Adiposity and Early Adolescent Emotional/Behavioral Problems

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Objective To examine whether life course adiposity is associated with emotional/behavioral problems in a non-Western developed setting with little social patterning of adiposity.

Study design In a prospective, population-representative Chinese birth cohort, "Children of 1997," multivariable partial least squares regression was used to assess the adjusted associations of birth weight z-score, body mass index (BMI) z-scores at ages 3 months, 9 months, 3 years, 7 years, 9 years, and BMI z-score changes with emotional/behavioral problems at ~11 years of age, assessed from the Chinese version of the Revised Parent's Rutter Scales.

Results Rutter score was available for 4976 (62.8% follow-up). Birth weight z-score, BMI z-scores at ages 3 months, 9 months, 3 years, 7 years, 9 years, and successive BMI z-scores changes had little association with Rutter score or subscores at ~11 years of age, adjusted for socioeconomic position, although birth weight was negatively associated with specifically hyperactivity.

Conclusions In a developed, non-Western setting, we did not find adiposity be a factor in the development of emotional/behavioral problems in early adolescence. Although, we cannot rule out the possibility of residual confounding by genetic or familial factors, our results suggest that the reported associations may be contextually specific rather than biologically based. Whether lower birth weight is associated with hyperactivity in early adolescence needs to be confirmed or refuted in other suitable settings. *(J Pediatr 2015;166:1404-9).*

Emotional/behavioral problems are common in adolescence and can have serious consequences.[1] Such problems are strong predictors of antisocial behavior and psychiatric problems in adult life.[2,3] Prior adiposity may be a factor in the development of emotional/behavioral problems during adolescence.[4] Adolescence is a vulnerable period of biological, psychological, and social transition,[5] when adiposity may result in impaired peer relationships, stigmatization, and weight bias.[6] Compared with their peers, obese teenagers (including children and adolescents) tend to describe themselves as having poorer health as well as feeling nervous and irritable more frequently.[7] Teasing about body weight by both peers and family members is associated with higher rates of emotional health problems.[8] Some studies have found associations of adiposity with psychopathology, for example with depression at 12-14 years of age,[9] lower self-esteem at 13-14 years of age,[10] and lower quality of life at 10-13 years of age,[11,12] however, the relation of adiposity with emotional/behavioral problems has less often been examined. Moreover, in Western settings socioeconomic position (SEP) is associated with childhood adiposity,[13] so any observed association of adiposity with emotional/behavioral problems are open to residual confounding.

Hong Kong is a recently developed non-western setting with a standard of living and social infrastructure similar to Western Europe or North America.[14] However, the Hong Kong population has experienced very rapid economic development from the pre-to postindustrial living conditions over a lifetime because the population was largely formed by migration in the mid-20th century from the neighboring province of China (Guangdong). Hong Kong is different from many Western countries in having little social patterning of birth weight,[15] or of infant and childhood body mass index (BMI),[16] perhaps as a result of such a recent history of very limited living conditions and the inevitable social re-assortment with migration. As such, Hong Kong provides a valuable setting in which to distinguish whether observed associations are contextually specific or biologically based. We took advantage of a large, contemporary, population-representative Hong Kong Chinese birth cohort "Children of 1997" to assess the associations of birth weight and childhood adiposity with emotional/behavioral problems in early adolescence.

Methods

Hong Kong's "Children of 1997" birth cohort is a prospective, population-representative Chinese birth cohort (n = 8327) that covered 88% of all births from April 1, 1997, to May 31, 1997. It has been described in detail elsewhere.[17]

BMI	Body mass index
MCHC	Maternal and Child Health Center
PLSR	Partial least squares regression
SEP	Socioeconomic position
SHS	Student Health Service

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The study was initially established to investigate the effect of secondhand smoke exposure on infant health.[18-20] Families were recruited at the first postnatal visit to any of the 49 Maternal and Child Health Centers (MCHCs) in Hong Kong, which parents of all newborns are encouraged to attend for free postnatal care, developmental checks, and vaccinations until the age of 5 years. Baseline characteristics were obtained at recruitment using a self-administered questionnaire in Chinese, including parental education, birth weight, gestational age, parity, breastfeeding, and secondhand smoke exposure. Passive follow-up by record linkage was instituted in 2005 to obtain: (1) weight and height from birth to 5 years from the MCHCs (96% success); (2) routine information from free annual check-ups for all school students provided by the Student Health Service (SHS), Department of Health, including annual measurements of weight and height (grade 1 onwards) and Revised Parent's Rutter Scales; (3) hospital discharge records from the Hospital Authority which manages all public hospitals; and (4) death records from the Death Registry. Active follow-up by direct contact was instituted in 2007. The study was reviewed by and received approval from the University of Hong Kong-Hospital Authority Hong Kong West Cluster Joint Institutional Review Board, Hong Kong SAR, People's Republic of China.

Adiposity was considered as age- and sex-specific z-scores (ie, SD scores) of birth weight, and BMI relative to the World Health Organization growth standards/reference.[21,22] Routine measurements from the MCHCs or SHS were used for birth weight, BMI at ages 3 months, 9 months, 3 years, 7 years, 9 years, and all changes in BMI z-scores between ages 3 months and ~9 years (ie, from 3-9 months, 9 months-3 years, 3-7 years, and 7-9 years). The World Health Organization growth standards/references were interpolated onto a daily scale by the akima package in R (The R Foundation, Vienna, Austria) because measurements were at slightly different ages. The closest available measurements to ages 3 months (within 2-4 months), 9 months (within 8-10 months), 36 months (within 32-40 months), 7 years (within 6.2-8 years), and 9 years (8.2-10 years) were used to ensure the use of routine measurements, rather than measurements taken for some other reason, such as monitoring of poor growth.

Emotional/behavioral problems at ~11 years of age (10-<13 years) were assessed from the Revised Parent's Rutter scales in Chinese.[23] Rutter scales were designed as a screening tool for common emotional and behavioral problems[24] and have been validated in Chinese adolescents.[23] The scales consist of a set of 31 items describing emotional/behavioral difficulties, as shown in Table I (available at www.jpeds.com), with each item scored 0 for does not apply, 1 for applies somewhat, or 2 for certainly applies. A total score and subscores for conduct problems (5 items), emotional problems (5 items), and inattention/hyperactivity (3 items) were calculated, where a higher score indicates more emotional/behavioral problems. A total score of 13 or more is considered as overall emotional/behavioral problems.[25]

Table II. Characteristics by birth weight z-scores, BMI z-scores at ages 3 months to 9 years and successive BMI z-scores changes (pairwise complete case) in Hong Kong's "Children of 1997" birth cohort

| Characteristics | Birth weight, mean (SD) | BMI at 3 mo, mean (SD) | BMI at 9 mo, mean (SD) | BMI at 3 y, mean (SD) | z-scores and changes in z-scores | | | | | |
					BMI at 7 y, mean (SD)	BMI at 9 y, mean (SD)	3-9 mo, mean (SD)	9 mo-3 y, mean (SD)	3-7 y, mean (SD)	7-9 y, mean (SD)
Sex										
Girls	−0.23 (0.95)	0.17 (0.91)	0.35 (0.92)	0.12 (0.91)	−0.05 (1.04)	−0.07 (1.15)	0.16 (0.77)	−0.21 (0.95)	−0.22 (0.84)	0.00 (0.53)
Boys	−0.31 (1.01)	0.26 (0.98)	0.38 (1.00)	0.22 (1.05)	0.27 (1.30)	0.42 (1.40)	0.12 (0.91)	−0.11 (1.00)	0.02 (1.07)	0.17 (0.62)
Mother's place of birth										
Non-Hong Kong	−0.20 (1.02)	0.27 (0.94)	0.39 (0.97)	0.20 (0.96)	0.19 (1.22)	0.25 (1.32)	0.10 (0.81)	−0.11 (0.97)	−0.06 (1.05)	0.10 (0.57)
Hong Kong	−0.32 (0.97)	0.19 (0.94)	0.34 (0.96)	0.15 (0.98)	0.06 (1.17)	0.14 (1.29)	0.14 (0.86)	−0.18 (0.99)	−0.12 (0.93)	0.09 (0.59)
Highest parental education										
≤Grade 9	−0.27 (1.05)	0.20 (0.96)	0.34 (0.97)	0.19 (0.99)	0.14 (1.26)	0.24 (1.36)	0.13 (0.83)	−0.06 (0.96)	−0.06 (1.02)	0.11 (0.57)
Grade 10-11	−0.25 (0.97)	0.23 (0.94)	0.37 (0.96)	0.18 (0.98)	0.12 (1.20)	0.19 (1.32)	0.13 (0.86)	−0.19 (0.98)	−0.08 (0.99)	0.09 (0.59)
≥Grade 12	−0.31 (0.93)	0.22 (0.95)	0.36 (0.96)	0.14 (0.98)	0.06 (1.14)	0.12 (1.23)	0.14 (0.83)	−0.20 (0.98)	−0.15 (0.89)	0.07 (0.58)
Household income per head at birth in quintiles (mean ± SD)										
1st (HK$1751 ± 413)	−0.20 (0.96)	0.24 (0.94)	0.44 (1.00)	0.25 (1.10)	0.13 (1.23)	0.22 (1.32)	0.11 (0.79)	−0.14 (0.89)	−0.14 (1.03)	0.09 (0.54)
2nd (HK$2856 ± 325)	−0.29 (1.08)	0.24 (0.98)	0.40 (0.95)	0.15 (1.03)	0.14 (1.25)	0.15 (1.36)	0.17 (0.87)	−0.21 (0.98)	−0.08 (1.05)	0.10 (0.60)
3rd (HK$4362 ± 556)	−0.25 (0.94)	0.20 (0.95)	0.29 (0.93)	0.19 (0.92)	0.09 (1.21)	0.18 (1.29)	0.07 (0.84)	0.02 (0.98)	−0.13 (0.95)	0.09 (0.58)
4th (HK$6822 ± 886)	−0.32 (1.01)	0.19 (0.91)	0.30 (0.97)	0.08 (0.95)	0.07 (1.16)	0.22 (1.31)	0.11 (0.88)	−0.21 (0.98)	−0.03 (0.94)	0.14 (0.60)
5th (HK$14850 ± 16050)	−0.28 (0.93)	0.21 (0.96)	0.38 (0.96)	0.19 (0.97)	0.07 (1.14)	0.13 (1.24)	0.19 (0.86)	−0.20 (0.97)	−0.11 (0.93)	0.05 (0.57)