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Socioeconomic disadvantages over the life-course and their influence on obesity among older Hong Kong Chinese adults

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Background: The life-course perspective on socioeconomic inequality in health is a burgeoning field of research. Nonetheless, the three classic life-course models (i.e. sensitive period, cumulative risk and social mobility models) have rarely been simultaneously applied to studies on obesity. Therefore, this study examined the associations of socioeconomic positions (SEPs) across life stages and their associated life-course models with both general and abdominal obesity. **Methods:** Face-to-face interviews were conducted among 1077 community-dwelling adults aged 50 or above during 2014–15 in Hong Kong. Experiences of poverty, educational attainment and deprivation of necessities represented respondents' SEP in childhood, early adulthood and late adulthood, respectively. General and abdominal obesity were defined as body mass index $\geq$25 kg m^{-2} and waist-to-height ratio >0.5. Multivariable modified Poisson regression with a robust error variance was performed. **Results:** Respondents with low childhood SEP tended to have reduced risk of general obesity [relative risk (RR) = 0.85; 95% confidence interval (CI) = 0.72–1.00], whereas those with low childhood SEP and low late-adulthood SEP tended to have increased risk of abdominal obesity (RR = 1.10; 95% CI = 1.00–1.21 and RR = 1.14; 95% CI = 1.03–1.26, respectively). Cumulative socioeconomic disadvantages showed a dose–response relationship with abdominal obesity. Also, those with upward socioeconomic mobility had lower risk of abdominal obesity, whereas those with downward socioeconomic mobility had greater risk. **Conclusions:** Low SEP, especially in childhood, exerted contrasting effects on general and abdominal obesity among older Hong Kong Chinese adults. The three life-course models operated simultaneously in determining the risk of abdominal obesity, while support for cumulative risk and social mobility models was weak in general obesity.

Introduction

Socioeconomic inequality in obesity has been widely observed in recent decades. In general, an inverse association between educational attainment and obesity has been observed in developed world regions,[1] whereas financial hardship was deemed an important risk factor of obesity.[2] Also, socioeconomic positions (SEPs) at different life stages may have unique effects on obesity or may even interact with each other to influence obesity.[3] Three classic life-course SEP conceptual models have been proposed to study the impact of SEP at different life stages on diseases in adulthood.[3] First, the sensitive period model suggests that adverse exposures at certain developmental periods (e.g. childhood poverty) could exert a critical impact on adult health status independent of the exposures experienced in later life. Second, the cumulative risk model assumes the accumulation of the negative impacts of recurring adverse exposures on health over the life-course. Finally, the social mobility model refers to the impact of changing SEP levels across life stages on health above and beyond the previous two models. Despite their differences, it is worth noting that these three models could operate simultaneously in determining the risk of diseases.[3]

The life-course approach has been adopted into research on socioeconomic inequality in obesity. Previous systematic reviews concluded an inverse relationship between life-course SEP and obesity especially among women in developed Western populations[4] and supported the sensitive period model as they found inverse associations of childhood SEP with obesity independent of SEP in adulthood.[5] In addition, previous research showed that cumulative social risks and downward social mobility were simultaneously associated with a higher risk of adult overweight and obesity.[6] Nonetheless, research applying all the three SEP models to explain the association between SEP over the life-course and obesity is very rare. To the best of our knowledge, the sole relevant study showed that Singaporean older adults with low childhood SEP had a reduced risk of general obesity and found no evidence for the cumulative risk model but supported the social mobility model as those with upward socioeconomic mobility (i.e. the upwardly mobile) had lower risk of general obesity.[7]

Another major research gap is that very few studies have attempted to disentangle the effect of SEP over the life-course on general obesity from that on abdominal obesity. Compared with general obesity, abdominal obesity, which reflects the distribution of abdominal fat rather than the total amount of body fat,[8] is particularly associated with cardiometabolic events.[9] Recent secular trend of general obesity was also found independent of the change in abdominal obesity,[10,11] suggesting the differential social patterning of the two types of obesity. Consistently, recent studies in Hong Kong and China also showed that socioeconomic disadvantages in adulthood was associated with abdominal obesity but not with general obesity.[12–14] Regarding the life-course SEP models, the closest two relevant studies found an inverse association of childhood and adulthood SEP with abdominal obesity especially among women and indicated a reduced risk among the upwardly mobile; nonetheless, both did not attempt to examine the cumulative risk model.[15,16]

The relative importance of these life-course SEP models appears to be context-specific,[7] subject to the different patterns and paces of development, demographic changes and other population-wide environmental factors. Given the scanty evidence in Asian settings, the present study aims to examine the associations of SEP at three different life stages (i.e. childhood, early adulthood and late adulthood) with both general and abdominal obesity, with reference to the three life-course SEP models, among older adults in Hong Kong, an advanced economy in Asia which had experienced rapid socioeconomic development but also a severely widening income inequality since the mid-20th century.[17]

Methods

Study population

Face-to-face household interviews were conducted from 2014 to 2015 in Hong Kong. Based on the sampling frame obtained from the Hong Kong Census and Statistics Department, a two-stage stratified sampling first by geographical area and then by type of quarters was adopted.[18] All households residing in selected quarters were then randomly sampled. Eventually, 4947 addresses were sampled with 3791 valid cases, of which 2282 household respondents were successfully enumerated with a response rate of 60.2%. After excluding three respondents with missing information on age or sex and 301 respondents randomly selected for construction of the Deprivation Index,[18] 1978 respondents remained in our sample.[12] Since the analyses on life-course SEP models required data on SEP in late adulthood, 1077 respondents aged 50 years or above, who have already reached their late adulthood, were included in the final analysis. Assuming the effect size = 1.3, $\alpha = 0.05$, base rate of obesity = 0.4, mean exposure = 1 and a binomial equal distribution of predictor, a sample size of 1077 could achieve a statistical power of 0.83 based on a two-tailed Poisson regression.

The study has been approved by the Survey and Behavioural Research Ethics Committee of the Chinese University of Hong Kong in June 2012. All respondents gave informed consents and were assigned a unique identifier for data anonymization. Collected data were only accessible to the relevant research staff. All data management procedures followed the data protection principles under the Personal Data (Privacy) Ordinance of Hong Kong.

Measurements

Standard structured questionnaires administered by trained interviewers were used to obtain information on obesity measures, socioeconomic indicators across life stages and potential confounding variables including demographic and lifestyle factors.[12,18]

Obesity measures

Both general and abdominal obesity were included as the dependent variables. Height was measured with respondents in bare feet, back against a wall, heels together and eyes looking straight ahead, while weight was measured in light clothing using beam balance scales. In addition, waist circumference was measured over the abdomen at the smallest diameter between the costal margin and iliac crest and with respondents breathing out gently, using a standard tape measure. General obesity was defined as body mass index (BMI) $\geq 25\,kg\,m^{-2}$ based on the recommended Asian cutoff,[19] which is officially adopted by the Hong Kong Government[20] and widely used in published studies in Hong Kong.[12,21] Abdominal obesity was defined as waist-to-height ratio (WHtR) >0.5 regardless of sex,[22] given that WHtR is height-adjusted and is increasingly recognized as a more useful screening tool than waist circumference in predicting cardiometabolic diseases.[23] To ensure the robustness of our results, we conducted sensitivity analyses using alternative cutoffs of BMI ($27\,kg\,m^{-2}$ as specific to Hong Kong[24]) and WHtR (0.52 as an optimal threshold for identifying diabetes among ethnic Chinese[25]).

Socioeconomic indicators across life stages

With reference to the methodology adopted by Malhotra et al.[7] in a relevant article on SEP over the life-course and general obesity, three different binary socioeconomic indicators were adopted to represent SEP in childhood (i.e. aged 18 or below), early adulthood (i.e. aged about early 20s) and late adulthood (i.e. aged 50 or above). Regarding childhood SEP, respondents were asked 'Looking back over your life, how often have there been times when you think you have lived in poverty by the standards of that time?'. Respondents reporting 'occasionally', 'often' or 'most of the time' were then asked with the follow-up question 'Was it during your childhood or adulthood?'; thus, those reporting 'childhood' or 'both' was defined as having low perceived childhood SEP. For robustness check, an alternative cutoff was used regarding those experiencing poverty 'often' or 'most of the time' only during childhood.

Concerning early-adulthood SEP, the highest level of education attained was used as it represents the opportunity for self-empowerment during the transition from childhood to early adulthood and is an upstream indicator of SEP in late life stages.[26] Respondents with their highest educational attainment being primary level or below were deemed having a low early-adulthood SEP. As very few respondents (4.9%) had tertiary education level, we did not take it as an alternative cutoff for robustness check.

As for late-adulthood SEP, instead of using housing type as in Malhotra et al.,[7] we adopted a context-specific 21-item Deprivation Index,[18] validated in the Hong Kong population, to measure the current affordability of basic necessities of life among our respondents aged 50 years or above. We followed the Townsend's theory of relative deprivation, which defines poverty as a lack of command over resources covering material and social necessities relative to the social norm.[27] Items perceived as necessities by at least half of these respondents were included in the Deprivation Index.[18] Deprived respondents who cannot afford two or more necessities[18] were considered having a low late-adulthood SEP. For robustness check, an alternative cutoff was used regarding those who cannot afford one or more necessities.

Life-course SEP conceptual models

The aforementioned three life-course SEP conceptual models and their relationships with obesity were examined in this study. While an independent effect of low perceived childhood SEP on obesity in adulthood indicates the operation of the sensitive period model, further data management were made to represent the cumulative risk and the social mobility models.[7,28] To examine the cumulative risk model, low SEP in each of the three life stages was assigned a score of '1' and an additive score of accumulated socioeconomic disadvantages over the life-course was derived, ranging from 0 (i.e. least cumulative risk) to 3 (i.e. greatest cumulative risk).[28] As for the social mobility model, eight mutually exclusive trajectories based on all possible combinations of SEP across the three life stages were identified: 'low-low-low' (LLL), 'low-low-high' (LLH), 'low-high-low' (LHL), 'high-low-low' (HLL), 'high-high-low' (HHL), 'high-low-high' (HLH), 'low-high-high' (LHH) and 'high-high-high' (HHH).[28]

Statistical analysis

Basic characteristics of respondents in the final sample were presented as percentages. Two sets of analyses for general and abdominal obesity were separately conducted. Univariate analyses on the crude associations of SEP across life stages and the associated life-course SEP models with each type of obesity were performed. Multivariable analysis included adjustments for age, sex, marital status, smoking, alcohol consumption, physical activity level, sleep duration and general or abdominal obesity status (depending on the outcome obesity measure). Adjustment for the other obesity measure in the regression model ensured that the association of SEP with abdominal obesity is not due to a different proportion of people with general obesity between high and low SEP groups, and vice versa. Also, when assessing the independent effect of perceived childhood SEP under the sensitive period model, SEP at the other two life stages were adjusted in the adjusted model. In addition, interaction tests between the three SEP and sex were performed. A supplementary analysis stratified by childhood SEP was also conducted. Multiple imputation by chained equations was employed to estimate the plausible values for the missing data based on the distribution of the existing data.[29] The imputation model included SEP at the three different life stages, weight, height and waist circumference and all the potential confounders listed above, plus income poverty as an auxiliary variable.

We estimated relative risks (RR) using the modified Poisson regression with a robust error variance[30] because the effect size estimated by odd ratios would be exaggerated given the relatively high prevalence of obesity in Hong Kong. The statistical package Stata version 14 was used. All statistical tests were two-tailed with a significance level of $P < 0.05$. 95% Confidence intervals (CIs) are provided wherever appropriate.

Results

Descriptive statistics

Among our respondents aged at least 50 years, 36.1% had general obesity while 59.5% had abdominal obesity (table 1). Regarding SEP across life stages, 60.4% respondents had low SEP in childhood, whereas 53.2% and 21.9% respondents had low SEP in early and late adulthood, respectively.

Associations with abdominal obesity

In addition to the significant crude associations of low SEP at all life stages with abdominal obesity, low SEP in childhood and late adulthood remained associated with abdominal obesity (RR = 1.10; 95% CI = 1.00–1.21; RR = 1.14; 95% CI = 1.03–1.26, respectively) after adjustments (table 2). The impact of SEP in early adulthood was stronger among those with low SEP in childhood (Supplementary table S1). No significant interactions between the three SEP across life stages and sex were observed (all $P > 0.535$) (Supplementary table S2).

Concerning the cumulative effect of SEP, a dose–response relationship between SEP over the life-course and abdominal obesity was observed. After adjustments, those having low SEP at all stages and at any two stages had an increased risk of abdominal obesity when compared with those who never experienced low SEP at all stages (3 vs. 0: RR = 1.33; 95% CI = 1.12–1.58, 2 vs. 0: RR = 1.18; 95% CI = 1.02–1.37, 1 vs. 0: RR = 1.05; 95% CI = 0.91–1.21).

As for the social mobility trajectories, respondents in the LLL and LLH trajectories had a significantly higher risk of abdominal obesity when compared with those in the HHH trajectory (RR = 1.32; 95% CI = 1.12–1.57, RR = 1.17; 95% CI = 1.01–1.36, respectively). It is also worth noting that the adjusted association of those in the intergenerational downward (HLL) trajectory was the strongest among all trajectories (RR = 1.36; 95% CI = 1.07–1.72).

Associations with general obesity

Low SEP in childhood showed an inverse association with general obesity (RR = 0.85; 95% CI = 0.72–1.00), while that in early and late adulthood exhibited no significant associations (table 3). Again, no significant interactions by sex were observed (all $P > 0.466$) (Supplementary table S2). No significant differences between groups with the greatest and the least cumulative disadvantage were observed. In addition, associations of the HHH trajectory with general obesity did not significantly differ from that of all other SEP trajectories.

Results of the main analyses showed similar pattern to that of the sensitivity analyses using alternative cutoffs of SEP, WHtR and BMI (Supplementary tables S3–S8).

Discussion

The present study is the first to simultaneously assess the associations of all the three classic life-course SEP models with abdominal obesity and one of the few studies in Asia to examine their associations with general obesity. Low SEP across life stages, especially in childhood, tended to exhibit contrasting associations with reduced risk of general obesity but increased risk of abdominal obesity, suggesting a preferential abdominal fat distribution among those with low SEP. Due to the differential social patterning of general and abdominal obesity, the associations of the life-course SEP models with these two types of obesity are also different.

Regarding general obesity, our finding supported the sensitive period model but showed weak evidence on the cumulative risk and social mobility models. The observed marginal protective effect of low childhood SEP on general obesity echoed previous research in developed Asia[7] but contradicted with the adverse effect reported in studies in the Western settings.[5,31] These context-specific associations may be explained by the difference in the pace of socioeconomic transition between Asia and the West. Compared with the gradual transition over the past two centuries since the industrial revolution in the Western world, the transition in today's developed Asian settings, such as Hong Kong and Singapore, was relatively rapid with a more recent start since the mid-20th century.[7,17] Referring to the period before the 1960s when our respondents aged 50 years or above were born, food insecurity was common in Asia.[32] Unlike the improved living standard experienced by poorer families in the relatively developed Western world at that time, recurring exposures to calorie-deficit diet in childhood in underdeveloped Asia[33] may reduce the risk of adult general obesity.

In contrast to the potential protective effect on general obesity, low childhood SEP tended to have adverse impact on abdominal obesity after adjustments for adulthood SEP, which echoed a previous systematic review supporting a positive association between childhood poverty and abdominal obesity.[34] In addition, consistent adverse effects of low SEP across the three life stages on abdominal obesity were observed, suggesting that the aforementioned explanation via diet for general obesity is insufficient to explain the socioeconomic inequality in abdominal obesity, because the calorie-deficit diet associated with low childhood SEP decades ago was distinctly different from calorie-empty diet (i.e. foods rich in calorie with minimal nutritional values) associated with low adulthood SEP nowadays.[35] While general obesity depends largely on the dietary energy balance, abdominal obesity is particularly associated with psychosocial distress.[36] People with low SEP over the life-course are often prone to stressful exposures.[37] The increased psychosocial distress could in turn be conducive to the preferential abdominal fat distribution, since the excess level of cortisol, a stress-related hormone, has depot-specific effect on adipocyte gene expression and metabolism that expand visceral fat depots but at the same time deplete peripheral subcutaneous fat depots.[38] Considering the mechanisms of heightened psychosocial distress disproportionately affecting the socioeconomically disadvantaged, it is not surprising to observe the consistent adverse effects of low SEP on abdominal obesity and the dose–response adverse effect of low SEP over the life-course. To better understand the mechanisms between life-course SEP and abdominal obesity, further longitudinal research on the role of psychosocial distress is warranted.

Furthermore, our study provided support for the operation of social mobility model in determining abdominal obesity. For example, the HLL trajectory in the social mobility model showed a higher risk of abdominal obesity (RR = 1.36) with reference to the expected cumulative risk of having low SEP at any two life stages in

Table 1 Basic characteristics of respondents ($N = 1077$)

	Column %	Proportion of general obesity Row %	Proportion of abdominal obesity Row %
General obesity[a]			
BMI ≥25 kg m^{-2}	36.1	NA	90.1
BMI <25 kg m^{-2}	63.9	NA	42.2
Abdominal obesity[b]			
WHtR >0.5	59.5	54.7	NA
WHtR ≤0.5	40.5	8.9	NA
Childhood SEP[c]			
Low	60.4	35.5	64.2
High	39.6	38.1	53.0
Early-adulthood SEP[d]			
Low	53.2	38.0	68.2
High	46.8	33.9	49.5
Late-adulthood SEP			
Low	21.9	35.4	67.4
High	78.1	36.2	57.5
Accumulation of SEP risk[e]			
3 (greatest cumulative SEP risk)	10.8	36.7	76.7
2	34.8	37.1	67.5
1	32.6	37.3	54.8
0 (least cumulative SEP risk)	21.8	34.3	46.6
Social mobility[e,f]			
LLL (stable low)	10.8	36.7	76.7
LLH	27.9	36.9	68.6
LHL	4.4	37.8	51.4
HLL	2.5	38.9	83.3
HHL	3.7	35.3	54.3
HLH	11.8	45.9	59.5
LHH	17.1	31.9	51.8
HHH (stable high)	21.8	34.3	46.6
Age (years)			
50–59	35.2	33.3	46.4
60–69	33.0	36.3	56.2
70–79	19.7	39.4	75.9
≥80	12.2	38.4	82.1
Sex			
Male	45.0	36.1	55.3
Female	55.0	36.1	63.0
Marital status[g]			
Married/cohabit	66.4	37.8	57.1
Single/divorced/separated/widowed	33.6	32.9	63.9
Smoking[h]			
Non-smoker	79.8	36.6	60.9
Past smoker/current smoker	20.2	34.3	54.0
Alcohol consumption[i]			
Non-risky drinker	97.1	36.2	60.3
Risky drinker	2.9	32.1	32.1
Physical activity level			
HEPA active	69.5	37.6	60.3
Minimally active	18.9	36.8	62.4
Inactive	11.5	26.1	50.4
Sleep duration per day[j]			
≤4 h	5.8	32.1	64.2
5–6 h	42.7	35.5	62.5
7–8 h	38.5	38.1	55.1
≥8 h	13.0	33.9	60.7

Missing data: a: 101; b: 100; c: 74; d: 6; e: 80; g: 3; h: 1; i: 8; j: 3.
f: First, second and third letters representing poverty status in childhood, educational attainment in early adulthood and deprivation status in late adulthood, respectively (H = high and L = low).

the cumulative risk model (RR = 1.18); and this RR was also comparable to that of the most disadvantaged LLL trajectory on abdominal obesity in the social mobility model (RR = 1.32). The higher-than-expected risk suggests that, among those with high childhood SEP, downward social mobility has an additional adverse effect on abdominal obesity. This pattern implies that childhood social advantages do not necessarily alleviate the adverse effects of low adulthood SEP on abdominal obesity; rather, the prolonged socioeconomic hardship after childhood prosperity could be a critically pernicious stressor of abdominal obesity beyond the independent effects of SEP. On the other hand, among trajectories with low SEP at any two life stages, the LHL trajectory was the only one that did not show significantly higher risk of abdominal obesity relative to the most advantaged HHH trajectory (RR = 1.12; 95% CI = 0.85–1.48), and its effect size was substantially lower than that of the LLH (RR = 1.17) and HLL (RR = 1.36) trajectories. The reduced risk implies that inter-generational upward social mobility (i.e. from low childhood to high early-adulthood SEP) may be protective of abdominal obesity despite the independent adverse effects of low childhood and late-adulthood SEP. To those with low childhood SEP who generally have less access to resources and poorer parenting quality, education serves as a particularly important opportunity to overcome poverty, gain social status and achieve better health.[39] Overall, our findings were consistent with relevant studies on adiposity and metabolic biomarkers supporting a reduced risk for upward mobility and a heightened risk for downward mobility.[15,16]

The present study has several limitations. First, the measurement of childhood SEP was dependent on retrospective recall; therefore, our observed association may be partially attributed to reverse causation. Second, inconsistency in the operationalization of SEP indicators may possibly bias the interpretation of our findings. Educational attainment in early adulthood mainly represents the level of knowledge and cognitive capability and partially reflects the level of social capital and network,[26,39] which may not directly reflect the respondent's financial circumstances. The lack of data on personal income and financial asset at early adulthood may limit the comparability of SEP across life stages. Having said that, the use of educational attainment is a good proxy measure of early-adulthood SEP when compared with other potential indicators such as occupation and income, since it is typically attained during late-adolescent and early-adulthood period and applies to all respondents including home-makers and the unemployed.[26] Third, the lack of significant findings with general obesity was possibly due to the inaccuracy of BMI to reflect adiposity among older adults.[40] Finally, our observed association could at most be generalized to Asian settings which had experienced rapid socioeconomic development since the mid-20th century.

Conclusions

Low SEP across life stages, especially in childhood, exerted contrasting effects with reduced risk of general obesity but heightened risk of abdominal obesity. While only the sensitive period model was supported for general obesity, the three life-course SEP models operated simultaneously in determining the risk of abdominal obesity. Facilitating upward mobility among those with low childhood SEP, possibly by ensuring equal education opportunities across the social ladder, seems to overcome the detrimental effects of early-life adversity on abdominal obesity.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Table 2 Associations of life-course socioeconomic position (SEP) conceptual models with abdominal obesity ($N = 1077$)

	Abdominal obesity, WHtR >0.5	
	Unadjusted model, RR (95% CI)	**Adjusted model,[a] RR (95% CI)**
Life-course SEP conceptual models		
Sensitive period model		
Low (vs. high) childhood SEP[b]	1.19 (1.07–1.32)	1.10 (1.00–1.21)
Low (vs. high) early-adulthood SEP[b]	1.35 (1.21–1.50)	1.08 (0.97–1.20)
Low (vs. high) late-adulthood SEP[b]	1.17 (1.05–1.32)	1.14 (1.03–1.26)
Cumulative risk model		
3 vs. 0	1.54 (1.29–1.85)	1.33 (1.12–1.58)
2 vs. 0	1.41 (1.21–1.65)	1.18 (1.02–1.37)
1 vs. 0	1.13 (0.96–1.34)	1.05 (0.91–1.21)
Social mobility model[c]		
LLL vs. HHH	1.54 (1.29–1.85)	1.32 (1.12–1.57)
LLH vs. HHH	1.43 (1.22–1.67)	1.17 (1.01–1.36)
LHL vs. HHH	1.16 (0.84–1.58)	1.12 (0.85–1.48)
HLL vs. HHH	1.68 (1.31–2.16)	1.36 (1.07–1.72)
HHL vs. HHH	1.12 (0.81–1.55)	1.09 (0.84–1.42)
HLH vs. HHH	1.21 (0.99–1.48)	1.00 (0.83–1.19)
LHH vs. HHH	1.07 (0.88–1.31)	1.08 (0.91–1.28)
HHH vs. LLL	0.65 (0.54–0.78)	0.76 (0.64–0.90)
LLH vs. LLL	0.92 (0.80–1.07)	0.89 (0.77–1.01)
LHL vs. LLL	0.75 (0.56–0.99)	0.85 (0.65–1.10)
HLL vs. LLL	1.09 (0.86–1.38)	1.02 (0.81–1.30)
HHL vs. LLL	0.73 (0.52–1.01)	0.83 (0.64–1.07)
HLH vs. LLL	0.79 (0.65–0.95)	0.75 (0.63–0.89)
LHH vs. LLL	0.70 (0.58–0.84)	0.82 (0.69–0.97)

a: Adjusted for age, sex, marital status, smoking, alcohol consumption, physical activity level, sleep duration and general obesity status.
b: Additionally adjusted for the other two SEP indicators in the adjusted model.
c: First, second and third letters representing poverty status in childhood, educational attainment in early adulthood and deprivation status in late adulthood, respectively (H = high and L = low).

Table 3 Associations of life-course socioeconomic position (SEP) conceptual models with general obesity ($N = 1077$)

Life-course SEP conceptual models	**General obesity, BMI $\geq$ 25 kg m^{-2}**	
	Unadjusted model, RR (95% CI)	**Adjusted model,[a] RR (95% CI)**
Sensitive period model		
Low (vs. high) childhood SEP[b]	0.93 (0.78–1.11)	0.85 (0.72–1.00)
Low (vs. high) early-adulthood SEP[b]	1.12 (0.94–1.33)	1.04 (0.88–1.22)
Low (vs. high) late-adulthood SEP[b]	1.00 (0.82–1.24)	0.93 (0.77–1.12)
Cumulative risk model		
3 vs. 0	1.02 (0.74–1.41)	0.81 (0.60–1.08)
2 vs. 0	1.07 (0.84–1.36)	0.92 (0.74–1.14)
1 vs. 0	1.07 (0.84–1.36)	1.02 (0.83–1.25)
Social mobility model[c]		
LLL vs. HHH	1.02 (0.74–1.41)	0.81 (0.61–1.09)
LLH vs. HHH	1.05 (0.82–1.36)	0.91 (0.73–1.15)
LHL vs. HHH	1.10 (0.69–1.74)	1.01 (0.67–1.52)
HLL vs. HHH	1.13 (0.62–2.07)	0.89 (0.52–1.52)
HHL vs. HHH	1.02 (0.63–1.65)	1.00 (0.70–1.44)
HLH vs. HHH	1.29 (0.96–1.73)	1.19 (0.92–1.54)
LHH vs. HHH	0.93 (0.69–1.25)	0.90 (0.70–1.16)
HHH vs. LLL	0.98 (0.71–1.35)	1.23 (0.92–1.64)
LLH vs. LLL	1.03 (0.75–1.41)	1.12 (0.85–1.48)
LHL vs. LLL	1.07 (0.65–1.76)	1.24 (0.79–1.95)
HLL vs. LLL	1.11 (0.61–2.02)	1.10 (0.63–1.90)
HHL vs. LLL	0.99 (0.57–1.73)	1.23 (0.81–1.87)
HLH vs. LLL	1.26 (0.90–1.77)	1.46 (1.08–1.98)
LHH vs. LLL	0.91 (0.64–1.29)	1.10 (0.81–1.51)

a: Adjusted for age, sex, marital status, smoking, alcohol consumption, physical activity level, sleep duration and abdominal obesity status.
b: Additionally adjusted for the other two SEP indicators in the adjusted model.
c: First, second and third letters representing poverty status in childhood, educational attainment in early adulthood and deprivation status in late adulthood, respectively (H = high and L = low).

Key points

- While only the sensitive period model was supported for general obesity, the three classic life-course models (i.e. sensitive period, cumulative risk and social mobility models) operated simultaneously to determine the risk of abdominal obesity among older Chinese adults in Hong Kong.
- Socioeconomic disadvantages over the life-course, especially in childhood, were associated with reduced risk of general obesity but heightened risk of abdominal obesity.
- The adverse effect of socioeconomic disadvantages over the life-course accumulated and exhibited a dose–response relationship with abdominal obesity.
- Despite the operation of the sensitive period model, efforts and opportunities in later life that facilitate upward social mobility could potentially reverse the detrimental effect of early-life disadvantages on abdominal obesity.

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