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Key Messages

1. Onset of obesity is related to age, gender, pubertal stage, dietary habits, and parental occupation. Targeting the high-risk groups may help curb obesity in children.
2. Obesity may lead to poor self-esteem and potential psychosocial risk. The psychosocial impact of obesity could be more pronounced in girls than boys.
3. The association between obesity and psychosocial health could be bi-directional. Improving psychosocial health could be beneficial in weight management for normal-weight and obese children.
4. Obesity is associated with higher blood pressures.

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Risk factors and outcomes of childhood obesity in Hong Kong: a retrospective cohort study

Introduction

Childhood obesity has become a major public health concern in Hong Kong. The prevalence of obesity among secondary and primary school students has been increasing, reaching 17.9% in 2003/04. The problem is more severe in primary schools and in boys than girls.[1]

The obesity pandemic is largely due to over-eating and under-activity. Obesity is also socially patterned; socioeconomic status may contribute to the temporal rise.[2] Obese children are more likely to experience psychological and physiological problems.[3] Persistent obesity from childhood predicts higher risks of morbidity and premature mortality in adulthood, which increases public health expenses in the long run.[4]

The Student Health Service (SHS) of the Department of Health has offered health assessments for local primary and secondary school students since 1995/96. Its readily accessible data facilitate retrospective cohort studies. The SHS has a consistently high overall participation rate (>80%). Hence, this database is representative of the primary school children in Hong Kong. The present study used the SHS database to investigate the prospective relationship between potential risk factors and childhood obesity. Possible health consequences of obesity later in childhood and early adolescence were also identified.

Methods

This retrospective cohort study was conducted from August 2007 to October 2008. All primary (P) 4 students (n=114 947) aged 8 to 12 years who participated in the SHS in the school years of 1998/1999 and 1999/2000 were included. The records of these students in subsequent academic years were traced until secondary (S) 2, using unique identifiers.

Height, weight, and blood pressure were measured by well-trained health care workers or nurses following standard protocols. Pubertal development was assessed by trained doctors using the progressive rating method based on Tanner stages of pubic hair development. Both blood pressure and puberty were assessed at odd-numbered grades only (ie P5, S1, S3, and S5).

Weight groups were determined by both the International Obesity Task Force (IOTF) standard and the local weight-for-height (WFH) reference. Under the IOTF standard, BMI cutoffs for childhood overweight and obesity are ≥ 25 and ≥ 30 kg/m², respectively, which are equivalent to those for western adults at age 18 years. For the local WFH reference, obesity, irrespective of age, was defined as above 120% of the median figure derived from Hong Kong reference data.

Starting from P4, every participant of even-numbered school grade (P4, P6, S2, S4, and S6) completed a self-administered standardised health assessment questionnaire. Closed answers were used to assess dietary and physical activity behaviours. Variables for analysis included four questions on dietary habits (milk consumption, breakfast habit, junk food intake, and fruit/vegetable intake), one on physical activity (frequency of aerobic exercise), and another on inactivity

(TV time). The last 60 questions in the primary school questionnaire addressed psychosocial health using the Chinese version of the form A of the culture-free Self-Esteem Inventories (SEI) for Children, which included four subscales: general self-esteem (SE), social SE, academic SE, and parent-related SE; the sum of these was total SE. According to SHS guidelines, students with a total score of ≤19 or having 'very low' scores in any subscale were classified as being in the 'high psychosocial risk' group. The last 112 questions in the secondary questionnaire consisted of the Chinese version of the Achenbach's Youth Self-Report (YSR), which measures psychological and behavioural problems in adolescents. There were eight subscales: withdrawal, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent problems, and aggressive problems. Students with total score or any subscale score reaching the local screening cutoffs were classified as having potential psychosocial risk.

After excluding ineligible subjects, the 2-year cohort included 69 045 P4 students (60.9% of the eligible subjects) who were successfully followed into P6. The traced and untraced subjects were similar in terms of socio-demographics, physiological and lifestyle characteristics (Cohen effect sizes ranged from 0.07-0.14) except for age. The subjects were also similar to the corresponding population group in Hong Kong in terms of gender, residential district, and housing type (all Cohen effect sizes <0.1). The 4-year cohort included all P4 students who were followed into F2. The final sample consisted of 36 599 subjects (32.3% of the original sample). Similarly, the characteristics of the traced and untraced subjects were very alike; the traced subjects were also comparable to the corresponding Hong Kong population.

Results

According to the IOTF standard, there was a higher prevalence of overweight (19.3% vs 13.8%) and obesity (6.4% vs 3.8%) in boys than girls in P4. Similar results were obtained based on the WFH reference (26.8% in boys vs 17.0% in girls). As the WFH system does not differentiate overweight from obesity, only the IOTF standard was used in subsequent analyses. In P6, the prevalence of overweight and obesity remained similar. In S2, the respective prevalences dropped noticeably to 15.8% and 3.6% in boys and 9.4% and 1.4% in girls.

Socio-demographic predictors of childhood obesity
In the P4-P6 cohort, older and female normal weight children were less likely to develop overweight/obesity (hereafter referred as obesity) 2 years later. Using primary parental education as a reference, children with parents having secondary level schooling were 12% less likely to develop obesity. Parental occupation was not a significant predictor of obesity onset. Overall, children who already started puberty at P5 had 32% higher risk of developing

obesity at P6 than their prepubertal counterparts. However, the results were influenced by gender (P<0.001); pubertal boys were 47% less likely to develop obesity, but pubertal girls were 63% more likely to develop obesity.

In the P4-S2 cohort, pubertal stage at S1 was a negative predictor of obesity onset. Children with onset of puberty were 36% less likely to develop obesity than their prepubertal counterparts. Again, this was influenced by gender (P<0.001) such that the association was significant in boys but not in girls. The risks of obesity for children were 1.71 and 1.67 times higher, respectively, when their parental occupation was classified as 'service/clerical' and 'professional/managerial', compared with 'unemployed' parents.

Lifestyle predictors of childhood obesity
'Breakfast eating' and 'milk consumption' were significantly associated with obesity onset 2 and 4 years later. Eating breakfast at home predicted ≥26% reduction in risk. However, children having breakfast outside home (eg fast food stall, cafeteria, or elsewhere) did not differ from those who skipped their breakfast (P=0.60, data not shown). Daily milk consumption also predicted 14% and 21% lower chance of obesity onset at P6 and S2, respectively, compared with less frequent or no consumption.

Self-esteem and obesity
Having lower SEI scores at P4 predicted a higher risk of obesity onset at P6 for each of the four subscales and total SEI score (P for trend all <0.01). Using overall psychosocial risk as a predictor, High-risk children had 32% (P<0.01) higher chance of becoming obese at P6. Among the baseline overweight/obese children, having high/very high total, general, and social SE independently predicted 26 to 37% higher chance of returning to normal weight (P for trend all <0.01) 2 years later. However, parent-related SE seemed not to be predictive of weight status at follow-up among the already obese group.

Conversely, weight status at baseline was used to predict SE 2 years later. Compared with normal weight children, overweight and obese children had 12 to 33% higher risk of developing low/very low total, general, social, and academic SEI scores (P for trend all <0.001). However, weight status was not predictive of parent-related SE at follow-up. Regarding overall psychosocial risk, the overweight and obese children had 16% and 44% higher risk of having psychosocial problems at P6. Stratification analysis by gender suggested that obese girls might have double the excess risk as boys (78% vs 31%), although the difference was not significant (P=0.50).

Youth Self-Report outcomes of childhood obesity
Overall, body fatness at baseline was positively associated with the YSR total score at S2 but not significantly (P=0.07). The obese and overweight respectively had 16% and 34% higher chance of meeting the screening cutoffs,

compared to the normal weight, although such did not reach significance. Nor were the associations for each of the eight YSR subscale scores.

Regarding potential psychosocial problems, the overweight had 23% higher chance of meeting the overall screening criteria at S2. The interaction between weight status and gender was not significant (P=0.63). Nevertheless, stratification analysis showed that the association was more pronounced and consistent in girls (P for trend=0.01), whereas the association almost disappeared in boys. In particular, obese girls had 61% (P<0.05) higher chance of having psychosocial risk compared with their normal weight counterparts.

Blood pressure and obesity

Cross-sectionally, systolic and diastolic blood pressures increased progressively from normal weight to overweight and obese (all P<0.001). From P4 to P5, increasing blood pressures was associated with increasing body fatness. Compared with normal weight children, overweight and obese children respectively had higher systolic blood pressure by 5.3 (95% confidence interval [CI], 5.2-5.5) and 9.2 (95% CI, 8.9-9.6) mm Hg, and higher diastolic blood pressure by 2.0 (95% CI, 1.9-2.1) and 3.7 (95% CI, 3.5-3.9) mm Hg (all P<0.001).

Discussion

Our study identified several risk factors of childhood obesity, namely socio-demographic factors, lifestyle, and psychosocial health. Obesity could lead to undesirable health consequences both psychosocially and physiologically.

Determinants of obesity

It is important to prevent obesity early in life and target boys. In our study, sexual maturation was associated with onset of puberty, and sex differences existed. Pubertal girls were more likely to become overweight/obese than later-maturing girls. In contrast, pubertal boys had reduced risk of obesity. Clinical guidelines for screening child obesity should take into consideration maturational stages.

In contrast to usual findings in developed countries, our findings showed that higher parental occupation status was associated with higher risk of childhood obesity 4 years later. This could be due to confounding by parental fatness. Fatness is commonly perceived as fortune among older Chinese, and people from higher socio-economic status can afford more nutritious food leading to a higher risk of obesity. Further research on the micro-environment of Chinese families and the influences of parenting on child-eating behaviours may help elucidate such observations.

Two modifiable lifestyle determinants of childhood obesity were identified: breakfast eating and milk consumption. Children eating breakfast at home had lower risk of obesity, whereas children eating breakfast outside home did not fare better than those skipping breakfast. The finding may help elucidate some of the inconsistent results in overseas research. It is important to differentiate the location of breakfast eating during data collection. Daily milk consumption was protective of obesity. The observation was consistent with some epidemiologic and clinical evidence in western populations. In light of the increasing milk consumption among Chinese children, further research with more vigorous measurement of milk consumption is warranted.

Psychosocial health

The bi-directional relation between self-esteem and obesity was demonstrated. Poor esteem could be both a cause and consequence of obesity. Higher self-esteem may help children who are already obese to return to normal weight. Improving self-esteem could be beneficial in weight control and management for both normal and overweight children.

Increasing body fatness predicted higher YSR psychosocial risk in obese girls only. Similar to other population-level studies, the association between emotional health and obesity may not be strong. Whether the measurement is sensitive enough to identify subtle psychosocial problems is unclear. In general, the undesirable psychosocial consequences were more pronounced in girls than boys. This has important implications for the planning of future health education programmes.

Physiological outcome

Obese children had substantially higher blood pressures than their non-obese counterparts, both cross-sectionally and prospectively. However, as the period of follow-up was relatively short (1 year), further research on cardiovascular health and other clinical outcomes is needed.

Acknowledgements

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