younger girls attempting to lose weight compared to older girls, but not between younger and older boys.

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

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

DISCUSSION:

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

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

In general, 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. Clearly, perceptions influence their decision to try to lose weight. This finding is similar to studies conducted in other countries [9, 19, 21]. Unless individuals or their families perceive their weight status correctly, their acceptance of programmes designed to encourage healthy weight may be low [12].

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

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

Included in our sample were children as young as 8 years of age. However, body dissatisfaction with increasing weight status was established even by the age of 5 in both boys and girls of South Asian origin in UK[2] . Irrespective of whether they were below or 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

contrary to the findings elsewhere, as for instance, the NHANES study [11], which indicated that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender differences in our study may, in part, be due to the relatively low prevalence of overweight or obesity.

It is encouraging that 46 % children indicated exercise their preferred choice of weight loss. Differences in the methods used to lose weight between overweight, normal and underweight children were not apparent unlike other studies where unhealthier weight loss methods like skipping meals are reported more in overweight or obese children compared to normal weight children [22]. However, an effect of social desirability cannot be discounted, given that exercise as a healthy lifestyle choice is promoted early in the school curriculum

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

Strengths and limitations: This is the first study to report perceptions of body weight in India in relation to weight loss attempts. A major strength of this study is that measured heights and weights rather than self-reported, were used and the study sample encompassed children of diverse socio-economic strata, from rural and urban areas and of a large body weight range. However, with the cross-sectional study design used in this study, the changes in perception as the children grow cannot be accounted for. Longitudinal evaluation of these children will allow us to establish causal links between weight perception and weight loss behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of the questionnaire were limitations as information regarding the frequency, duration, and intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or past) at which such behaviours occurred could not be obtained. Data on the reliability and validity of the questionnaire are not available for this population. With the question asked on attempt to lose weight being dichotomous, there is a possibility that a child who is currently normal weight may report weight loss behaviours because they were overweight in the past. The small numbers of children in each category in the analysis stratified by actual and perceived weight status necessitates further exploration with larger numbers of children in each category. A further limitation is that we have not collected data on attempt to gain weight.

Overall, perceptions of weight status influenced the decision of children to lose weight. This needs to be further explored as a longitudinal study to establish causal links. However, regardless of weight status, many children did resort to weight loss. Public health campaigns should emphasize healthy weight management rather than weight loss.

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Contributors: MP, SS and MV were responsible for the concept and design of the study. SS drafted and the manuscript. MP acquired the data. Sumithra Selvam (SRS) performed the statistical analysis and interpreted the data. MV conceived the study and interpreted the data. All authors revised the manuscript critically for important intellectual content. SS is the guarantor.

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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			
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 7th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7th	400 (36%)	727 (65%)	1		1			
Education of father (Standard)									
	Up to 7th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7th	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 (0.40 – 0.67)	<0.001	0.71 (0.51 – 0.98)	0.04	0.66 (0.50 – 0.86)	0.002
Overweight	125 (73%)	47 (27%)	4.96 (3.43 – 7.20)	<0.001	4.38 (2.64 – 7.28)	<0.001	3.86 (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 (0.48 – 0.77)	<0.001	0.67 (0.49 – 0.93)	0.01	0.64 (0.49 – 0.82)	<0.001
A little /Too fat	195 (68%)	91 (32%)	4.48 (3.35 – 6.00)	<0.001	2.91 (1.95 – 4.34)	<0.001	3.48 (2.57 – 4.69)	<0.001
Normal	318 (32%)	665 (68%)	1		1			
Child's desire to be								
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76 (0.58 – 0.98)	0.03	0.84 (0.59 – 1.20)	0.35		
Slightly/Much thinner	260(52%)	237 (48%)	2.53 (2.00 – 3.19)	<0.001	1.56 (1.14 – 2.15)	0.006	-	-
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 (0.38 – 0.71)	<0.001	0.76 (0.52 – 1.12)	0.15	-	-
A little /Too fat	95 (54%)	82 (46%)	2.20 (1.58 – 3.08)	<0.001	0.86 (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 (0.41- 0.72)	<0.001	0.75 (0.52 – 1.07)	0.11	-	-
Slightly /Much thinner	170 (56%)	134 (44%)	2.61 (1.98 – 3.46)	<0.001	1.79 (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

† 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.

Figure Legends:

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/U- normal by actual measurements/perceived by child/parent to be underweight, 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, O/U: overweight by actual measurements/child's or parent's perception of being underweight.

Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category based on actual weight status and children and parent's perception of child's body weight. UW – Underweight, OW – Overweight

Figure 3: Actual weight status and weight loss practices of children

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

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

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.

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.

INTRODUCTION:

Body image is a psycho-social dimension of body size that encompasses both perceptual and attitudinal factors[1] and has been associated with eating disorders. In recent years, its association with overweight and obesity has been described [2]. It is recognised that individuals make decisions on lifestyle behaviours based on body weight perceptions (a dimension of body image) [1, 3]. In India, 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 as it has been observed that Asian women have less body dissatisfaction than other ethnic groups[6]. In India, it is often believed that an overweight person is wealthier and happier and reflects social mobility to a higher status compared to an underweight person, although there are no studies to corroborate this. 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 beauty[7]. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures [8]. 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 [9, 10].Analysis of data from the National Health and Nutrition Examination Survey (NHANES) [11] and the Youth Risk Behaviour Surveillance Survey (YRBSS) [7, 12] 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 currents attempt to lose weight [10].

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 [7, 9, 11, 13] with a few on ethnic minorities, including South Asians [2, 14]. The present analysis aims to examine the associations between the actual weight status, body weight perceptions of both children and their parents, and body weight satisfaction with weight loss intentions. The study sample included a wide range of body weights to reflect the dual burden of under-nutrition and overweight/obesity that India currently faces.

METHODS:

Study population:

A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-economic status located in rural areas, towns in Karnataka and urban Bangalore in South India, were contacted at baseline out of which 1907 (91.6%) children participated in a longitudinal study on body image perceptions and growth indices of school children, details of which are published earlier [15]. Convenience sampling of 7 city and non-city (rural and small towns) co-educational, non-residential schools was employed, such that children representing various socio-economic statuses (based on school fees linked to medium of instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and 2 in Bangalore city. The schools in which Kannada, the regional state language, was the language of instruction, received government support and had annual tuition fees of Rs.250 to 500 whereas English medium schools did not receive government support and had annual tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an indicator of socio-economic status (SES). Three schools (1 each in a village, small town and city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small towns and 1 in the city) had English as the medium of instruction.

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

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

Measurements:

Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was measured in school uniforms but without shoes using a calibrated digital scale (Home Health, Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were made using a standardized protocol. Body mass index (BMI) was computed and the BMI-for-age z score values were obtained using the World Health Organization Anthroplus software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI 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) [16].

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 identical 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 as “too/little thin” and “a little fat” and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

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

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

The Stunkard's silhouettes[17] were also used to assess body image perception in children and this was also administered in the classroom. In order to make comparisons with the body weight perception questions, the nine images were regrouped to reflect the 3 categories of weight status as underweight, normal and overweight. The agreement between the perceived visual image and the body weight perception obtained by questions of current weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement between underweight/fat and normal, and a moderate agreement between both the extremes of weight (underweight versus overweight) was seen. There were no gender differences in agreement. Parental perceptions of the body weight were assessed using structured questions only, and since this was available both for the parent and the child, further analyses were done using the questions only.

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). The response rate (of a total of 1907 children) was 98.3%; socio-demographic (age, gender, medium of instruction) characteristics between the responders and non responders were comparable.

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 (the adolescent period)[18], 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 eight groups were formed. As there were no children who were underweight but were perceived either by themselves or their parents to be overweight, this category was not considered.

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

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

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

The referent group was the N/N group.

The association between attempting weight loss with various socio-demographic factors as well with the above eight groups was evaluated using the Chi-square test and the unadjusted odds ratio reported. Association between attempt to lose weight and child's actual weight status, child's and parent's perception of child's weight status and the above mentioned eight groups were done using Chi square test stratified by age and gender. Binary logistic regression was performed to identify the factors associated with attempted weight loss adjusted for socio-demographic variables of age, gender, medium of instruction, parent's education and current actual body weight status, child's and parent's perceived and desired weight status of the child as model 1. In addition, a model (model 2) adjusted only for age, sex, medium of instruction, actual weight status and the child's weight perception was performed. Binary logistic regression was also performed to identify the factors associated with attempting to lose weight (Yes/No) based on the 8 groups (details above) 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 perceived them to be underweight attempted to lose weight. Correlations between actual weight status of the child, child's or parent's perception of child's weight status, as well as child's and parent's perceptions on desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$) (Supplementary table 1) indicating a low to moderate correlation between these variables.

Among the socio-demographic factors (Table 1, Model 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 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental perception of weight status, however, did not have a significant impact on children attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys. Otherwise, the findings were similar to Model 1.

A stratified analysis based on age and gender (Supplementary table 2) was also done. While the groups were largely similar in terms of attempting to lose weight, significant differences were observed only among those children who were actually underweight as well as those who perceived themselves to be underweight. In these children, the prevalence of attempting to lose weight was significantly higher in older boys compared to older girls. Similarly, there

was a significantly higher prevalence of younger girls attempting to lose weight compared to older girls, but not between younger and older boys.

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

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

DISCUSSION:

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

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

In general, 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. Clearly, perceptions influence their decision to try to lose weight. This finding is similar to studies conducted in other countries [9, 19, 21]. Unless individuals or their families perceive their weight status correctly, their acceptance of programmes designed to encourage healthy weight may be low [12].

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

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

Included in our sample were children as young as 8 years of age. However, body dissatisfaction with increasing weight status was established even by the age of 5 in both boys and girls of South Asian origin in UK[2] . Irrespective of whether they were below or 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

contrary to the findings elsewhere, as for instance, the NHANES study [11], which indicated that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender differences in our study may, in part, be due to the relatively low prevalence of overweight or obesity.

It is encouraging that 46 % children indicated exercise their preferred choice of weight loss. Differences in the methods used to lose weight between overweight, normal and underweight children were not apparent unlike other studies where unhealthier weight loss methods like skipping meals are reported more in overweight or obese children compared to normal weight children [22]. However, an effect of social desirability cannot be discounted, given that exercise as a healthy lifestyle choice is promoted early in the school curriculum

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

Strengths and limitations: This is the first study to report perceptions of body weight in India in relation to weight loss attempts. A major strength of this study is that measured heights and weights rather than self-reported, were used and the study sample encompassed children of diverse socio-economic strata, from rural and urban areas and of a large body weight range. However, with the cross-sectional study design used in this study, the changes in perception as the children grow cannot be accounted for. Longitudinal evaluation of these children will allow us to establish causal links between weight perception and weight loss behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of the questionnaire were limitations as information regarding the frequency, duration, and intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or past) at which such behaviours occurred could not be obtained. Data on the reliability and validity of the questionnaire are not available for this population. With the question asked on attempt to lose weight being dichotomous, there is a possibility that a child who is currently normal weight may report weight loss behaviours because they were overweight in the past. The small numbers of children in each category in the analysis stratified by actual and perceived weight status necessitates further exploration with larger numbers of children in each category. A further limitation is that we have not collected data on attempt to gain weight.

Overall, perceptions of weight status influenced the decision of children to lose weight. This needs to be further explored as a longitudinal study to establish causal links. However, regardless of weight status, many children did resort to weight loss. Public health campaigns should emphasize healthy weight management rather than weight loss.

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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			
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 7th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7th	400 (36%)	727 (65%)	1		1			
Education of father (Standard)									
	Up to 7th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7th	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 (0.40 – 0.67)	<0.001	0.71 (0.51 – 0.98)	0.04	0.66 (0.50 – 0.86)	0.002
Overweight	125 (73%)	47 (27%)	4.96 (3.43 – 7.20)	<0.001	4.38 (2.64 – 7.28)	<0.001	3.86 (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 (0.48 – 0.77)	<0.001	0.67 (0.49 – 0.93)	0.01	0.64 (0.49 – 0.82)	<0.001
A little /Too fat	195 (68%)	91 (32%)	4.48 (3.35 – 6.00)	<0.001	2.91 (1.95 – 4.34)	<0.001	3.48 (2.57 – 4.69)	<0.001
Normal	318 (32%)	665 (68%)	1		1			
Child's desire to be								
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76 (0.58 – 0.98)	0.03	0.84 (0.59 – 1.20)	0.35		
Slightly/Much thinner	260(52%)	237 (48%)	2.53 (2.00 – 3.19)	<0.001	1.56 (1.14 – 2.15)	0.006	-	-
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 (0.38 – 0.71)	<0.001	0.76 (0.52 – 1.12)	0.15	-	-
A little /Too fat	95 (54%)	82 (46%)	2.20 (1.58 – 3.08)	<0.001	0.86 (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 (0.41- 0.72)	<0.001	0.75 (0.52 – 1.07)	0.11	-	-
Slightly /Much thinner	170 (56%)	134 (44%)	2.61 (1.98 – 3.46)	<0.001	1.79 (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

† 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.

Figure Legends:

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/U- normal by actual measurements/perceived by child/parent to be underweight, 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, O/U: overweight by actual measurements/child's or parent's perception of being underweight.

Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category based on actual weight status and children and parent's perception of child's body weight. UW – Underweight, OW – Overweight

Figure 3: Actual weight status and weight loss practices of children

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

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

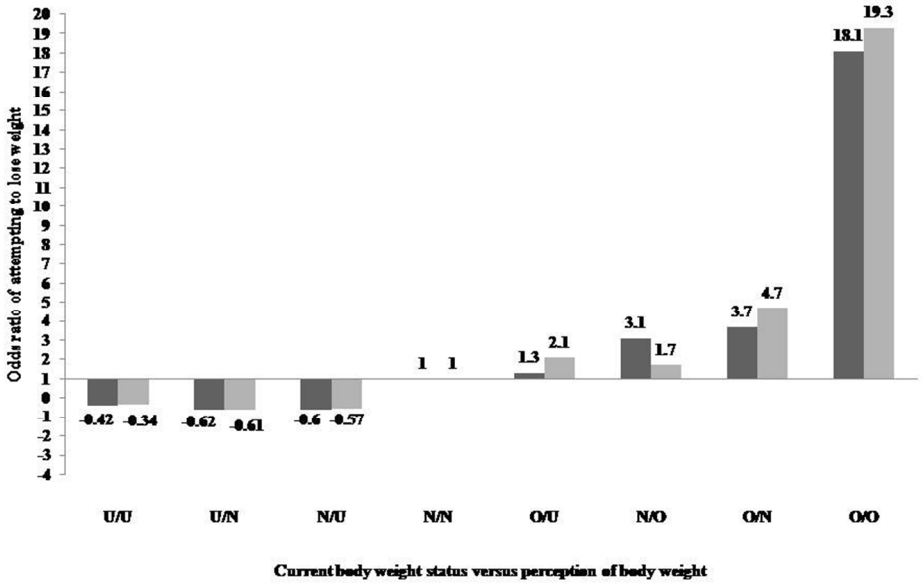
Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	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	*Not applicable*
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.

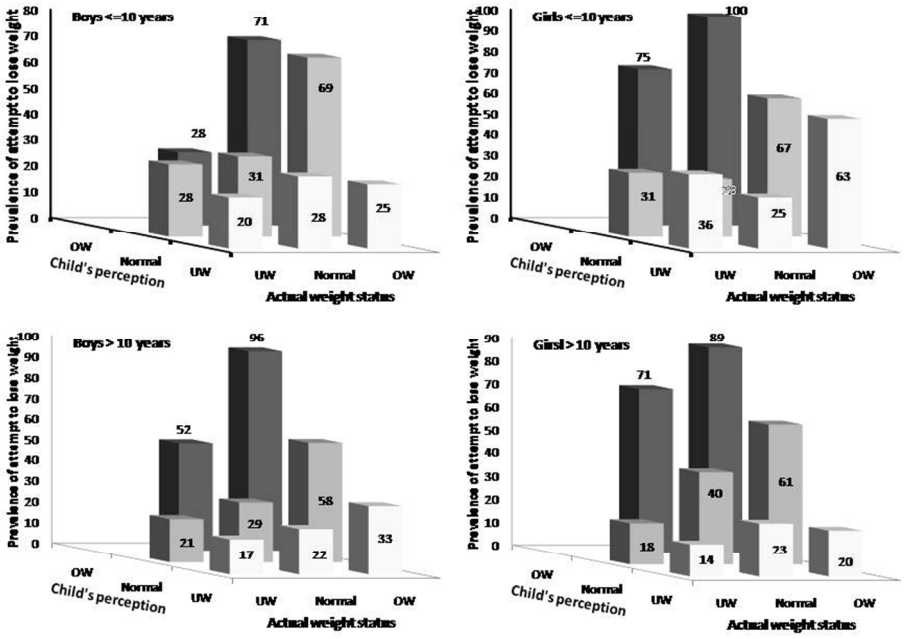
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, 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.

FIGURE1: 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



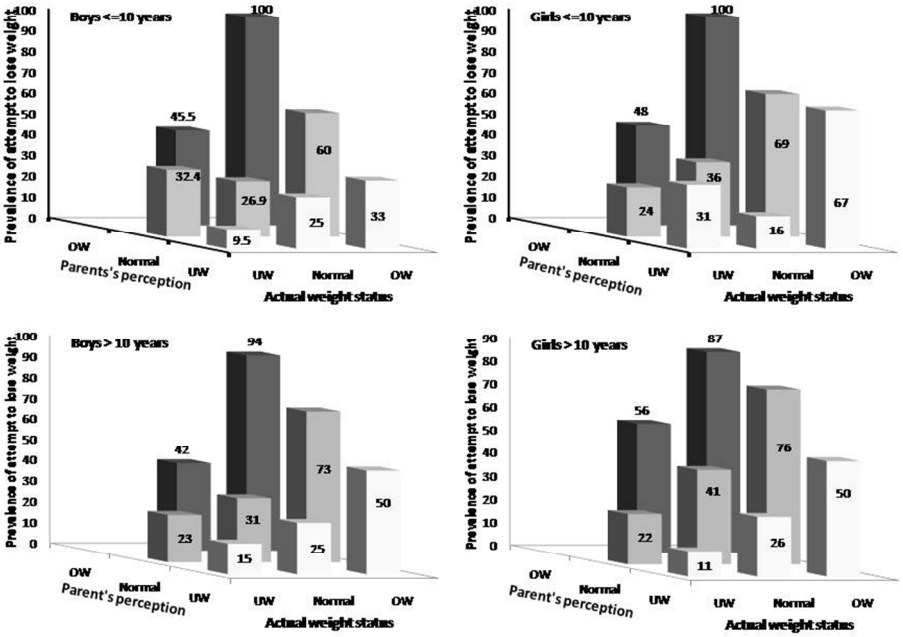
254x190mm (96 x 96 DPI)

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



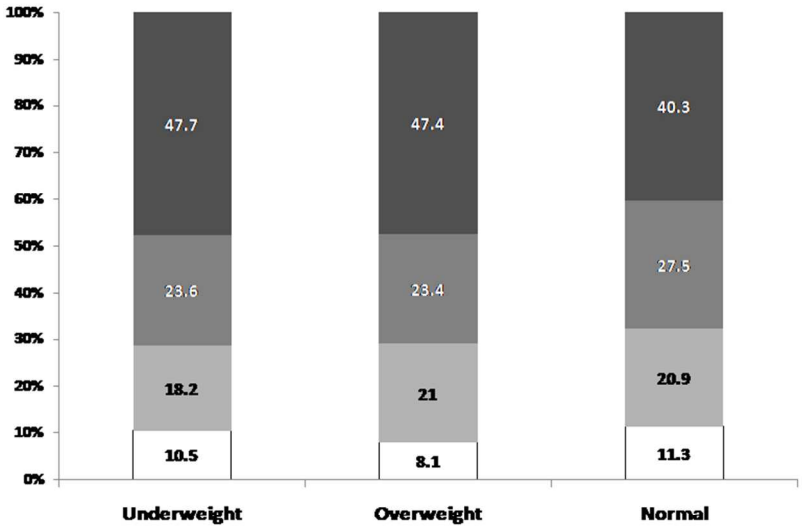
254x190mm (96 x 96 DPI)

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



254x190mm (96 x 96 DPI)

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



254x190mm (96 x 96 DPI)

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

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

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Keywords:	Community child health < PAEDIATRICS, PUBLIC HEALTH, EPIDEMIOLOGY, Cross Sectional Study, INDIA

ASSOCIATIONS BETWEEN BODY WEIGHT PERCEPTION AND WEIGHT CONTROL BEHAVIOR IN SOUTH INDIAN CHILDREN– A CROSS-SECTIONAL STUDY

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

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 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.

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.

INTRODUCTION:

Body image is a psycho-social dimension of body size that encompasses both perceptual and attitudinal factors [1] and has been associated with eating disorders[1, 2]. In recent years, its association with overweight and obesity has been described [3]. It is recognised that individuals make decisions on lifestyle behaviours based on body weight perceptions (a dimension of body image) [1, 4]. In India, there is a large burden of under-nutrition alongside increasing overweight and obesity [4]. 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 [5-10]. 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 [11, 12]. Perceptions of body weight are, in part, influenced by external factors including cultural norms and social preferences as it has been observed that Asian women have less body dissatisfaction than other ethnic groups [13]. In India, it is often believed that an overweight person is wealthier and happier and reflects social mobility to a higher status compared to an underweight person, although there are no studies to corroborate this. 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 beauty[14]. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures [6]. 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 [7, 15].Analysis of data from the National Health and Nutrition Examination Survey (NHANES) [16] and the Youth Risk Behaviour Surveillance Survey (YRBSS) [14, 17] 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 and age were significant factors associated with current attempts to lose weight [15].

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 [5, 7, 14, 16] with a few on ethnic minorities, including South Asians [3, 10]. The present analysis aims to examine the associations between the actual weight status, body weight perceptions of both children and their parents, and body weight satisfaction with weight loss intentions. The study sample included a wide range of body weights to reflect the dual burden of under-nutrition and overweight/obesity that India currently faces.

METHODS:

Study population:

A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-economic status located in rural areas, towns in Karnataka and urban Bangalore in South India, were contacted at baseline out of which 1907 (91.6%) children participated in a longitudinal study on body image perceptions and growth indices of school children, details of which are published earlier [18]. Convenience sampling of 7 city and non-city (rural and small towns) co-educational, non-residential schools was employed, such that children representing various socio-economic statuses (based on school fees linked to medium of instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and 2 in Bangalore city. The schools in which Kannada, the regional state language, was the language of instruction, received government support and had annual tuition fees of Rs.250 to 500 whereas English medium schools did not receive government support and had annual tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an indicator of socio-economic status (SES). Three schools (1 each in a village, small town and city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small towns and 1 in the city) had English as the medium of instruction.

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

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

Measurements:

Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was measured in school uniforms but without shoes using a calibrated digital scale (Home Health, Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were made using a standardized protocol. Body mass index (BMI) was computed and the BMI-for-age Z score values were obtained using the World Health Organization Anthroplus software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI 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) [19].

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 identical 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 as “too/little thin” and “a little fat” and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

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

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

The Stunkard's silhouettes [20] were also used to assess body image perception in children and this was also administered in the classroom. In order to make comparisons with the body weight perception questions, the nine images were regrouped to reflect3 categories of weight status: underweight, normal and overweight. The agreement between the perceived visual image and the body weight perception obtained by questions of current weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement between underweight/fat and normal, and a moderate agreement between both the extremes of weight (underweight versus overweight) was seen. There were no gender differences in agreement. Parental perceptions of the body weight were assessed using structured questions, and since this was available for both parent child; further analyses was done using only the questions.

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). The response rate (of a total of 1907 children) was 98.3%; socio-demographic (age, gender, medium of instruction) characteristics between the responders and non responders were comparable.

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 (the adolescent period)[21], 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 eight groups were formed. As there were no children who were underweight but were perceived by either themselves or their parents to be overweight, this category was not considered.

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

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

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

The referent group was the N/N group.

The association between the various socio-demographic factors as well with the above eight groups and attempt to lose weight was evaluated using the Chi-square test and the unadjusted odds ratio are reported. Association between attempt to lose weight and child's actual weight status, child's and parent's perception of child's weight status and the above mentioned eight groups were done using Chi square test stratified by age and gender. Binary logistic regression was performed to identify the factors associated with attempted weight loss adjusted for socio-demographic variables of age, gender, medium of instruction, parent's education and current actual body weight status, child's and parent's perceived and desired weight status of the child as model 1. In addition, a model (model 2) adjusted only for age, sex, medium of instruction, actual weight status and the child's weight perception was performed. Binary logistic regression was also performed to identify the factors associated with attempting to lose weight (Yes/No) based on the 8 groups (detailed above) 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 perceived them to be underweight attempted to lose weight. Correlations between actual weight status of the child and the child's or parent's perception of the child's weight status, as well as the child's and parent's perceptions of desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$) (Supplementary table 1) indicating a low to moderate correlation between these variables.

Among the socio-demographic factors (Table 1, Model 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 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental perception of weight status, however, did not have a significant impact on children attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys. Otherwise, the findings were similar to Model 1.

A stratified analysis based on age and gender (Supplementary table 2) was also done. While the groups were largely similar in terms of attempting to lose weight, significant differences were observed only among those children who were actually underweight as well as those who perceived themselves to be underweight. In these children, the prevalence of attempting to lose weight was significantly higher in older boys compared to older girls. Similarly, there

was a significantly higher prevalence of younger girls attempting to lose weight compared to older girls, but not between younger and older boys.

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

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

DISCUSSION:

In concurrence with the findings of our study, misperception of weight status among children has been reported in other studies conducted in the United States of America, with perceptions differing between various ethnic groups. Among African American adolescents, one-third perceived their weight status inaccurately[7]. Racial or ethnic differences in weight perception have been reported [5, 7, 8], where Caucasians were more likely than African Americans to perceive themselves as overweight [5, 7, 9]. However, this has not been a universal finding, as for instance in multi-ethnic adolescents in the United Kingdom [14].

Perceptions, however, were also associated with their decision to attempt weight loss, notwithstanding their current weight status.

In general, 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.. This finding is similar to studies conducted in other countries [7, 8, 22]. Unless individuals or their families perceive their weight status correctly, their acceptance of programmes designed to encourage healthy weight may be low [17].

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

The fact that there were reported weight loss attempts even in the underweight group suggests that factors other than weight status and weight perception are operative. This is corroborated by the higher odds of children from Kannada medium schools, who belong to a relatively lower socio-economic status compared to children from English medium schools (higher SES) trying to lose weight. Thus socio-cultural factors may be associated with their decision to lose weight. This could be linked to the continuous exposure to images and unrealistic body shapes that encourage weight loss regardless of body weight[8]. These factors must be further explored so that suitable programmes that encourage overweight children but not underweight or normal children to lose weight are planned.

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

contrary to the findings elsewhere, as for instance, the NHANES study [16], which indicated that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender differences in our study may, in part, be due to the relatively low prevalence of overweight or obesity.

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

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

Strengths and limitations: This is the first study to report perceptions of body weight in India in relation to weight loss attempts. A major strength of this study is that measured heights and weights rather than self-reported, were used and the study sample encompassed children of diverse socio-economic strata, from rural and urban areas and of a large body weight range. However, with the cross-sectional study design used in this study, the changes in perception as the children grow cannot be accounted for. Longitudinal evaluation of these children will allow us to establish causal links between weight perception and weight loss behaviours. Both the fact that the study was cross-sectional in nature, as well as the design of the questionnaire were limitations as information regarding the frequency, duration, and intensity of weight loss efforts, or time-sequence of events, that is, the time (recent/current or past) at which such behaviours occurred could not be obtained. Data on the reliability and validity of the questionnaire are not available for this population. With the question asked on attempt to lose weight being dichotomous, there is a possibility that a child who is currently normal weight may report weight loss behaviours because they were overweight in the past. The small numbers of children in each category in the analysis stratified by actual and perceived weight status necessitates further exploration with larger numbers of children in each category. A further limitation is that we have not collected data on attempt to gain weight.

Overall, perception of weight status was associated with the decision of children to lose weight. This needs to be further explored as a longitudinal study to establish causal links. However, regardless of weight status, many children did resort to weight loss. Public health 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 at 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			
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 7th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7th	400 (36%)	727 (65%)	1		1			
Education of father (Standard)									
	Up to 7th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7th	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 (0.40 – 0.67)	<0.001	0.71 (0.51 – 0.98)	0.04	0.66 (0.50 – 0.86)	0.002
Overweight	125 (73%)	47 (27%)	4.96 (3.43 – 7.20)	<0.001	4.38 (2.64 – 7.28)	<0.001	3.86 (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 (0.48 – 0.77)	<0.001	0.67 (0.49 – 0.93)	0.01	0.64 (0.49 – 0.82)	<0.001
A little /Too fat	195 (68%)	91 (32%)	4.48 (3.35 – 6.00)	<0.001	2.91 (1.95 – 4.34)	<0.001	3.48 (2.57 – 4.69)	<0.001
Normal	318 (32%)	665 (68%)	1		1			
Child's desire to be								
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76 (0.58 – 0.98)	0.03	0.84 (0.59 – 1.20)	0.35		
Slightly/Much thinner	260(52%)	237 (48%)	2.53 (2.00 – 3.19)	<0.001	1.56 (1.14 – 2.15)	0.006	-	-
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 (0.38 – 0.71)	<0.001	0.76 (0.52 – 1.12)	0.15	-	-
A little /Too fat	95 (54%)	82 (46%)	2.20 (1.58 – 3.08)	<0.001	0.86 (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 (0.41- 0.72)	<0.001	0.75 (0.52 – 1.07)	0.11	-	-
Slightly /Much thinner	170 (56%)	134 (44%)	2.61 (1.98 – 3.46)	<0.001	1.79 (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

† 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.

Figure Legends:

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/U- normal by actual measurements/perceived by child/parent to be underweight, 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, O/U: overweight by actual measurements/child's or parent's perception of being underweight.

Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category based on actual weight status and children and parent's perception of child's body weight. UW – Underweight, OW – Overweight

Figure 3: Actual weight status and weight loss practices of children

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

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

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

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.

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.

INTRODUCTION:

Body image is a psycho-social dimension of body size that encompasses both perceptual and attitudinal factors [1] and has been associated with eating disorders[1, 2]. In recent years, its association with overweight and obesity has been described [3]. It is recognised that individuals make decisions on lifestyle behaviours based on body weight perceptions (a dimension of body image) [1, 4]. In India, there is a large burden of under-nutrition alongside increasing overweight and obesity [4]. 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 [5-10]. 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 [11, 12]. Perceptions of body weight are, in part, influenced by external factors including cultural norms and social preferences as it has been observed that Asian women have less body dissatisfaction than other ethnic groups [13]. In India, it is often believed that an overweight person is wealthier and happier and reflects social mobility to a higher status compared to an underweight person, although there are no studies to corroborate this. 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 beauty[14]. There are also reports that individuals in less socio-economically developed societies positively evaluate overweight and obese figures [6]. 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 [7, 15].Analysis of data from the National Health and Nutrition Examination Survey (NHANES) [16] and the Youth Risk Behaviour Surveillance Survey (YRBSS) [14, 17] 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 and age were significant factors ~~influencing~~ associated with current~~s~~ attempts to lose weight [15].

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 [5, 7, 14, 16] with a few on ethnic minorities, including South Asians [3, 10]. The present analysis aims to examine the associations between the actual weight status, body weight perceptions of both children and their parents, and body weight satisfaction with weight loss intentions. The study sample included a wide range of body weights to reflect the dual burden of under-nutrition and overweight/obesity that India currently faces.

METHODS:

Study population:

A total of 2083 school children aged 8 to 14 years from 7 schools of varying socio-economic status located in rural areas, towns in Karnataka and urban Bangalore in South India, were contacted at baseline out of which 1907 (91.6%) children participated in a longitudinal study on body image perceptions and growth indices of school children, details of which are published earlier [18]. Convenience sampling of 7 city and non-city (rural and small towns) co-educational, non-residential schools was employed, such that children representing various socio-economic statuses (based on school fees linked to medium of instruction) were recruited. Of these schools, 2 were located in villages, 3 in small towns and 2 in Bangalore city. The schools in which Kannada, the regional state language, was the language of instruction, received government support and had annual tuition fees of Rs.250 to 500 whereas English medium schools did not receive government support and had annual tuition fees of above Rs.6000. Hence the medium of instruction in schools was used as an indicator of socio-economic status (SES). Three schools (1 each in a village, small town and city) had Kannada as the medium of instruction while four schools (1 in a village, 2 in small towns and 1 in the city) had English as the medium of instruction.

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

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

Measurements:

Height was measured using a fibreglass tape without foot wear to 0.2 cm. Weight was measured in school uniforms but without shoes using a calibrated digital scale (Home Health, Model 8604, Dr. Morepen Lab, Hong Kong) to the nearest 100 gm. All measurements were made using a standardized protocol. Body mass index (BMI) was computed and the BMI-for-age Z score values were obtained using the World Health Organization Anthroplus software version 1.0.2 (WHO, Geneva, Switzerland). Children were then categorized by actual weight status as overweight (>+1 SD), normal (< -2 to +1) and underweight (< -2 SD). These values at 19 years of age, at +1 standard deviation (SD) correspond to the BMI 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) [19].

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 identical 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 as “too/little thin” and “a little fat” and ‘very fat’ were combined as “a little/too fat” and “normal” remained “normal”.

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

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

The Stunkard's silhouettes [20] were also used to assess body image perception in children and this was also administered in the classroom. In order to make comparisons with the body weight perception questions, the nine images were regrouped to reflect ~~the~~ 3 categories of weight status~~:~~ ~~as~~ underweight, normal and overweight. The agreement between the perceived visual image and the body weight perception obtained by questions of current weight status, evaluated using kappa statistics ranged from 0.23 to 0.53. A fair agreement between underweight/fat and normal, and a moderate agreement between both the extremes of weight (underweight versus overweight) was seen. There were no gender differences in agreement. Parental perceptions of the body weight were assessed using structured questions ~~only~~, and since this was available ~~both~~ for both ~~the~~ parent ~~and the~~ child; further analyses ~~were~~ was done using only the questions ~~only.~~

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). The response rate (of a total of 1907 children) was 98.3%; socio-demographic (age, gender, medium of instruction) characteristics between the responders and non responders were comparable.

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 (the adolescent period)[21], 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 7^{th} grade and above 7^{th} 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 eight groups were formed. As there were no children who were underweight but were perceived ~~either~~ by either themselves or their parents to be overweight, this category was not considered.

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

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

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

The referent group was the N/N group.

The association between the various socio-demographic factors as well with the above eight groups and attempt to lose weight was evaluated using the Chi-square test and the unadjusted odds ratio are reported. Association between attempt to lose weight and child's actual weight status, child's and parent's perception of child's weight status and the above mentioned eight groups were done using Chi square test stratified by age and gender. Binary logistic regression was performed to identify the factors associated with attempted weight loss adjusted for socio-demographic variables of age, gender, medium of instruction, parent's education and current actual body weight status, child's and parent's perceived and desired weight status of the child as model 1. In addition, a model (model 2) adjusted only for age, sex, medium of instruction, actual weight status and the child's weight perception was performed. Binary logistic regression was also performed to identify the factors associated with attempting to lose weight (Yes/No) based on the 8 groups (detailed above) 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 perceived them to be underweight attempted to lose weight. Correlations between actual weight status of the child and the child's or parent's perception of the child's weight status, as well as the child's and parent's perceptions ~~on~~ of desired (ideal) body weight ranged from 0.12 to 0.31 ($p<0.01$) (Supplementary table 1) indicating a low to moderate correlation between these variables.

Among the socio-demographic factors (Table 1, Model 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 about 3 times more likely (AOR=2.91, 95% C.I: 1.95 to 4.34) to try to lose weight. Parental perception of weight status, however, did not have a significant impact on children attempting to lose weight. Children's (AOR=1.56, 95% C.I: 1.14 to 2.15) and parent's desire (AOR=1.79, 95% C.I: 1.25 to 2.58) for the child to be thinner also increased the likelihood of attempting to lose weight. Based on a simpler model (Model 2) the odds of attempting to lose weight was significantly higher among girls (1.37, CI: 1.11-1.70) compared to boys. Otherwise, the findings were similar to Model 1.

A stratified analysis based on age and gender (Supplementary table 2) was also done. While the groups were largely similar in terms of attempting to lose weight, significant differences were observed only among those children who were actually underweight as well as those who perceived themselves to be underweight. In these children, the prevalence of attempting

to lose weight was significantly higher in older boys compared to older girls. Similarly, there was a significantly higher prevalence of younger girls attempting to lose weight compared to older girls, but not between younger and older boys.

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

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

DISCUSSION:

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

universal finding, as for instance in multi-ethnic adolescents in the United Kingdom [14]. Perceptions, however, ~~also governed~~ were also associated with their decision to attempt weight loss, notwithstanding their current weight status.

In general, 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. ~~Perceptions were associated with their decision to try to lose weight~~. This finding is similar to studies conducted in other countries [7, 8, 22]. Unless individuals or their families perceive their weight status correctly, their acceptance of programmes designed to encourage healthy weight may be low [17].

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

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

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

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 contrary to the findings elsewhere, as for instance, the NHANES study [16], which indicated that girls were about 2 ½ times more likely to attempt to lose weight. The absence of gender differences in our study may, in part, be due to the relatively low prevalence of overweight or obesity.

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

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

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

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

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

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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			
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 7th	146 (34%)	278 (66%)	0.95 0.75 – 1.22	0.69	0.81 0.58 – 1.14	0.22	-	-
	> 7th	400 (36%)	727 (65%)	1		1			
Education of father (Standard)									
	Up to 7th	161 (39%)	256 (61%)	1.21 0.95 – 1.53	0.10	1.24 0.87-1.78	0.22	-	-
	> 7th	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 (0.40 – 0.67)	<0.001	0.71 (0.51 – 0.98)	0.04	0.66 (0.50 – 0.86)	0.002
Overweight	125 (73%)	47 (27%)	4.96 (3.43 – 7.20)	<0.001	4.38 (2.64 – 7.28)	<0.001	3.86 (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 (0.48 – 0.77)	<0.001	0.67 (0.49 – 0.93)	0.01	0.64 (0.49 – 0.82)	<0.001
A little /Too fat	195 (68%)	91 (32%)	4.48 (3.35 – 6.00)	<0.001	2.91 (1.95 – 4.34)	<0.001	3.48 (2.57 – 4.69)	<0.001
Normal	318 (32%)	665 (68%)	1		1			
Child's desire to be								
A lot /Slightly fatter	114 (25%)	347 (75%)	0.76 (0.58 – 0.98)	0.03	0.84 (0.59 – 1.20)	0.35		
Slightly/Much thinner	260(52%)	237 (48%)	2.53 (2.00 – 3.19)	<0.001	1.56 (1.14 – 2.15)	0.006	-	-
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 (0.38 – 0.71)	<0.001	0.76 (0.52 – 1.12)	0.15	-	-
A little /Too fat	95 (54%)	82 (46%)	2.20 (1.58 – 3.08)	<0.001	0.86 (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 (0.41- 0.72)	<0.001	0.75 (0.52 – 1.07)	0.11	-	-
Slightly /Much thinner	170 (56%)	134 (44%)	2.61 (1.98 – 3.46)	<0.001	1.79 (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

† 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.

Figure Legends:

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/U- normal by actual measurements/perceived by child/parent to be underweight, 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, O/U: overweight by actual measurements/child's or parent's perception of being underweight.

Figure 2a and 2b: Prevalence of attempting to lose weight by gender and age category based on actual weight status and children and parent's perception of child's body weight. UW – Underweight, OW – Overweight

Figure 3: Actual weight status and weight loss practices of children

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

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

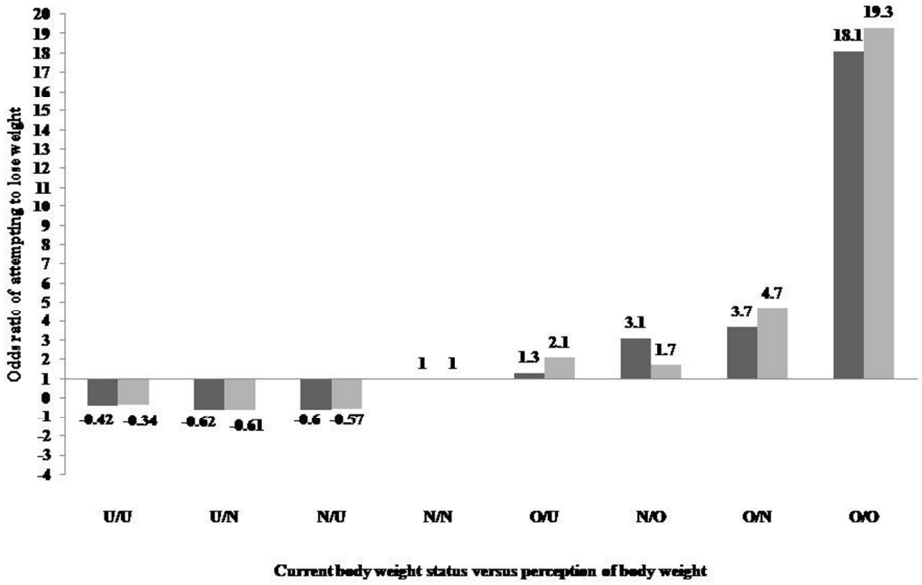
Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	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	*Not applicable*
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.

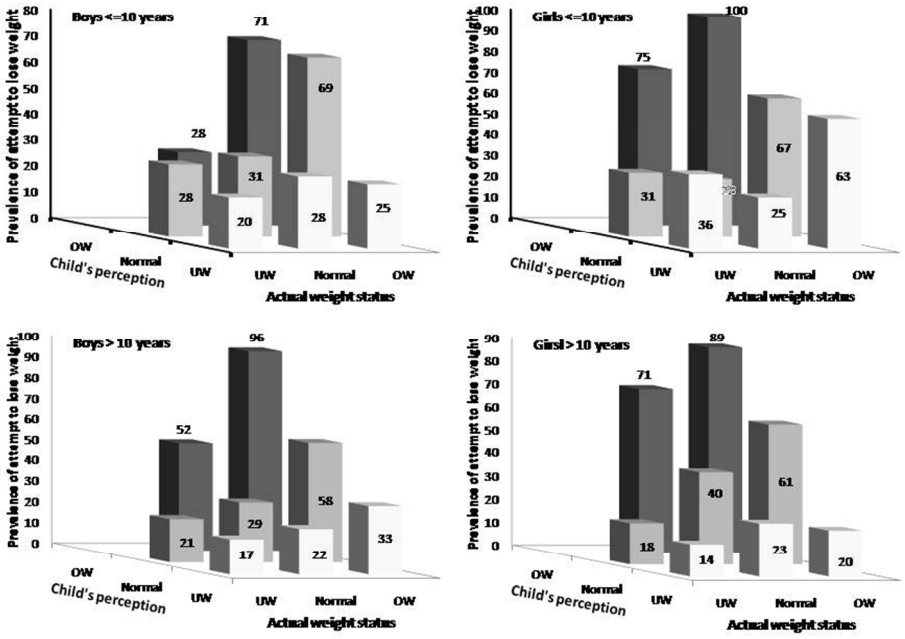
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, 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.

FIGURE1: 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



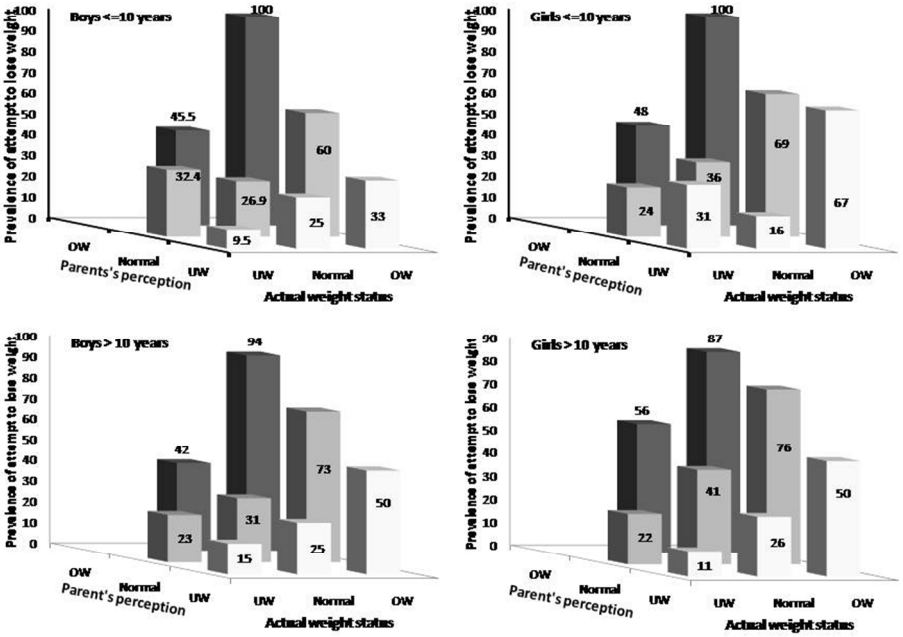
254x190mm (96 x 96 DPI)

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



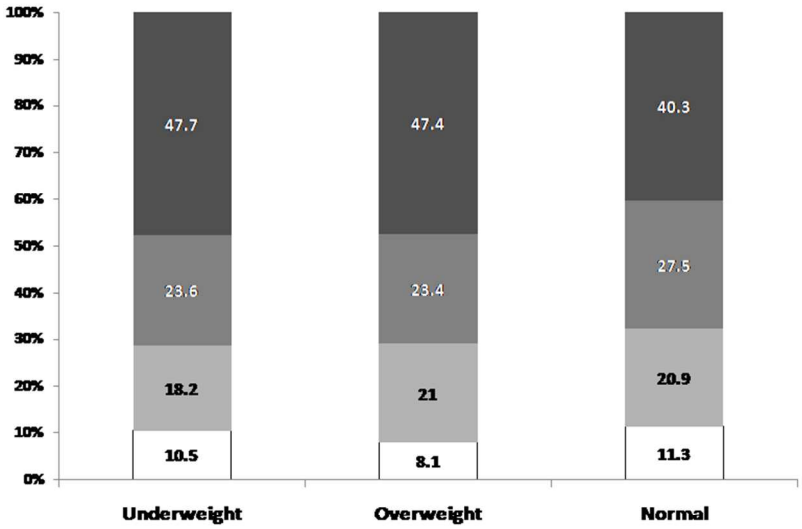
254x190mm (96 x 96 DPI)

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



254x190mm (96 x 96 DPI)

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



254x190mm (96 x 96 DPI)

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 **Yes**	**No**	Unadjusted OR 95% C.I.	P value*	Adjusted† OR 95% C.I.	P value‡
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 Yes	No	Unadjusted OR 95% C.I.	P Value*	Adjusted † OR 95% C.I.	P value‡
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