

Original Article

Parental overweight as an indicator of childhood overweight: how sensitive?

Kayoung Lee PhD¹, Eun-Ryoung Kwon PhD¹, Tae-Jin Park MD¹, Min-Seon Park PhD², and Carine M Lenders PhD³

¹Department of Family Medicine, Pusan Paik Hospital, Medical College of Inje University

²Department of Family Medicine, Seoul National University Hospital, Medical College of Seoul University

³Department of Pediatrics, Boston Medical Center, Boston University

This study determined the sensitivity and specificity of parental overweight from self-reported height and weight to identify families with overweight school age children. A cross sectional study was conducted among 3059 parents and their children (1558 boys and 1501 girls) aged 7-12 years in five primary schools of Busan, Korea. BMI was calculated from parental reported height and weight and from children's measured height and weight. Parents were considered overweight when their BMI was $>25 \text{ kg/m}^2$ (WHO, 2000). Children were considered overweight when their BMI was >95 th percentile (CDC, 2000). Prevalence of overweight was calculated and logistic regressions were performed. The sensitivity and specificity of parental overweight were calculated. A total of 26% (805/3059) parents were overweight. Of the families with one overweight parent, 15% ($N = 109$) had an overweight child. When both parents were overweight, 17% ($N = 9$) had an overweight child. After adjusting for child's age and gender, parental education, family income, and spouse's BMI as required, the odds of having an overweight child were 2.5 [1.8, 3.3] for one overweight parent, and 3.2 [1.4, 7.1] for both overweight parents. While the sensitivity of one overweight parent to identify families with overweight school age children was 44%, specificity was 75%. The presence of both overweight parents provided a 3% sensitivity and 98% specificity for the identification of an overweight school age child. Although parental overweight was obtained from self-reported weight and height in Busan (Korea), it is a practical indicator to identify families with an overweight school age child, it has poor sensitivity.

Key Words: BMI, parent, children, overweight, sensitivity, specificity, Korea.

Introduction

The prevalence of under-nutrition is declining in Asian countries while increasing over-nutrition is emerging in this region.^{1,2} There have been concerns about over-nutrition in Asian population because several studies show a higher risk of obesity-related complications at lower body mass index (BMI) than western populations.³⁻⁶ Although, in this region, both conditions have been co-existing, the prevalence of under-nutrition and over-nutrition over time varies by countries.¹

Using local charts from the 1998 Korea National Health and Nutrition Survey, the prevalence of overweight adults ($\text{BMI} > 25 \text{ kg/m}^2$) was 26.7%, while that of underweight adults ($\text{BMI} < 18.5 \text{ kg/m}^2$) was 5.2%.^{4,7} This trend has not spared children aged 6-17 years old. From 1979 to 2002, BMI has increased by 5.7 kg/m^2 among boys and by 6.2 kg/m^2 among girls.⁸⁻¹⁰

Because of the fast rising BMI among Korean children and the higher occurrence of complications at lower BMI, obesity prevention programs for children in Korea are necessary. Results from several longitudinal studies showed tracking of BMI categories from childhood to adolescence and adulthood.¹¹⁻¹³ There is evidence that lifestyle interventions may be more effective in preadolescents.¹⁴ Therefore, the identification of a practical indicator to target

families at risk of having overweight preadolescents might be appropriate. Cross-sectional and longitudinal studies in western and other Asian countries have shown a relationship between parental BMI and child's BMI.¹⁵⁻²³ Although definitions for overweight (choice of BMI cut-offs for parents and children) and the obtainment of weight and height (self-reported or measured) varied across studies, the relationship between parental and children overweight has been strong. Thus, parental overweight may be a good tool to identify families in need for interventions. However, we found no report on the sensitivity and specificity of parental overweight to identify families with overweight children. We propose to use this cross-sectional study to calculate the sensitivity and specificity of parental overweight based on self-reported height and weight as an indicator of school-age childhood overweight.

Correspondence address: Dr Kayoung Lee, Department of Family Medicine, Pusan Paik Hospital, 633-165 Kaegum-dong, Busan Jin-Gu, Busan, 614-735, Republic of Korea
Tel: 82-51-890-6229, FAX: 82-51-894-7554
E-mail: fmlky@dreamwiz.com

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Methods

Subjects and characteristics

Parents and their children were recruited from five primary schools in Busan, between March and May 2001. A total of 3,966 parents and children were surveyed. Children were eligible if they were between 7-12 years. We excluded 568 parents who were without anthropometric data, 267 children that were without a documented age, and 71 children younger than 7 years. Social and demographic characteristics of excluded parents and children were not significantly different from the study sample. After all exclusions, the study sample consisted of 3,059 parents and children with complete data. Consent was obtained from both parents and children. This study was approved by the Institutional Review Board of Busan Paik Hospital in Korea.

Anthropometric data

We obtained parents' weight and height by self-report and calculated BMI based on weight in kilogram divided by height in meter squared (kg/m^2). Self-reported weight and height have shown excellent correlation ($r > 0.90$) with measured weight and height in Korean adults.²⁴ Parents with $\text{BMI} \geq 25 \text{ kg}/\text{m}^2$ were considered overweight and those with $\text{BMI} < 18.5 \text{ kg}/\text{m}^2$ were considered underweight (WHO, 2000).²⁵ Trained school nurses measured children's weight and height. Their weight and height were measured in light indoor clothing using automated weight and height scale (Dongsan Jenix, inc, Seoul, Korea). BMI was calculated as weight in kilogram divided by height in square meter. To define overweight and underweight in children, we used the 2000 CDC gender- and age-specific BMI growth charts.²⁶ Overweight was defined by a BMI of >95 th percentile and underweight by a BMI of <5 th percentile. We also calculated the prevalence of overweight using two other references: The International Obesity Task Force (IOTF)²⁷ and the 1998 Korean growth charts.¹⁰

Using the IOTF reference, overweight was defined as a BMI at or above the cutoff point corresponding to $30 \text{ kg}/\text{m}^2$ at 18 years old for each gender and at each age. This cutoff point is compatible to a BMI of the 95th percentile at 18 years old on the CDC chart. Using the local growth charts, overweight was defined as a BMI of >95 th percentile cutoff and underweight as a BMI of <5 th percentile cutoff for Korean population.

Statistical analysis

Multiple logistic regression analyses were used to predict children's overweight status. Models were constructed for parents', father's, and mother's overweight status. Furthermore, models were adjusted for child's age and gender, parent education, family income and spouse's BMI as required. The receiver operating characteristics (ROC) curve analyses of parental overweight for the identification of an overweight child was performed. Sensitivity, specificity, and positive and negative predictive values were calculated for parental overweight. All analyses were performed using SPSS (version 10.0).

Results

We found that 21% of the fathers, 8% of the mothers, 25% of either father or mother, and 2% of both parents were overweight in a sample of 3,059 families with children aged 7-12 years (Table 1). By contrast, 6% of the mothers, 1% of the fathers, 7% of either father or mother, and 0.1% of both parents were underweight (data not shown). Among the school-age children, prevalence of overweight was 9% (CDC reference), 8% (Korean reference), and 4% (IOTF reference) (Table 1). Using the guideline of CDC or Korean references, the prevalence of underweight children was 3% (data not shown). We observed that boys were more likely than girls to be overweight, and the reverse was true for underweight (data not shown).

Table 1. Prevalence of overweight among parents and children

	All (N=3059)	Boys (N=1558)	Girls (N=1501)
	N (%)		
Overweight parents			
Fathers	640 (21)	329 (21)	311 (21)
Mothers	218 (7)	110 (7)	108 (7)
Only one parent	752 (25)	391 (25)	361 (24)
Both parents	53 (2)	24 (1)	29 (2)
Overweight children			
CDC (>95 th percentile)	269 (9)	201 (13)	68 (4)
IOTF*	132 (4)	94 (6)	38 (3)
Local (>95 th percentile)	235 (8)	136 (9)	99 (7)

*BMI \geq corresponding to $30 \text{ kg}/\text{m}^2$ at 18 years old for each gender and at each age (Ref. 27), CDC=Center for Disease Control, IOTF = International Obesity Task Force.

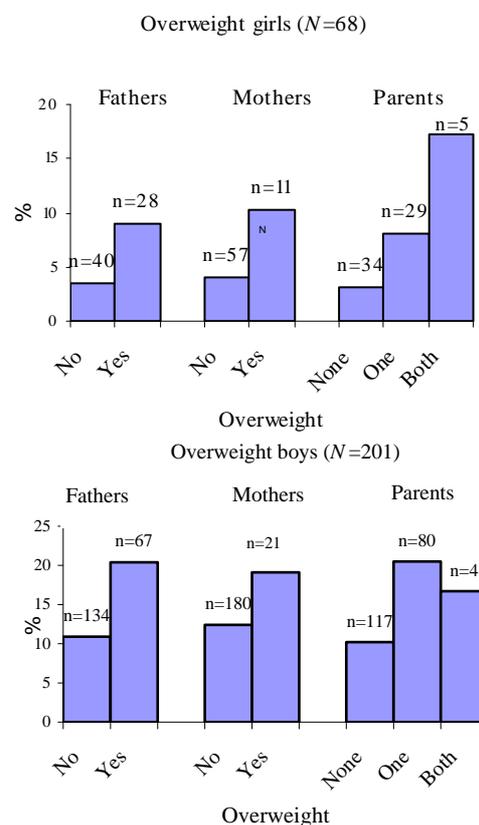


Figure 1. Overweight boys and girls given the overweight status of their parents

As shown in Figure 1, overweight fathers or mothers were more likely to have overweight boys or girls compared to non-overweight fathers or mothers ($P < .001$). Two overweight parents were more likely to have overweight boys or girls compared to neither overweight parent ($P < .001$). This was confirmed using logistic regression analyses. (Table 2). After adjusting for child's age and gender, parental education, family income, and spouse's BMI as required, the odds of having an overweight child were 1.5 (95% C.I. [1.3-1.8]) for overweight father, 1.8 [1.1-2.8] for overweight mother, 2.5 [1.8-3.3] for either overweight parent, and 3.2 [1.4-7.1] for two overweight parents (Table 2).

Table 2. Odds ratios of children overweight by parental overweight.

Variable	Overweight children ($N=269$)		
	N (%)	O.R. (95% C.I.)	A.O.R. (95% C.I.)*
Fathers			
Non-overweight ($N = 2419$)	174 (7)	1.0	1.0
Overweight ($N = 640$)	95 (15)	1.5 (1.3-1.7)	1.5 (1.3-1.8)
Mothers			
Non-overweight ($N = 2841$)	237 (8)	1.0	1.0
Overweight ($N = 218$)	32 (15)	1.9 (1.3-2.8)	1.8 (1.1-2.8)
Parents'			
overweight	151		
Neither ($N = 2255$)	(7)	1.0	1.0
Either ($N = 752$)	109 (15)	2.4 (1.8-3.1)	2.5 (1.8-3.3)
Both ($N = 53$)	9 (17)	2.8 (1.4-5.9)	3.2 (1.4-7.1)

O.R., odds ratio; A.O.R., adjusted odds ratio; C.I., confidence interval. * Adjusted for child's age and gender, parent's education level, and family income, father's BMI (model for mother's overweight) and mother's BMI (model for father's overweight).

Among the 269 overweight children, 35% and 12% had overweight fathers and mothers, respectively. 44% had either overweight parent, and only 3% had both overweight parents (Table 3). Based on which parent(s) were overweight, the sensitivity of parental overweight for identification of overweight school-age children aged from .03 to .44; specificity from .75 to .98; positive predictive value from .15 to .17; and negative predictive value from .91 to .93 (Table 3). When ROC curve analyses examined parental overweight as a screening tool for childhood overweight, most of the ROC areas under the curve were near .5. Although the ROC areas under the curve for either overweight parent was significantly higher than .5, the sensitivity for identification of families with overweight school-age children was .44 and the specificity was .75 (Table 3).

Discussion

The relationship between parental and children's obesity have been explored in multiple studies¹⁵⁻²³, including Asian

Table 3. Receiver operating characteristics curve analysis for identification of overweight children.

	Overweight			
	Fathers ($N=640$)	Mothers ($N=218$)	One parent ($N=752$)	Both parents ($N=53$)
A.U.C.	0.58	0.53	0.60	0.51
(95% C.I.)	(0.54-0.62)	(0.49-0.56)	(0.56-0.63)	(0.47-0.55)
Sensitivity	0.35	0.12	0.44	0.03
Specificity	0.81	0.93	0.75	0.98
+ predictive value	0.15	0.15	0.15	0.17
- predictive value	0.93	0.92	0.93	0.91

A.U.C., area under the curve; C.I., confidence interval

countries.^{19,20} Despite differences in study design and definition of overweight, overweight parents tend to have overweight children in cross-sectional studies¹⁵⁻¹⁹ especially when school aged.^{17,18} Overweight parents were also more likely to have children becoming overweight adults.^{22,23} In the present study, we confirmed the previous relationship, that is, one overweight parent was twice as likely to have an overweight child and both overweight parents tripled their risk of having overweight children compared to the absence of overweight parents. The strength of association of maternal or paternal overweight and their children's overweight was similar.

Previous studies and our findings support that parental overweight is an important indicator for identifying families with overweight children in need of lifestyle intervention. However, this does not mean that parental overweight is a sensitive and specific tool to identify families with an overweight child. Although parental BMI calculated from self-reported height and weight can be used as a screening tool of children overweight, only 3~44% of school-age overweight Korean children were identified as overweight. While 9% of children were overweight (CDC reference), the positive predictive value of parental overweight for having an overweight child was low. By contrast, specificity and negative predictive value were high. Based on this result, self-reported parental weight and height to calculate BMI and overweight should not be used to screen families for an overweight child.

An interesting finding of this study includes prevalence of overweight among Korean population. Because there are different references of childhood overweight, we evaluated the prevalence of children overweight using three references. Using the CDC reference, the prevalence of children overweight in Korea was half of that in the United States.²⁸ While several studies compared the validity of these references using percent body fat, the best reference to assess children overweight is unclear.^{29,30} A valid internationally applicable standard of children overweight is necessary to make our findings across studies more comparable. In this data, the prevalence of obesity was higher among boys. This gender disparity was persistent after adjusting for parental weight status and socioeconomic variables. Because previous Korean studies observed the same gender-discrepancy in prevalence of children overweight,⁸⁻¹⁰ which factors contribute

to the gender overweight differences among school aged children is an area of further inquiry. Similarly, the prevalence of overweight was 21% among fathers but only 7% among mothers. By contrast, using the Korea national data, the reported prevalence of adult overweight was higher among women.^{4,7} These differences may be related to the sampling methods specific to our study.

This study has its limitations. We used parental BMI calculated from self-reported height and weight. Although the correlation between self-reported and measured BMI in Korean adults was excellent in a previous study²⁴ we may underestimate the magnitude of association between parental BMI and children's overweight given the possible misclassification of parental BMI. Also, generalization of these findings should not be made as the subjects were not a random sample of all children aged 7-12 years in Korea. Although parental overweight, estimated by self-reported weight and height is a risk factor for overweight children among school aged children in Korea, it should not be used as a screening tool to identify families at risk of having overweight school aged children because of its poor sensitivity.

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References

1. Ke-You G, Da-Wei F. The magnitude and trends of under- and over-nutrition in Asian countries. *Biomed Environ Sci* 2001 Jun; 14 (1-2): 53-6
2. James PT, Leach R, Kalamara E, Shayeghi M. The Worldwide Obesity Epidemic. *Obes Res* 2001;9: s228-s233.
3. Moon O, Kim N, Jang S, Yoon T, Kim S. The relationship between body mass index and the prevalence of obesity-related diseases based on the 1995 National Health Interview Survey in Korea *Obes Rev* 2000; 3:191-6
4. Kim Y, Suh Y, Choi H. BMI and Metabolic Disorders in South Korean Adults: 1998 Korea National Health and Nutrition Survey. *Obes Res* 2004 12: 445-53.
5. Deurenberg-Yap M, Chew SK, Deurenberg P. Elevated body fat percentage and cardiovascular risks at low body mass index levels among Singaporean Chinese, Malays and Indians *Obes Rev* 2002; 3:209-15.
6. Gill TP. Cardiovascular risk in the Asia-Pacific region from a nutrition and metabolic point of view: abdominal obesity. *Asia Pac J Clin Nutr* 2001; 10: 85-9.
7. Ministry of Health and Social Welfare. Report on 1998 National Health and Nutrition Survey, Korea Ministry of Health and Social Welfare Gyeonggi-do, Korea, 1999.
8. Kang YJ, Hong CH, Hong YJ. The prevalence of childhood and adolescent obesity over the last 18 years in Seoul Area. *Kor J Nutr* 1997; 30: 832-9.
9. Park YS, Lee DH, Choi JM, Kang YJ, Kim CH. Trend of Obesity in School Age Children in Seoul Over the Past 23 Years. *Korean J Pediatr* 2004; 47: 247-57.
10. Hong YM, Moon KR, Seo JW, Sim JG, Yoo KW, Jeong BJ, Choe YH. Nationwide Study on Body Mass Index, Skinfold Thickness, and Arm Circumference in Korean Children. *J Korean Pediatr Soc* 1999; 42:1186-200.
11. Guo SS, Huang C, Maynard LM, Demerath E, Towne B, Chumlea WC, Siervogel RM. Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: the Fels Longitudinal Study. *Int J Obes Relat Metab Disord* 2000; 24: 1628-35.
12. Wang Y, Ge K, Popkin BM. Tracking of body mass index from childhood to adolescence: a 6-y follow-up study in China. *Am J Clin Nutr* 2000; 72: 1018-24.
13. Kotani K, Nishida M, Yamashita S et al. Two decades of annual medical examinations in Japanese obese children: do obese children grow into obese adults? *Int J Obes Relat Metab Disord* 1997; 21: 912-21.
14. Campbell K, Waters E, O'Meara S, Kelly S, Summerbell C. Interventions for preventing obesity in children. *Cochrane Database Syst Rev* 2002; (2): CD001871.
15. Danielzik K, Langnase M, Mast C, Spethmann C, Muller MJ. Impact of parental BMI on the manifestation of overweight 5-7 year old children. *Eur J Nutr* 2002; 41: 132-8.
16. Heidiger ML, Overpeck MD, Kuczumski RJ, Ruan WJ. Association between infant breastfeeding and overweight in young children. *JAMA* 2001; 285: 2453-60.
17. Celi F, Bini V, De Giorgi G, Faraoni F, Di Stefano G, Bacosi ML, Berio MG, Contessa G, Falorni A. Epidemiology of overweight and obesity among school children and adolescents in three provinces of central Italy, 1993-2001: study of potential influencing variables. *Eur J Clin Nutr* 2003; 57: 1045-51.
18. Kromeyer-Hauschild K, Zellner K, Jaeger U, Hoyer H. Prevalence of overweight and obesity among school children in Jena (Germany). *Int J Obes Relat Metab Disord* 1999; 23: 1143-50.
19. Sekine M, Yamagami T, Hamanishi S, Handa K, Saito T, Nanri S, et al. Parental obesity, lifestyle factors and obesity in preschool children: results of the Toyama Birth Cohort study. *J Epidemiol* 2002; 12: 33-9.
20. Hui LL, Nelson EA, Yu LM, Li AM, Fok TF. Risk factors for childhood overweight in 6- to 7-y-old Hong Kong children. *Int J Obes Relat Metab Disord* 2003; 27: 1411-8.
21. Magarey AM, Daniels LA, Boulton TJ, Cockington RA. Predicting obesity in early adulthood from childhood and parental obesity. *Int J Obes Relat Metab Disord* 2003; 27: 505-13.
22. Lake JK, Power C, Cole TJ. Child to adult body mass index in the 1958 British birth cohort: associations with parental obesity. *Arch Dis Child* 1997; 77: 376-81.
23. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 1997; 337: 869-73.
24. Song Y, Yoon J. The validity of self-reported weight and height in Korea. *Kor J Epidemiol* 1995; 17: 257-68.
25. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. WHO Obesity Technical Report Series No. 894 WHO, Switzerland, 2000.
26. New growth charts (2000). Available at www.cdc.gov/growthcharts.
27. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000; 320: 1240-3.
28. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA* 2004; 291: 2847-50
29. Fu WP, Lee HC, Ng CJ, Tay YK, Kau CY, Seow CJ, Siak JK, Hong CY. Screening for childhood obesity: international vs population-specific definitions. Which is more appropriate? *Int J Obes Relat Metab Disord* 2003;27:1121-6.
30. Zimmermann MB, Gubeli C, Puntener C, Molinari L. Detection of overweight and obesity in a national sample of 6-12-y-old Swiss children: accuracy and validity of reference values for body mass index from the US Centers for Disease Control and Prevention and the International Obesity Task Force. *Am J Clin Nutr* 2004; 79: 838-43.

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Kayoung Lee PhD¹, Eun-Ryoung Kwon PhD¹, Tae-Jin Park MD¹, Min-Seon Park PhD², and Carine M Lenders PhD³

¹Department of Family Medicine, Pusan Paik Hospital, Medical College of Inje University

²Department of Family Medicine, Seoul National University Hospital, Medical College of Seoul University

³Department of Pediatrics, Boston Medical Center, Boston University

父母肥胖作为儿童肥胖的预示，有多么敏感？

本研究检验了父母肥胖（据自报的身高体重所确定）作为预示其家庭中生出肥胖学龄儿童的敏感性和特异性。在韩国釜山五所小学开展了一次横断面调查研究，年龄在 7-12 岁的 3059 个儿童（1558 个男孩和 1501 个女孩）及他们的父母参加此次研究。体重指数是通过父母自报的身高体重及儿童测量后的身高体重来计算的。当父母的体重指数大于 25 千克/平方米（世界卫生组织，2000）、儿童的体重指数大于标准体重的 95%（疾病预防控制中心）时，确定为肥胖。调查结束后，进行肥胖流行率的计算并进行相应的逻辑回归分析。对父母肥胖的敏感性和特异性进行计算后，发现 26%（805/3059）的父母患有肥胖。父母只有一方患有肥胖的家庭中，15%（N=109）的生有一个肥胖儿童。父母双方都患有肥胖的家庭中，17%（N=9）的生有一个肥胖儿童。对儿童的年龄和性别、父母的教育程度、家庭的收入和配偶的体重指数进行校正后，父母单方患有肥胖的家庭中，生出肥胖儿童的几率为 2.5 [1.8, 3.3]，父母双方均患肥胖的家庭中，生出肥胖儿童的几率为 3.2 [1.4, 7.1]。单方患肥胖的父母预示该家庭中有肥胖学龄儿童的敏感性为 44%，特异性为 75%。双方均患肥胖的父母有 3%的敏感性和 98%的特异性预示其家庭中有肥胖学龄儿童。尽管双亲的肥胖是通过对他们自报的身高体重计算所得，但是对确定某家庭是否会生有一个肥胖的学龄儿童来说，它是一个实用的指标，尽管这个指标具有很低的敏感性。

关键词： 体重指数、父母、儿童、肥胖、敏感性、特异性、韩国。