

Predictors of Maternal Perceptions of their Offspring's Weight Status During Adolescence: Evidence from the Mater-University of Queensland Study of Pregnancy Cohort

Abdullah A Mamun^{1*}, Brett M McDermott², Munim Mannan¹, Michael J O'Callaghan³, Jake M Najman¹ and Gail M Williams¹

¹School of Population Health, University of Queensland, Brisbane, Australia

²Kids in Mind Research: The Mater Centre for Service Research in Mental Health and Department of Psychiatry, University of Queensland, Brisbane, Australia

³Child Development and Rehabilitation Services, Mater Children's Hospital, University of Queensland, Brisbane, Australia

Abstract

We examined the predictors of maternal perceptions on their adolescent offspring's weight status. A mother-child linked analysis was carried out using 14 years follow-up data from a population-based prospective birth cohort of 3721 children (52% males) who born in Brisbane, Australia, between 1981 and 1983. Maternal perception of offspring weight was reported when the offspring were 14 years old and predictors were prospectively. We found that mothers perceived their adolescents' sons were more underweight and less overweight than their daughters. The independent predictors of maternal perceptions of child overweight status were gender, maternal perceived child dissatisfaction of appearance, shape, size and weight, adolescent dieting to lose weight, their general health status, sports and maternal BMI. Mainly two factors- child health and dieting predict maternal perception of offspring underweight. This study found more child factors than family or maternal factors predict maternal perceptions of their offspring weight status. The finding that child factors are related to maternal perception should be helpful to clinicians as it suggests understanding adolescent and maternal perceptions of weight will best be achieved by a focus on current adolescent body image, dieting, behavioural problems, and parental weight status.

Keywords: Perception; Adolescents; Body weight; Diet

Introduction

The prevalence of overweight and obesity are at epidemic level [1] and to date most of the interventions or treatments have had limited long-term effectiveness [2,3]. There is a consistent argument that prevention of overweight and obesity should start from early life and intervention programs are more successful with parental involvement [4,5]. Therefore, parental recognition, especially mother, of their children's weight status may be important to motivate help seeking behaviour and if appropriate facilitate intervention strategies early in life. Studies suggest that clinically defined weight categories (e.g. normal, overweight or obese) of children differ from the parental perceived weight of their children [6-8]. Recent studies, including in the United States, Australia and United Kingdom, have found that parents tend to underestimate the weight status of their overweight or obese child [9-16]. Parental weight status estimation was less accurate for younger children and for sons [14]. There was also a trend for under-estimation seen more often in mothers who themselves were heavier [14,17,18].

These studies consistently found that some parents perceived their offspring's weight status to be different from observed weight. There is speculation that weight perception rather than measured weight status per se is causally related to depressive symptoms [19] because obese people experience weight-related stigma, which eventually could lead to the stances of distress and depression. Few studies, including our recent study [20], supported this hypothesis by finding stronger associations between overweight perception and depressive symptoms compared with actual overweight status and depressive symptoms [19-22]. Research is warranted to better understand factors predicting parental perceptions of their child's weight status. If our intention is to promote early help seeking behaviour by parents, including increased parent motivation to change then knowing what predicts parental perceptions of their offspring weight status and reducing the gap between subjective and objective differences of overweight and obesity is crucial.

This study is an extension of a previous study [7], where we examined the extent of misclassifications and the possible predictors of the maternal misclassifications of their offspring weight status. Using the similar set of predictors and methodology, the aim of this study was to identify the predictors of maternal perceptions of their child's weight status, using a cohort of Australian adolescents.

Methods

The study

The data used for this study were from the Mater-University of Queensland Study of Pregnancy and its Outcomes (MUSP). MUSP is a prospective study of 7223 mother-offspring pairs. Participant mothers received antenatal care at their First Clinic Visit (FCV) around 18 weeks of gestation at a major public hospital in Brisbane between 1981 and 1983 and delivered a live singleton child who was not adopted out before leaving hospital [23]. Both mother-offspring pairs have been followed-up prospectively with maternal questionnaires being administered when their children were 3-5 days, 6 months, 5 and 14 years. In addition, at the 5 and 14 year follow-up detailed physical, cognitive and developmental examinations of the children were undertaken and at 14 years the children completed a questionnaire with health, socio-demographic and lifestyle questions. Participants gave signed informed consent for their participation and that of their

*Corresponding author: Abdullah Al Mamun, Associate Professor, School of Population Health, Herston Rd, Herston, QLD 4006, Australia, Fax: +61(0)733655599; Tel: +61(0)733464689; E-mail: mamun@sph.uq.edu.au

Received April 30, 2012; Accepted May 22, 2012; Published May 24, 2012

Citation: Mamun AA, McDermott BM, O'Callaghan MJ, Najman JM, Williams GM (2012) Predictors of Maternal Perceptions of their Offspring's Weight Status During Adolescence: Evidence from the Mater-University of Queensland Study of Pregnancy Cohort. J Obes Wt Loss Ther 2:133. doi:10.4172/2165-7904.1000133

Copyright: © 2012 Mamun AA, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

children. Full details of the study participants and measurements have been previously reported [23,24].

In this paper, we examined the predictors of maternal perceptions of child weight status. Data are restricted to the 3721 mother-offspring pairs for whom we had recorded maternal perceptions on their offspring weight at 14-years follow-up. Non-participants were more likely to be from families with low income at birth, to have mothers who smoked throughout their pregnancy and to have mothers and fathers with lower educational attainment [24,25].

Measures

Outcomes: The main outcome of interest of this study was maternal perception on their offspring's overweight status. At 14 years follow-up, mothers were asked to complete the statement "Do you think your child is..." by giving 1 of 5 possible responses: "very underweight", "slightly underweight", "about the right weight", "slightly overweight" or "very overweight". In the analysis of maternal perception of child weight status, the 5 categories are collapsed into 3 categories because of small numbers of the two extreme categories. The mothers who answered very or slightly underweight were classified as believing that their child was underweight, and those who responded very or slightly overweight were classified as believing their child was overweight. Mothers answering at about the right weight were classified as believing their child was neither underweight nor overweight.

Predictors and confounders: The selection of potential factors at different follow-ups of the study were based on identification of studies examining self reporting bias for height, weight, BMI [26,27] and our previous study [7] where we identified predictors of maternal misclassifications of offspring overweight status. These factors are, at FCV, maternal age (three categories 13-19, 20-29 and 30 or more years), maternal educational attainment (did not complete secondary school, completed secondary school, completed further/higher education) and parental racial origin (Caucasian, Asian and Aboriginal-Islander) were obtained from questionnaires at the FCV and obstetric records in the study. Maternal measured height and self-reported pre-pregnancy weight were obtained at the study initiation. A high degree of correlation was obtained between maternal estimate of her pre-pregnancy weight and her measured weight on the FCV (Pearson's correlation coefficient = 0.95). We defined three BMI categories (normal, overweight and obese) for the mother based on the World Health Organization guidelines (1998) [28]. Factors from FCV to 14 years follow-up measured consistently were maternal depression (using Bedford and Fould's [29]. Delusions Symptoms States Inventory, the experience of four or more symptoms was used to define those who were depressed). Combining all follow-ups, a composite indicator of maternal depression over 14 years of follow-up was generated with two categories: (1) not depressed at any follow-ups or (2) at least one episode of depression. A composite indicator of maternal tobacco consumption based on prospectively collected maternal smoking status (non-smokers or smoked at least one cigarette per day at each follow-up) was categorized as never smoked (reported non-smoker at each follow-up), smokers (consistently reported smoked at least one cigarettes at each follow-up) and otherwise ex-smokers.

A 5 and 14 years follow-up child behavioral problems were prospectively assessed from maternal reports of child behavior using Achenbach's child behavior check list (CBCL) [30] at age 5 and 14.

We refer to those with scores above one standard deviation (1SD) of the mean score as having behavioral problems. Based on this cut-off the CBCL was categorized into four mutually exclusive groups: (a) no behavioral problems (<1SD on the CBCL) at ages 5 and 14; (b) early remitter (>1SD percentile on the CBCL) at age 5 but normal at 14; (c) adolescent onset – normal at age 5 but had problems at 14 years and (d) persistent problems at ages 5 and 14 years. Change in gross-family income from ages 5 to 14 years: poor if income ≤A\$ 15548/year at 5 years follow-up and income ≤\$ 20799/year at 14 years follow-up; rich if income >26000/year at 5 years follow-up and ≥\$ 31149/year at 14 years follow-up, otherwise middle income.

At 14 years follow-up, mothers were asked how often their child was dissatisfied about their personal appearance, body shape, body size and weight, each having the response options "often", "sometimes", "rarely" and "never". Combining the four items a composite indicator (standardized alpha coefficient = 0.92) was generated with the lower quintile of scores being used to indicate children most dissatisfied (i.e. low score indicates most dissatisfaction) with their appearance, shape, size and weight. Adolescent's BMI (weight in kg/height in meter²) at the 14-year follow-up was calculated from the measured weight and height. In all assessments, the average of two measures of the participant's weight, with the participant wearing light clothing, with a scale accurate to 0.2 kg was used. A portable stadiometer was used to measure height.

Adolescent's were asked "How often do you go on a diet to lose weight?" with four options 'most of the time', 'a few times a year', 'rarely' or 'never'. For the purpose of analysis, the first two categories are combined into one category to increase the frequencies in this group. Maternal and child self-reported general health status was categorized as excellent, good and fair/poor. Change in marital status (no change, 1 to 2 changes and 3 or more changes during last 7 years) was used to assess the family stability. The Parent-Adolescent Communication Scale [31] was used to assess mother-child communication at adolescence. Maternal report of the amount of time the child spent watching television (<1 hour per day, 1 to <3 hours per day, 3 to <5 hours per day and 5 or more hours per day), time spent on sports or exercise (4-7 days per week; 0-3 days per week), as well as the family attitude to having meals together (at least once a day, few times/once/less than once a week) were considered as predictors.

Statistical Analysis

The associations of maternal perceptions with maternal, child and family characteristics are assessed using Chi-square tests. Those factors appeared statistically significant ($p < 0.05$) in bivariate analysis were included in the multivariable analysis. Multivariable associations were evaluated using multinomial logistic regression [32]. Finally, those factors remain statistically significant in the multivariable models were included in the final analyses (Table 1, Table 2). Statistical evidence for a difference in effect between males and females was assessed by computing a likelihood ratio test of the interaction with sex. As we found statistical evidence that the association for maternal perceptions of child weight status differ between the sexes ($p < 0.001$) and the difference was substantial, results are presented for males and females separately. All analyses were undertaken using Stata version 10.0 (Stata inc., Texas).

Results

Mothers perceived more boys than girls to be underweight (16.82% and 11.46%, respectively) and fewer boys than girls to be overweight

Factors at different time points of the follow-up	Maternal perception of their male offspring's (N=1695) weight status					
	N	Underweight		About the right weight (ref. ^o) (n=1014)	Overweight	
		UnadjOR ^o	AdjOR ^s		UnadjOR ^o	AdjOR ^s
		(n=236)			(n=247)	
Child dissatisfaction						
Least dissatisfaction (Upper 80%)	1295	1.00	1.00	1.00	1.00	1.00
Most dissatisfaction (lower 20%)	202	3.39 (2.28,5.05)	3.14 (2.07,4.77)	1.00	6.72 (4.70,9.61)	4.92 (3.25,7.44)
Child health						
Excellent	729	1.00	1.00	1.00	1.00	1.00
Good	759	1.42 (1.05,1.92)	1.29 (0.95,1.77)	1.00	2.09 (1.54,2.83)	1.85 (1.31,2.61)
Fair/poor	109	3.08 (1.83,5.16)	2.32 (1.33,4.03)	1.00	4.73 (2.87,7.77)	3.54 (1.93,6.50)
Child diet to lose weight						
Never	1157	1.00	1.00	1.00	1.00	1.00
Rarely	254	0.48 (0.28,0.81)	0.44 (0.26,0.76)	1.00	5.62 (4.04,7.82)	4.98 (3.48,7.13)
Most of the time or a few times a year	86	0.77 (0.32,1.86)	0.59 (0.23,1.46)	1.00	13.05 (8.00,21.39)	9.63 (5.58,16.61)
Child behavioral problems						
No behavioral problems at ages 5 and 14	1104	1.00	1.00	1.00	1.00	1.00
Adolescent onset – normal at age 5 but had problems at 14 years	128	2.17 (1.38,3.40)	1.58 (0.96,2.58)	1.00	1.46 (0.89,2.38)	0.71 (0.38,1.31)
Early remitter- problem at age 5 but normal at 14	164	1.22 (0.78,1.91)	1.15 (0.73,1.83)	1.00	0.94 (0.89,2.38)	0.85 (0.50,1.43)
Persistent problems at ages 5 and 14 years	101	1.46 (0.84,2.54)	1.28 (0.70,2.33)	1.00	1.68 (1.01,2.78)	0.72 (0.38,1.38)
Problem with family communication						
Few/some problems	1375	1.00	1.00	1.00	1.00	1.00
Many problems	122	1.26 (0.76,2.09)	0.92 (0.53,1.60)	1.00	1.65 (1.04,2.61)	1.16 (0.65,2.05)
Maternal BMI						
Underweight	123	1.60 (1.02,2.52)	1.61 (1.01,2.59)	1.00	0.82 (0.45,1.48)	0.91 (0.47,1.76)
Normal	1126	1.00	1.00	1.00	1.00	1.00
Overweight/obese	248	0.87 (0.57,1.33)	0.85 (0.55,1.32)	1.00	2.03 (1.46,2.84)	1.74 (1.18,2.58)
Sports						
Less than 3-days per week	581	1.00	1.00	1.00	1.00	1.00
Four or more days per week	916	0.77 (0.58,1.03)	0.81 (0.60,1.09)	1.00	0.44 (0.33,0.58)	0.49 (0.36,0.68)
Watching TV						
<1-hour per day	117	1.00	1.00	1.00	1.00	1.00
1 to <3-hours per day	407	0.72 (0.43,1.20)	0.74 (0.43,1.26)	1.00	2.81 (1.17,6.75)	2.76 (1.05,7.22)
3 to <5-hours per day	441	0.69 (0.41,1.16)	0.70 (0.41,1.22)	1.00	4.53 (1.91,10.70)	4.94 (1.91,12.74)
5 or more hours per day	532	0.79 (0.48,1.31)	0.76 (0.45,1.29)	1.00	3.68 (1.56,8.69)	3.62 (1.41,9.30)
Family meals together						
At least once a day	1187	1.00	1.00	1.00	1.00	1.00
Few times/once/ less than once a week	310	1.31 (0.94,1.83)	1.31 (0.93,1.86)	1.00	1.02 (0.72,1.44)	0.95 (0.63,1.42)

^oReference category

^oUnadjusted Odds Ratios estimated using multinomial logistic regression considering about the right weight as the reference

^sAdjusted Odds Ratios estimated using multinomial logistic regression considering about the right weight as the reference. Adjusted by all other factors listed in this table

Table 1: Multivariable analyses (N=1497) of maternal perceptions of their males offspring's weight status at age 14 years.

Factors at different time points of the follow-ups	Maternal perception of their male offspring's (N=1695) weight status					
	N	Underweight (n=149)		About the right weight (ref. ^o) (n=983)	Overweight (n=267)	
		UnadjOR ^o	AdjOR ^s		UnadjOR ^o	AdjOR ^s
Child dissatisfaction						
Least dissatisfaction (Upper 80%)	891	1.00	1.00	1.00	1.00	1.00
Most dissatisfaction (lower 20%)	508	1.34 (0.92,1.93)	1.48 (0.99,2.22)	1.00	5.51 (4.11,7.39)	3.54 (2.56,4.91)
Child health						
Excellent	640	1.00	1.00	1.00	1.00	1.00
Good	655	1.89 (1.30,2.74)	1.96 (1.33,2.88)	1.00	1.76 (1.31,2.36)	1.24 (0.89,1.72))
Fair/poor	104	3.39 (1.82,6.32)	3.63 (1.88,7.00)	1.00	4.06 (2.51,6.56)	2.35 (1.35,4.08)
Child diet to lose weight						
Never	703	1.00	1.00	1.00	1.00	1.00
Rarely	372	0.38 (0.23,0.62)	0.32 (0.19,0.54)	1.00	4.01 (2.75,5.86)	3.06 (2.04,4.60)
Most of the time or a few times a year	324	0.49 (0.29,0.83)	0.34 (0.19,0.59)	1.00	8.04 (5.54,11.67)	4.59 (3.05,6.91)
Child behavioral problems						
No behavioral problems at ages 5 and 14	1111	1.00	1.00	1.00	1.00	1.00
Adolescent onset – normal at age 5 but had problems at 14 years	120	2.07 (1.17,3.69)	1.77 (0.94,3.32)	1.00	3.47 (2.28,3.69)	2.19 (1.32,3.62)
Early remitter- problem at age 5 but normal at 14	121	1.08 (0.58,2.00)	1.02 (0.54,1.92)	1.00	1.21 (0.74,1.97)	1.17 (0.67,2.03)
Persistent problems at ages 5 and 14 years	47	1.09 (0.37,3.18)	0.66 (0.21,2.04)	1.00	2.92 (1.55,5.50)	1.65 (0.80,3.41)
Problem with family communication						
Few/some problems	1270	1.00	1.00	1.00	1.00	1.00
Many problems	129	1.54 (0.88,2.68)	1.37 (0.74,2.54)	1.00	1.86 (1.22,2.84)	0.74 (0.44,1.23)
Maternal BMI						
Underweight	134	1.28 (0.77,2.16)	1.03 (0.60,1.77)	1.00	0.41 (0.21,0.81)	0.63 (0.31,1.31)
Normal	1044	1.00	1.00	1.00	1.00	1.00
Overweight/obese	221	0.86 (0.49,1.50)	0.81 (0.46,1.44)	1.00	2.80 (2.03,3.88)	2.77 (1.92,4.00)
Sports						
Less than 3-days per week	799	1.00	1.00	1.00	1.00	1.00
Four or more days per week	600	1.16 (0.82,1.63)	1.22 (0.85,1.75)	1.00	0.52 (0.39,0.70)	0.58 (0.42,0.81)
Watching TV						
<1-hour per day	126	1.00	1.00	1.00	1.00	1.00
1 to <3-hours per day	440	0.73 (0.39,1.36)	0.83 (0.44,1.58)	1.00	1.04 (0.61,1.76)	0.91 (0.50,1.64)
3 to <5-hours per day	386	0.88 (0.47,1.63)	1.03 (0.54,1.96)	1.00	1.08 (0.63,1.84)	0.80 (0.44,1.47)
5 or more hours per day	447	0.85 (0.46,1.58)	1.00 (0.53,1.89)	1.00	1.17 (0.69,1.97)	0.94 (0.52,1.70)
Family meals together						
At least once a day	1047	1.00	1.00	1.00	1.00	1.00
Few times/once/ less than once a week	352	1.51 (1.04,2.19)	1.47 (1.00,2.17)	1.00	0.93 (0.68,1.28)	0.77 (0.53,1.10)

^oReference category

^oUnadjusted Odds Ratios estimated using multinomial logistic regression considering about the right weight as the reference

^sAdjusted Odds Ratios estimated using multinomial logistic regression considering about the right weight as the reference Adjusted by all other factors listed in this table

Table 2: Multivariable analyses (N=1399) of maternal perceptions of their females offspring's weight status at age 14 years.

(16.87% and 19.56%, respectively). The remaining children were described as 'about the right weight'.

In the bivariate analyses, the following child, maternal and family factors were associated with maternal perceptions of child weight status for adolescent boys and girls. Child factors included dissatisfaction with personal appearance, dieting to lose weight, general health and behavioral problems and their involvement in sports. Maternal and family factors were maternal attitude to having family meals together, maternal health status, and maternal pre-pregnancy BMI and family communication problems. However, in the fully adjusted model, factors independently associated with maternal perception of child weight status were child dissatisfaction with their personal appearance, child health, and behavioral problems, dieting to lose weight, child sports and maternal BMI and for boys, TV watching (Tables 1, Table 2). Maternal education, age, race, mental health, smoking status, change in marital status and family income were not associated with their perception of child's weight status.

Mothers who perceived their boys were most dissatisfied with appearance, shape, size and weight, were three folds (AdjOR 3.14; 95% CI: 2.07, 4.77) more likely to be underweight and nearly five folds (AdjOR 4.92; 95% CI: 3.25, 7.44) more likely to be overweight compared to mothers who perceived their boys were least dissatisfied (fully adjusted model, Table 1). Similarly, mothers who perceived their girls were most dissatisfied were nearly 1.48 (95%CI: 0.99, 2.22) times more likely to be underweight and 3.54 (95% CI: 2.56, 4.91) times more likely to be overweight (Tables 2). Those boys who reported they dieted to lose weight were five to ten times more likely to be perceived as overweight by their mother compared to their counterparts. Girls were three to four times more likely to be perceived as overweight by their mothers if they reported that they went for dieting. Those girls had experienced behavioral problems at 14 years but not age 5 years, were two fold more likely to be perceived as overweight. Boys who spent at least one hour of watching TV everyday were perceived by their mothers as two to three folds more likely to be overweight.

In the additional analyses, we found adolescents measured BMI was significantly associated with maternal perceptions of their adolescents weight status. However, inclusion of this variable in the adjusted model did not substantially alter the associations we presented in tables 1 and 2 (results are not shown since the inclusion of adolescents BMI reduced the sample substantially).

Discussion

In this mother-offspring link study in an Australian population, in relation to maternal perceptions of the child being overweight, we found five common factors (dissatisfaction, child health, diet, sports and maternal BMI) are in similar directions apart from dieting which is stronger in males and maternal overweight status which is stronger for females. Two factors TV watching and adolescent behavioral problems are associated differently. TV watching is positively associated with males but no association with females. Adolescent behavioral problems positively associated with females but no association with males. For maternal perception of the child been underweight two factors- child health and dieting are common. Early life, social, maternal mental health and maternal life style and other family factors considered in this analysis are not associated with maternal perceptions of their child overweight and underweight.

From a broader perspective, the predictors we found in this study are similar with our previous study where we identified six independent

predictors (gender, child dissatisfaction, dieting to lose weight, general health status, maternal BMI and family meals) of maternal misclassifications of their offspring's weight status [7]. Although these predictors are in similar direction in both studies, the strength of association (measured in odds ratios) is stronger for the predictors of maternal perceptions compared to maternal misclassifications. For example, the odds of child dissatisfaction ranges from 1.71 (AdjOR, Underweight) for females (Table 2) to 4.74 (AdjOR, Overweight) for males (Table 1), which was 1.35 for underestimation and 1.94 for overestimation, for male and female combined model in the previous study [7]. It is interesting child personal appearance dissatisfaction predictions both maternal underweight and overweight perception. Children voicing their dissatisfaction may place the issue "on the table". This factor may be necessary for the mother to form a perception but not sufficient to influence direction, this is influenced by other factors such as engagement in sport. From an early intervention perspective there is a strong message that parents being attentive to children voicing body dissatisfaction, especially boys, will enable parents to form opinions about their child's weight status. Similarly for other factors, except maternal BMI, the odds are two to three times higher than previous study. In addition, we also found three more factors such as child sports, child behavioural problems and problems with family communication are independent predictors of maternal perception of their child weight status.

Our predicting model of maternal perceptions of child weight status showed that the more mothers perceived their children are concerned about their physical appearance, shape, size and weight, and the more they dieted to lose weight. Consistent with the finding that the child-parent concordance for externalizing behaviors is higher than internalizing (e.g. anxiety and depression) symptoms [33], the behavior of dieting is well recognized by parents and creates the opportunity for the parent to make a clear perception about the child's weight.

Maternal perception of social values for adolescent boys and girls are different. Involvement in sports is seen as healthy for both boys and girls. The perceived weight status associated with TV watching in boys may reflect a gender specific perception that boys are more expected to be outside playing sport. Girls may give up sports in adolescence and are perceived as more likely to be at home, where TV watching is considered normal.

Study limitations

The lost of follow-ups are considerable in this study. However, our results would be biased if the associations we have assessed were non-existent or in the opposite direction in non-participants, which is unlikely. We have compared our estimates of overweight or obese at age 14 to the Australian National Nutritional Survey (NNS) 1995 for similar age categories and the results are compatible. At age 14, the prevalence of overweight or obesity was 25% in MUSP and 23% in NNS. These small differences are likely to be explained by regional variations and this comparison does not suggest a major problem with selection due to loss of follow-up. A variety of modeling strategies have been used in MUSP studies in order to adjust for attrition, though use of these methods have not resulted in marked alteration of findings [34,35]. From our recent investigation, we found that the proportion lost to follow up in MUSP is consistent with that in other large life-course cohorts (e.g. the British 1946, 58 and 70 birth cohorts, and the Avon Longitudinal Study of Parents and Children). We also found broad similarities between our published findings and those of previous birth cohort studies (with shorter follow-ups) with lower attrition

rates, providing some support that our findings were not biased by lost of follow up. We do not have information about father's perception of offspring weight status, which could be different from mothers.

Implications of the findings

We found more child factors than family or maternal factors predict maternal perceptions of their offspring weight status. This study suggests that, irrespective of offspring observed BMI, maternal perception of child weight status depends on how mothers perceived their children appearance, shape, size and weight, adolescent dieting, their health status and maternal BMI status. This perceived weight is less affected by the maternal mental health, socio economic status and life style factors.

Consistent evidence suggest that primary prevention of childhood overweight and obesity, including promoting healthy nutrition and patterns of activity, is likely to be successful with parental involvement [4,5]. However, such support is less likely to occur if parents, particularly mothers, do not recognize or perceive their overweight children as overweight. The finding that child factors are related to maternal perception should be helpful to clinicians as it suggests understanding adolescent and maternal perceptions of weight will best be achieved by a focus on current adolescent body image (appearance, shape, size), dieting, behavioural problems, and parental weight status.

Funding

The core study was funded by the National Health and Medical Research Council (NHMRC) of Australia. AAM is supported by a Career Development Awards from the NHMRC (ID 519756). For the work in this paper AAM has a grant from the National Heart Foundation of Australia (ID G07B3135). The views expressed in the paper are those of the authors and not necessarily those of any funding body and no funding body influenced the way in which the data were analysed and presented.

Acknowledgements

We thank all participants in the study, the MUSP data collection team, and data manager, University of Queensland who has helped to manage the data for the MUSP.

Ethics approval: Written informed consent from the mothers was obtained at all data collection phases of the study. Ethics committees at the Mater Hospital and the University of Queensland approved each phase of the study.

References

1. Ebbeling CB, Pawlak DB, Ludwig DS (2002) Childhood obesity: public-health crisis, common sense cure. *Lancet* 360: 473-482.
2. Sharma M (2007) International school-based interventions for preventing obesity in children. *Obes Rev* 8: 155-167.
3. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, et al. (2005) Interventions for preventing obesity in children. *Cochrane Database Syst Rev* :CD001871.
4. Epstein LH, Valoski A, Wing RR, McCurley J (1990) Ten-year follow-up of behavioral, family-based treatment for obese children. *JAMA* 264: 2519-2523.
5. Lindsay AC, Sussner KM, Kim J, Gortmaker S (2006) The role of parents in preventing childhood obesity. *Future Child* 16: 169-186.
6. Yan AF, Zhang G, Wang MQ, Stoesen CA, Harris BM (2009) Weight perception and weight control practice in a multiethnic sample of US adolescents. *South Med J* 102: 354-360.
7. Mamun AA, McDermott BM, O'Callaghan MJ, Najman JM, Williams GM (2008) Predictors of maternal misclassifications of their offspring's weight status: a longitudinal study. *Int J Obes (Lond)* 32: 48-54.
8. Genovesi S, Giussani M, Faini A, Vigorita F, Pieruzzi F, et al. (2005) Maternal perception of excess weight in children: a survey conducted by paediatricians in the province of Milan. *Acta Paediatr* 94: 747-752.
9. Baughcum AE, Chamberlin LA, Deeks CM, Powers SW, Whitaker RC (2000) Maternal perceptions of overweight preschool children. *Pediatrics* 106: 1380-1386.
10. Carnell S, Edwards C, Croker H, Boniface D, Wardle J (2005) Parental perceptions of overweight in 3-5 y olds. *Int J Obes (Lond)* 29: 353-355.
11. Etelson D, Brand DA, Patrick PA, Shirali A (2003) Childhood obesity: do parents recognize this health risk? *Obes Res* 11: 1362-1368.
12. Genovesi S, Giussani M, Faini A, Vigorita F, Pieruzzi F, et al. (2005) Maternal perception of excess weight in children: a survey conducted by paediatricians in the province of Milan. *Acta Paediatr* 94: 747-752.
13. Jeffery AN, Voss LD, Metcalf BS, Alba S, Wilkin TJ (2005) Parents' awareness of overweight in themselves and their children: cross sectional study within a cohort (EarlyBird 21). *BMJ* 330: 23-24.
14. Maynard LM, Galuska DA, Blanck HM, Serdula MK (2003) Maternal perceptions of weight status of children. *Pediatrics* 111: 1226-1231.
15. Campbell MW, Williams J, Hampton A, Wake M (2006) Maternal concern and perceptions of overweight in Australian preschool-aged children. *Med J Aust* 184: 274-277.
16. Eckstein KC, Mikhail LM, Ariza AJ, Thomson JS, Millard SC, et al. (2006) Parents' perceptions of their child's weight and health. *Pediatrics* 117: 681-690.
17. Genovesi S, Giussani M, Faini A, Vigorita F, Pieruzzi F, et al. (2005) Maternal perception of excess weight in children: a survey conducted by paediatricians in the province of Milan. *Acta Paediatr* 94: 747-752.
18. Jackson J, Strauss CC, Lee AA, Hunter K (1990) Parents' accuracy in estimating child weight status. *Addict Behav* 15: 65-68.
19. Atlantis E, Ball K (2008) Association between weight perception and psychological distress. *Int J Obes (Lond)* 32: 715-721.
20. Al Mamun A, Cramb S, McDermott BM, O'Callaghan M, Najman JM, et al. (2007) Adolescents' perceived weight associated with depression in young adulthood: a longitudinal study. *Obesity (Silver Spring)* 15: 3097-3105.
21. MacInnis RJ, English DR, Hopper JL, Giles GG (2006) Body size and composition and the risk of gastric and oesophageal adenocarcinoma. *Int J Cancer* 118: 2628-2631.
22. ter Bogt TF, van Dorsselaer SA, Monshouwer K, Verdurmen JE, Engels RC, et al. (2006) Body mass index and body weight perception as risk factors for internalizing and externalizing problem behavior among adolescents. *J Adolesc Health* 39: 27-34.
23. Keeping JD, Najman JM, Morrison J, Western JS, Andersen MJ, et al. (1989) A prospective longitudinal study of social, psychological and obstetric factors in pregnancy: response rates and demographic characteristics of the 8556 respondents. *Br J Obstet Gynaecol* 96: 289-297.
24. Lawlor DA, Najman JM, Sterne J, Williams GM, Ebrahim S, et al. (2004) Associations of parental, birth, and early life characteristics with systolic blood pressure at 5 years of age: findings from the Mater-University study of pregnancy and its outcomes. *Circulation* 110: 2417-2423.
25. Najman JM, Bor W, O'Callaghan M, Williams GM, Aird R, et al. (2005) Cohort Profile: The Mater-University of Queensland Study of Pregnancy (MUSP). *Int J Epidemiol* 34: 992-997.
26. Kuczmarski MF, Kuczmarski RJ, Najjar M (2001) Effects of age on validity of self-reported height, weight, and body mass index: findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *J Am Diet Assoc* 101: 28-34.
27. Yannakoulia M, Panagiotakos DB, Pitsavos C, Stefanadis C (2006) Correlates of BMI misreporting among apparently healthy individuals: the ATTICA study. *Obesity (Silver Spring)* 14: 894-901.
28. World Health Organization (1998) Obesity. Preventing and Managing the Global Epidemic. Report of a WHO Consultation on Obesity, 3-5 June 1997. Geneva, Switzerland, World health Organization.

-
29. Bedford A, FG A (1978) *Delusions Symptoms States Inventory: State of Anxiety and Depression (Manual)*. Berkshire, England: NFER Publishing.
 30. Achenbach TM (1991) *Integrative guide for the 1991 CBCL/4-18, YSR, and TRF profiles*. Burlington: University of Vermont Department of Psychiatry.
 31. Barnes GE, Olson DH (1982) Parent-adolescent communication scale. In: Olson DH, et al., editors. *Family inventories: Inventories used in a national survey of families across the family life cycle*. St. Paul: Family Social Science, University of Minnesota 33-48.
 32. (2001) *Multilevel modelling of health statistics*. Wiley, Chichester, New York.
 33. Stanger C, Lewis M (1993) Agreement Among Parents, Teachers, and Children on Internalizing and Externalizing Behavior Problems. *J Clin Child Psychol* 22: 107-116.
 34. Alati R, Al Mamun A, O'Callaghan M, Najman JM, Williams GM (2006) In utero and postnatal maternal smoking and asthma in adolescence. *Epidemiology* 17: 138-144.
 35. Al Mamun A, Lawlor DA, Alati R, O'Callaghan MJ, Williams GM, et al. (2006) Does maternal smoking during pregnancy have a direct effect on future offspring obesity? Evidence from a prospective birth cohort study. *Am J Epidemiol* 164: 317-325.