

# Central adiposity and the propensity for rehearsal in children

Fiona CM Ling  
Rich SW Masters  
Clare CW Yu  
Alison M McManus

Institute of Human Performance, The  
University of Hong Kong, Pokfulam,  
Hong Kong

**Background:** There is increasing evidence that continuous activation of the hypothalamic-pituitary adrenal axis and the central sympathetic nervous system contributes to the pathogenesis of central adiposity via increased psychological stress. The purpose of this study was to examine the link between central adiposity and the propensity for Chinese children to rehearse emotionally upsetting events, a dimension of psychological stress. Additionally, gender differences in this relationship were explored.

**Methods:** Waist circumference, which is a marker of central adiposity and associated risks of developing cardiovascular disease, was measured and the propensity for rehearsal was assessed twice over two consecutive years in Hong Kong Chinese children ( $n = 194$ , aged 7–9 years), using a psychometric tool.

**Results:** Children with waist circumference indicative of a risk of cardiovascular disease displayed higher rehearsal scores than children categorized as “not at risk”, as did boys compared with girls. Our results suggest that central adiposity and the propensity for rehearsal of emotionally upsetting events may be linked in Chinese children.

**Conclusion:** Future prospective studies examining the direction of causality between central adiposity and rehearsal can potentially have valuable clinical implications.

**Keywords:** obesity, abdominal, stress, psychological, Hong Kong, child

## Introduction

Central adiposity is the accumulation of visceral adipose tissues in the abdomen. The association between central adiposity and cardiovascular disease risks is well documented.<sup>1,2</sup> There is increasing evidence that the continuous activation of the hypothalamic-pituitary adrenal axis and the central sympathetic nervous system contributes to the pathogenesis of central adiposity by causing neuroendocrinological dysregulation, which amplifies the risk of visceral fat accumulation in the intra-abdominal area.<sup>3</sup> Continuous psychosocial stress, for example, can cause elevated cortisol levels that upset lipid metabolism in the adipose tissues concentrated around the abdominal region.

One psychological dimension of the stress response that appears to be related to sustained activation of the hypothalamic-pituitary adrenal axis, and that has been linked with elevated cortisol levels, is rehearsal.<sup>4,5</sup> Rehearsal refers to rumination about emotionally upsetting experiences that have occurred in the past, are occurring in the present, or that may occur in future.<sup>6</sup> Roger and Jamieson<sup>4</sup> found a negative association between the propensity for rehearsal and heart rate recovery following performance of a laboratory stressor (Stroop task competition), while Roger and Najarian<sup>5</sup> found that

Correspondence: Alison M McManus  
Institute of Human Performance,  
University of Hong Kong, Patrick  
Manson Building, 7 Sassoon Road,  
Pokfulam, Hong Kong  
Tel +852 2589 0582  
Fax +852 2855 1712  
Email alimac@hku.hk

the propensity of nurses to rehearse was positively associated with urinary cortisol secretion at least two weeks after they had completed their nursing examinations. Therefore, we speculated that the propensity to rehearse about emotionally upsetting events might be linked to central adiposity status as a consequence of the potential role of rehearsal in sustained hypothalamic-pituitary adrenal activity.

Crucially, the developmental course of central adiposity in childhood plays a significant role in the onset of obesity, which typically occurs prior to adolescence.<sup>7</sup> Indeed, neuroendocrinological dysfunction in childhood has been implicated in elevated central adiposity,<sup>8</sup> so the part that rehearsal plays in sustained physiological responses to stress may be significant in children. The primary aim of our study was thus to examine in children the link between central adiposity and scores on an established psychometric measure of rehearsal, over a two-year period. To achieve this, we assessed central adiposity from waist circumference using established waist circumference cutoffs, which categorize children as “at risk” or “not at risk” of cardiovascular disease<sup>9</sup> and we assessed rehearsal tendencies annually for two years using the Rehearsal Scale for Children-Chinese (RSC-C).<sup>10</sup> We hypothesized those Chinese children “at risk” of cardiovascular disease, as reflected by waist circumference measurements, would display higher rehearsal scores over time than those categorized as “not at risk” of cardiovascular disease. Moreover, consistent with findings by Maxwell and Siu,<sup>11</sup> we hypothesized that Chinese males would display a greater tendency for rehearsal than females because males have been shown to reflect more on negative events.

## Methods

### Participants

Participants (109 boys and 85 girls, mean age  $8.22 \pm 1.11$  years) were recruited from a Hong Kong government-aided primary school. Waist circumference was measured at baseline in July 2004 and participants completed the RSC-C questionnaire twice in the subsequent two years. Parental consent was obtained for all children and the Institutional Ethics Committee for Human Research approved the measures and protocols.

### Measurements and procedures

#### Anthropometric measurement

Participants' stature, body mass, and waist circumference were assessed at school (in the morning) while wearing light clothing. Stature was measured barefoot to the nearest 0.1 cm using a fixed stadiometer (Invicta 2007246, Leicester, UK).

Body mass was measured to the nearest 0.1 kg using electronic scales (TBF-410, Tanita Corporation, Tokyo, Japan). Waist circumference was assessed according to the standards of the International Society for the Advancement of Kinanthropometry,<sup>12</sup> defined as the narrowest point between the lower costal border and the superior border of the iliac crest. Waist circumference measurement was taken twice to the nearest 0.1 cm and the average was used for analyses. Based on age-specific and gender-specific waist circumference cutoffs for at least three cardiovascular risk factors in Chinese children,<sup>9</sup> the children were categorized as “at risk” ( $n = 47$ ; 60% male) or “not at risk” ( $n = 147$ ).

### Rehearsal Scale for Children-Chinese

The RSC-C was used to measure rehearsal tendencies in Chinese preadolescents.<sup>10</sup> It contains 13 items, rated on a four-point Likert scale (from 1 = “never” to 4 = “all the time”). The RSC-C has high internal validity ( $\alpha = 0.83$ ) and satisfactory one-year test-retest reliability ( $r = 0.43$ ). An example of the scale is “If I lose out, I get over it quickly”. All participants completed the RSC-C a year after the waist circumference measurement (T1) and again the year after (T2).

### Statistical analyses

Descriptive data are presented as means and standard deviations. A factorial repeated-measures analysis of variance, taking time as a within-group factor and risk and gender as between-group factors, was utilized to investigate if risk and gender mediate RSC-C scores at T1 and T2. A  $P$  value of  $<0.05$  was set a priori for all analyses.

## Results

Table 1 shows the mean T1 and T2 RSC-C scores, waist circumference and body mass index of the “at risk” and “not at risk” group by gender. Analysis of variance revealed no main effect of time ( $P > 0.05$ ) but a significant main effect was present for risk ( $F [1, 190] = 5.12, P = 0.025, \eta^2 = 0.03$ ; overall mean rehearsal score for those “at risk” =  $30.72 \pm 7.83$ ; overall mean rehearsal score for those “not at risk” =  $28.58 \pm 6.45$ ), as shown in Figure 1. A significant main effect was also present for gender ( $F [1, 190] = 6.18, P = 0.014, \eta^2 = 0.03$ ; overall mean rehearsal score for boys =  $30.82 \pm 7.45$ ; overall mean rehearsal score for girls  $28.48 \pm 5.93$ , also shown in Figure 1. No significant interactions ( $P > 0.05$ ) were found.

## Discussion

Our results demonstrate that central adiposity is associated with rehearsal tendencies in Chinese children.

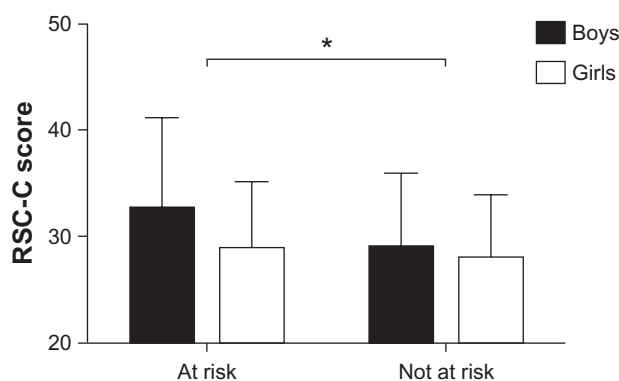
**Table 1** Mean Rehearsal Scale for Children-Chinese scores at T1 and T2, waist circumference, and body mass index for boys and girls categorized as “at risk” and “not at risk”

Group		Mean RSC-C score	WC (cm)	BMI (kg/m <sup>2</sup> )
At risk	Boys	T1 32.57 (8.91) T2 32.46 (8.45)	64.93 (6.98)	18.88 (3.23)
	Girls	T1 28.11 (5.91) T2 29.74 (6.18)	63.61 (5.76)	19.49 (2.90)
Not at risk	Boys	T1 29.57 (7.13) T2 28.69 (6.52)	53.48 (3.49)	15.97 (1.33)
	Girls	T1 28.02 (6.41) T2 28.04 (5.43)	52.11 (3.46)	15.37 (1.43)

**Notes:** Values are means and (standard deviation). “At risk” and “not at risk” groups are based on age-specific and gender-specific WC cutoffs for at least three cardiovascular risk factors in Chinese children.<sup>7</sup>

**Abbreviations:** T1, time one; T2, time two; BMI, body mass index; RSC-C, Mean Rehearsal Scale for Children-Chinese; WC, waist circumference.

Rehearsal scores were higher for the “at risk” group compared with the “not at risk” group, but did not change over time. The finding might be explained by the effect of dysregulation of the hypothalamic-pituitary adrenal axis on central adiposity when one has a high propensity to rehearse about emotionally upsetting past, present, or future events. However, our results do not indicate the causal direction of the relationship, so, equally, high adiposity may cause an increased propensity for rehearsal, possibly mediated by negative psychosocial factors, such as teasing and stigmatization.<sup>13</sup> Prospective studies are needed to examine this question in more detail. For example, does emotion control training to reduce the propensity for rehearsal<sup>6</sup> help to prevent sustained activation of the hypothalamic-pituitary adrenal axis and thus improve central adiposity status? Other potential covariates should also be considered for future examination. For example, related regulatory systems, such as appetite control, have also been found to accentuate the propensity of central adiposity and have been related to



**Figure 1** Mean score for the Rehearsal Scale for Children-Chinese for boys and girls categorized as “at risk” and “not at risk”.

psychological stress.<sup>14</sup> A high propensity to rehearse may therefore also cause high adiposity through an increased preoccupation with food and/or disordered eating behavior.<sup>15</sup> Overweight children are generally unhappy about their weight, and have been found to experience psychological distress and depression. Thirteen percent of Chinese children similar in age to our cohort have been found to show a high risk for depression, with depressive risk scores greater in the overweight.<sup>16</sup> Whether high risk for depression in overweight children corresponds to a higher tendency to rehearse is worthy of future examination.

Our study also demonstrated that boys have greater rehearsal tendencies than girls. Gullone et al<sup>17</sup> contended that young boys were more likely than girls or adolescent boys to adopt coping strategies, such as suppression of emotions. Ironically, attempts to suppress unwanted thoughts can often result in a rebound effect, in which the thoughts receive increased, rather than decreased, attention.<sup>18</sup> This raises the intriguing question of whether, particularly in boys, attempts to suppress thoughts related to adiposity may result in heightened propensity for rehearsal of emotions related to being overweight.

There are limitations to this study that should be considered. First, we used waist circumference as a proxy measure of cardiovascular risk, rather than actual cardiovascular disease. We also only assessed waist circumference at T1. This fails to provide the direction of causality, and future prospective studies should assess both rehearsal and central adiposity over time. Additionally, cross-cultural differences have been shown to exist in rehearsal tendencies.<sup>19</sup> In contrast with Western beliefs, Chinese culture typically disapproves of extreme emotional expression, because extreme emotions are seen as pathological. As a result, the Chinese may tend to internalize their emotions with the effect of increasing rehearsal. This is consistent with our finding that Chinese boys displayed a greater propensity for rehearsal. Therefore, it is unclear whether our results are generalizable, given the cultural and gender differences.

In summary, we show that Chinese boys tend to have a higher propensity for rehearsal of emotionally upsetting events than Chinese girls and that central adiposity in Chinese children may be associated with higher rehearsal tendencies. The development of emotion control training to reduce the propensity for rehearsal in youngsters may prove important in preventing excess adiposity. More concrete research evidence about the relationship will confirm whether rehearsal plays a significant role in children’s health and direct future multidisciplinary programs for pediatric weight management.

## Acknowledgment

The authors are grateful to the University of Hong Kong Research Council Strategic Research Theme Public Health for supporting this project.

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Flegal KM, Shepherd JA, Looker AC, et al. Comparisons of percentage body fat, body mass index, waist circumference, and waist-stature ratio in adults. *Am J Clin Nutr*. 2009;89:500–508.
2. Walls HL, Stevenson CE, Mannan HR, et al. Comparing trends in BMI and waist circumference. *Obesity*. 2011;19:216–219.
3. Spencer SJ, Tilbrook A. The glucocorticoid contribution to obesity. *Stress*. 2011;14:233–246.
4. Roger D, Jamieson J. Individual differences in delayed heart-rate recovery following stress: The role of extraversion, neuroticism and emotion control. *Pers Individ Dif*. 1988;9:721–726.
5. Roger D, Najarian B. The relationship between emotion rumination and cortisol secretion under stress. *Pers Individ Dif*. 1998;24:531–538.
6. Roger D, Masters R. The development and evaluation of an emotion control training programme for sex offenders. *Legal Criminol Psychol*. 1997;2:51–64.
7. Wardle J, Brodersen NH, Cole TJ, Jarvis MJ, Boniface DR. Development of adiposity in adolescence: Five year longitudinal study of an ethnically and socioeconomically diverse sample of young people in Britain. *Br Med J*. 2006;13:1130–1135.
8. Roemmich JN, Smith JR, Epstein LH, Lambiase M. Stress reactivity and adiposity of youth. *Obesity*. 2007;15:2303–2310.
9. Sung RYT, Yu CCW, Choi KC, et al. Waist circumference and body mass index in Chinese children: Cutoff values for predicting cardiovascular risk factors. *Int J Obesity*. 2007;31:550–558.
10. Ling FCM, Maxwell JP, Masters RSW, McManus AM. Development and validation of the Chinese Rehearsal Scale for preadolescent Chinese children. *J Clin Psychol*. 2010;66:355–364.
11. Maxwell JP, Siu OL. The Chinese Coping Strategies Scale: Relationships with aggression, anger, and rumination in a diverse sample of Hong Kong Chinese adults. *Pers Individ Dif*. 2008;44:1049–1059.
12. Marfell-Jones M, Olds T, Stewart A, Carter L. International Standards for Anthropometric Assessment. Potchefstroom, South Africa: International Society for the Advancement of Kinanthropometry; 2006.
13. Hebebrand J, Herpertz-Dahlmann B. Psychological and psychiatric aspects of pediatric obesity. *Child Adolesc Psychiatr Clin N Am*. 2009;18:49–65.
14. Torres SJ, Nowson CA. Relationship between stress, eating behavior, and obesity. *Nutrition*. 2007;23:887–894.
15. Lynch WC, Eppers KD, Sherrodd JR. Eating attitudes of native American and white female adolescents: A comparison of BMI- and age- matched groups. *Ethn Health*. 2004;9:253–266.
16. Li YP, Ma GS, Shouten EG, et al. Report on childhood obesity in China. Body weight, body dissatisfaction, and depression symptoms of Chinese children aged 9–10 years. *Biomed Environ Sci*. 2007;20:11–18.
17. Gullone E, Hughes EK, King NJ, Tonge B. The normative development of emotion regulation strategy use in children and adolescents: A 2-year follow-up study. *J Child Psychol Psych*. 2010;51:567–574.
18. Wegner DM. How to think, say, or do precisely the worst thing for the occasion. *Science*. 2009;325:48–50.
19. Roger D, de la Banda GG, Lee HS, Olason DT. A factor-analytic study of cross-cultural differences in emotional rumination and emotional inhibition. *Pers Individ Dif*. 2001;31:227–238.

### Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy

Dovepress

### Publish your work in this journal

Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy is an international, peer-reviewed open-access journal committed to the rapid publication of the latest laboratory and clinical findings in the fields of diabetes, metabolic syndrome and obesity research. Original research, review, case reports, hypothesis formation, expert

opinion and commentaries are all considered for publication. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/diabetes-metabolic-syndrome-and-obesity-targets-and-therapy-journal>