Prevalence of Obesity and Its Association with Cardiovascular Disease Risk Factors in Adolescent Girls from a College in Central Taiwan

John Jenn-Yenn Lu,[1,2] Donald Dah-Shyong Jiang,[3] Shieu-Ming Chou,[1] Chang-Bor Hor,[4] Jong-Ding Lay,[1] and Hsiang-Ling Wang[1]

[1]National Taichung Nursing College, Taichung, [2]College of Medicine, Taipei Medical University, Taipei, [3]Field Epidemiology Training Program, Centers for Disease Control, Department of Health, Executive Yuan, and [4]Taichung Hospital, Department of Health, Executive Yuan, Taiwan.

Although obesity is associated with important hemodynamic disturbances, little data exists on population-wide cardiovascular risk factors in obese adolescent girls in Taiwan. This study measured the prevalence of overweight/obesity and related cardiovascular disease risk factors in adolescent females. This was a school-based survey of a representative sample of 291 females aged 15 and 18 years in a public college in Central Taiwan. The main measures were height, body weight, systolic (SBP) and diastolic blood pressure (DBP), uric acid, cholesterol, triglyceride (TG) and high-density lipoprotein cholesterol (HDL-C). Obese (body mass index [BMI] ≥ 25.3) and overweight (22.7 ≤ BMI ≤ 25.2) individuals were combined and labeled as overweight (BMI ≥ 22.7) to make communication of results clearer. Data gleaned from freshmen's health examinations were analyzed. The prevalence of obesity (BMI ≥ 25.3) was 9.28% and of overweight (BMI ≥ 22.7) was 21.31%. Being overweight was associated with higher SBP, DBP, uric acid and TG, and lower levels of HDL-C, but was not associated with cholesterol. The 15-year-old group showed higher mean levels of uric acid, total cholesterol, TG and HDL-C than the 18-year-old group ($p < 0.05$). All told, 3.1%, 15.12% and 2.1% of the girls showed abnormally elevated levels of uric acid, cholesterol and TG, respectively. In addition, 5.84% had abnormally lower HDL-C levels, indicating that interventions should focus on reducing obesity and encouraging proper dietary habits and sufficient exercise, especially in subjects with lower HDL-C levels and higher levels of cholesterol, TG and uric acid.

Key Words: adolescent, cardiovascular disease, female, obesity, overweight
(*Kaohsiung J Med Sci* 2008;24:144–51)

Overweight and obesity are the most common nutritional disorders. Their ranks are swelling alarmingly worldwide [1], and they collectively comprise one of the most pressing health problems of the 21st century [2–4]. The prevalence of overweight in American adolescents aged 12–19 years rose from 6% in the period 1971–1974 to 15% during 1999–2000 [5]. Obesity in children and adolescents is associated with several metabolic and hemodynamic abnormalities: dyslipidemia, high blood pressure, impaired glucose tolerance, insulin resistance and assorted cardiovascular risk factors [6]. Obesity starting from childhood and extending into adulthood accounts for a wave of severe

Received: Aug 1, 2007 Accepted: Oct 30, 2007
Address correspondence and reprint requests to: Dr John Jenn-Yenn Lu, Basic Medical Science, National Taichung Nursing College, No. 193, Section 1, San-Min Road, Taichung 403, Taiwan. E-mail: johnlu@ntcnc.edu.tw

adult obesity [7,8]. Higher body mass index (BMI) or obesity is reportedly correlated with hypertension [9–11] and metabolic risk factors like hyperlipidemia [12,13]; these and obesity, if they continue into adulthood, are associated with early atherosclerosis [14,15].

The epidemiology of obesity in adolescent females in Taiwan is still unknown, and little is known about how strongly adolescent female obesity is associated with cardiovascular risk factors. The goal of this study was to evaluate the prevalence of obesity and related cardiovascular risk factors among teenage girls. We collected and analyzed the health examination data of female students aged 15 and 18 years. Health examination was performed upon enrolment in school; data included age, height, body weight, systolic (SBP) and diastolic blood pressure (DBP), as well as levels of uric acid, total cholesterol, triglycerides and high-density lipoprotein cholesterol (HDL-C) in blood serum.

Methods

Subjects and measurement

Study subjects included all newly enrolled students admitted to a public college in central Taiwan in 2002. There were two groups of enrolled students in this study: freshmen of junior college (mean age, 15.4 ± 0.5 years) and college (mean age, 18.5 ± 0.5 years), hereafter named the 15-year-old group and 18-year-old group, respectively. The number of subjects was 195 aged 15 and 96 aged 18. The public college in central Taiwan enrolled a wide variety of students, from the lowest to highest socioeconomic level, quite representative of adolescents in central Taiwan. Therefore, the subjects in the present study were considered to be a valid and unbiased sample. Age, height, body weight, blood pressure and clinical chemistry analysis of blood were recorded, our database comprising the results of medical checkups performed by us.

During medical checkups, experienced nurses measured a subject's height to within 0.1 cm and body weight to the nearest 0.1 kg. Blood pressure was measured in the morning, on the right arm of subjects, using an automatic oscillometric sphygmomanometer (Model FT-201; Parama-Tech Co. Ltd., Fukuoka, Japan) after the student had been seated and rested for at least 5 minutes. BMI was computed as weight (kg)/height^2 (m^2), adiposity levels were classified into four groups based on BMI in adolescent girls aged 15–18 years, as defined by the Department of Health, Executive Yuan, Taiwan: underweight (BMI ≤ 17.9), normal weight (18.0 ≤ BMI ≤ 22.6), overweight (22.7 ≤ BMI ≤ 25.2) and obese (BMI ≥ 25.3).

Blood samples and biochemical measurement

Blood samples were collected from each freshman upon entrance into the college. Ten milliliters of blood were collected in non-anticoagulant sterile tubes after at least an 8-hour fast, centrifuged within 90 minutes, and analyzed within 4 hours. Blood samples were analyzed for uric acid, cholesterol, triglyceride and HDL-C using a Roche–Hitachi Modular P800 analyzer (Roche Diagnostics, F. Hoffmann-La Roche Ltd., Basel, Switzerland).

Statistical analysis

Two sets of continuous variables were analyzed using Student's *t* test and category variables were analyzed using the χ^2 test. The relationships among BMI and SBP, DBP, serum uric acid, serum total cholesterol, serum triglyceride and serum HDL-C were tested by regression analysis. Statistical analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA) for Windows. A value of p less than 0.05 was considered statistically significant.

Results

Characteristics of subjects

Mean ages in the 15- and 18-year-old groups were 15.4 ± 0.5 years and 18.5 ± 0.5 years, respectively; mean heights were 158.1 ± 5.4 cm and 159.0 ± 5.4 cm, respectively; mean body weights were 52.0 ± 9.5 kg and 52.9 ± 10.5 kg, respectively; and mean BMIs were 20.8 ± 3.6 and 20.9 ± 3.9, respectively (Table 1).

Table 1. Characteristics of study subjects*

	15-yr-old group (n = 195)	18-yr-old group (n = 96)	Total (N = 291)
Age (yr)	15.4 ± 0.5	18.5 ± 0.5	16.4 ± 1.6
Height (cm)	158.1 ± 5.4	159.0 ± 5.4	158.4 ± 5.5
Weight (kg)	52.0 ± 9.5	52.9 ± 10.5	52.3 ± 9.9
BMI (kg/m^2)	20.8 ± 3.6	20.9 ± 3.9	20.8 ± 3.7

*Data are presented as mean ± standard deviation. BMI = body mass index.

Table 2. Prevalence of obesity and overweight in adolescent girls

	15-yr-old group* ($n=195$)	18-yr-old group* ($n=96$)	Total* ($N=291$)	OR (95% CI)†	p
Obese (BMI ≥ 25.3)	18 (9.23)	9 (9.38)	27 (9.28)	0.98 (0.40–2.59)	0.861
Overweight (22.7 ≤ BMI ≤ 25.2)	18 (9.23)	17 (17.71)	35 (12.03)	0.47 (0.22–1.04)	0.058
Total (BMI ≥ 22.7)	36 (18.46)	26 (27.09)	62 (21.31)	0.61 (0.33–1.14)	0.092

*Data are presented as n (%); †Yate's corrected odds ratios (OR) with exact confidence intervals (CI).

Table 3. Comparison of mean body mass index (BMI) and mean clinical measure values between the two different age groups of adolescent girls

	15-yr-old group ($n=195$)	18-yr-old group ($n=96$)	p*
Height (cm)	158.1	159.0	0.157
Weight (kg)	52.0	52.9	0.476
BMI (kg/m^2)	20.8	20.9	0.835
SBP (mmHg)	109.0	109.3	0.864
DBP (mmHg)	72.0	71.2	0.478
Uric acid (mg/dL)	5.7	4.9	< 0.001
CHO (mg/dL)	175.0	151.0	< 0.001
TG (mg/dL)	73.2	56.4	< 0.001
HDL-C (mg/dL)	50.8	44.2	< 0.001

*Student's t test, two-tailed. SBP = systolic blood pressure; DBP = diastolic blood pressure; CHO = total cholesterol; TG = triglyceride; HDL-C = high-density lipoprotein cholesterol.

Prevalence of obesity and overweight in adolescent girls

The obesity rates in the 15- and 18-year-old groups were 9.23% and 9.38%, respectively; the overweight rates were 9.23% and 17.71%, respectively; and the total rates of obesity plus overweight were 9.28% and 12.03%, respectively (Table 2). No statistically significant differences in the rates of obesity ($\chi^2=0.03$, $p=0.861$) or overweight ($\chi^2=3.61$, $p=0.058$) were seen (Table 2). When the numbers of obese and overweight individuals in these two groups were combined (BMI ≥ 22.7) and compared, no marked difference was found between the two groups ($\chi^2=2.36$, $p=0.092$; Table 2).

BMI and clinical measure values between groups

There were no statistically significant differences in height, weight, BMI, SBP or DBP between the 15- and 18-year-old groups (Table 3).

The mean levels of uric acid in the 15- and 18-year-old groups were 5.7 mg/dL and 4.9 mg/dL, respectively ($p=8.89\times10^{-9}$). Nine 15-year-olds but no 18-year-olds showed elevated uric acid levels in serum (reference range, 3.5–8.0 mg/dL).

The mean levels of total cholesterol in the 15- and 18-year-old groups were 175 mg/dL and 151 mg/dL, respectively ($p=4.47\times10^{-10}$). Thirty-nine 15-year-olds and five 18-year-olds had elevated total cholesterol levels in serum (reference value < 200 mg/dL). The mean values of triglyceride in the 15-year-old and 18-year-old groups were 73.2 mg/dL and 56.4 mg/dL, respectively ($p=9.31\times10^{-7}$). Six 15-year-olds but no 18-year-olds had elevated triglyceride levels in serum (reference range, 50–150 mg/dL). The mean levels of HDL-C in the 15- and 18-year-old groups were 50.8 mg/dL and 44.2 mg/dL, respectively ($p=5.44\times10^{-7}$). Six 15-year-olds and 11 18-year-olds showed decreased levels of HDL-C (reference range, 35–100 mg/dL).

Clinical measurements between normal/underweight and overweight/obese girls

We pre-tested the associations among four BMI subgroups and clinical measure values individually in the two age groups (data not shown) to find similar results between individual groups and the total number of subjects which combined the 15- and 18-year-old groups. As there was no difference in mean BMI between the 15- and 18-year-old groups (Table 3), we

Table 4. Comparison of mean clinical and biochemical parameters between normal/underweight and overweight/obese adolescent girls

	BMI ≤ 22.6* (n = 229)	BMI ≥ 22.7† (n = 62)	p‡
Age (yr)	16.4	16.7	0.098
Height (cm)	158.3	158.6	0.352
Weight (kg)	48.6	66.1	< 0.001
SBP (mmHg)	107.1	116.6	< 0.001
DBP (mmHg)	70.9	75.0	0.001
Uric acid (mg/dL)	5.3	6.1	< 0.001
CHO (mg/dL)	167.5	167.0	0.458
TG (mg/dL)	66.1	73.3	0.074
HDL-C (mg/dL)	49.7	44.7	0.001

*BMI ≤ 22.6 is normal + underweight; †BMI ≥ 22.7 is overweight + obese; ‡Student's t test, one-tailed. BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; CHO = total cholesterol; TG = triglyceride; HDL-C = high-density lipoprotein cholesterol.

combined the 15- and 18-year-old groups and subgrouped them into four BMI groups as defined by the Department of Health, Taiwan: underweight (BMI ≤ 17.9), normal weight (18.0 ≤ BMI ≤ 22.6), overweight (22.7 ≤ BMI ≤ 25.2) and obese (BMI ≥ 25.3).

To compare the clinical and biochemical parameters between normal/underweight and overweight/obese adolescent girls, we combined the overweight and obese groups and labeled them as overweight (BMI ≥ 22.7), and combined the normal weight and underweight groups and labeled them as normal (BMI ≤ 22.6). When comparing the two groups using Student's t test, age, height and levels of total cholesterol and triglyceride still showed no statistically significant differences (Table 4). However, SBP, DBP, uric acid and HDL-C showed significant differences (p = 2.22×10^{-8}, 0.001, 9.5×10^{-5} and 0.001, respectively). It was reasonable that weight was different between the two BMI groups because the primary affective factor for BMI is body weight (Table 4).

Simple regression analysis of relationships between BMI and clinical measurements

To further examine the relationships between obesity and cardiovascular risk factors, we performed a regression analysis that first used the clinical measurements as independent variables and BMI as the dependent variable, and tested these variables by multiple linear regressions. Age, SBP, DBP, and levels of uric acid, cholesterol, triglyceride and HDL-C did not affect BMI; only height and weight had an effect (data not shown), which was expected since BMI is calculated as weight/height (m^2). We therefore conducted a simple linear regression with BMI as an independent variable and clinical measurements as dependent variables. Table 5 shows that BMI affected SBP, DBP, and levels of uric acid, triglyceride and HDL-C, but not cholesterol.

Table 5. Simple regression analysis of the relationship between body mass index (the independent variable) and clinical measurements

Dependent variables	Regression coefficient*	p
SBP	1.03 ± 0.17	< 0.0001†
DBP	0.42 ± 0.15	0.0064†
Uric acid	0.11 ± 0.02	< 0.0001†
CHO	0.40 ± 0.49	0.4237
TG	1.07 ± 0.50	0.0346†
HDL-C	–0.51 ± 0.17	0.0034†

*Data are presented as mean ± standard deviation; †statistically significant at alpha level 0.05. SBP = systolic blood pressure; DBP = diastolic blood pressure; CHO = total cholesterol; TG = triglyceride; HDL-C = high-density lipoprotein cholesterol.

Discussion

This study found no statistically significant differences in height and body weight between 15- and 18-year-old adolescent girls. We thereby infer that height and body weight have developed completely by the age of 15 in females in Taiwan. After that time, no significant increases in height or body weight were found. It would be worth further evaluating this inference by collecting many more samples. Obesity rates were similar among both 15- and 18-year-old adolescent

girls in central Taiwan (9.23% *vs.* 9.28%). Although the rate of overweight seemed different between these two groups (9.23% in 15- *vs.* 17.71% in 18-year-old girls), this difference was not statistically significant (Table 2). More samples are needed to detect if there is any difference. The prevalence of overweight and obesity (BMI ≥ 22.7) in teenage girls in our study was 21.3% (62/291) (Table 2), similar to data reported in the United States that showed that more than 17% of teenagers (aged 12–19 years) in 2003–2004, in the US, were overweight [16].

In this study, higher mean levels of cholesterol, triglyceride and uric acid as well as lower mean levels of HDL-C were found in 15-year-olds compared with 18-year-olds (Table 3). Although the blood levels of cholesterol, triglyceride and uric acid may increase with age in adults, and lower HDL-C was found in overweight adolescent males ≥ 11 years compared to overweight males < 11 years [17], this phenomenon has never been reported in teenage females until now. However, detailed analysis revealed that 20% (39/195), 4.1% (8/195) and 4.6% (9/195) of 15-year-old girls showed abnormally elevated total cholesterol, triglyceride and uric acid levels, respectively, whereas only 5% (5/96) of 18-year-old girls showed abnormally elevated total cholesterol levels and none showed abnormally elevated triglyceride or uric acid levels. Also, 0.5% (1/195) of 15-year-old girls and 3% (3/96) of 18-year-old girls showed decreased levels of uric acid. Therefore, the differences in total cholesterol, triglyceride and uric acid levels between these two age groups may arise from the higher percentage of 15-year-old girls with abnormal levels. Alternatively, it may be because many junior college students consume too much high-cholesterol, fermented and carbohydrate food which are over-nutritious, or they undertake little exercise during their junior high school period. On the other hand, all of the 18-year-old girls were from nursing occupational high schools and it is possible that they are more knowledgeable about nutrition and pay more attention to their food intake. In addition, 3.1% (6/195) of 15-year-old girls versus 11.5% (11/96) of 18-year-old girls showed decreased levels of HDL-C. Therefore, the lower mean value of HDL-C in 18-year-old girls may be due to the fact that a higher percentage of them have decreased levels of HDL-C or relatively lower levels of total cholesterol. The correlation coefficient (r) between total cholesterol and HDL-C was 0.548 ($F = 125 > F_{.01(1,289)}$, $p < 0.01$; data not shown). This means that the value of HDL-C was correlated with total cholesterol in blood. This phenomenon in adolescent girls is interesting and merits the collection of more samples for further study.

Hypertension is the strongest risk factor for atherosclerosis, and is associated with obesity in the adult population. It is also a major risk factor for cardiovascular disease [18] and has been traced from youth to adulthood as a useful predictor of essential hypertension in adulthood [19,20]. This study showed significantly higher SBP and DBP in overweight and obese groups than in normal and underweight adolescent female groups (Table 4). This result is consistent with other reports that showed that mean SBP and the prevalence of high-normal and elevated SBP are elevated in obese children and adolescents [21].

Hyperlipidemias are defined as serum cholesterol and triglyceride levels over the reference value. America's national cholesterol education program (NCEP) lists their reference values for cholesterol as follows: normal, < 200 mg/dL; marginal hypercholesteremia, 200–239 mg/dL; hypercholesteremia ≥ 240 mg/dL. In this study, 17.9% of 15-year-old girls were classified as having marginal hypercholesteremia and 2.1% had hypercholesteremia. High cholesterol levels can cause atherosclerosis; the intake of lower cholesterol food, along with exercises, pharmaceutical therapy and reduced body weight can alleviate hypercholesteremia. In addition, elevated blood triglyceride levels are correlated with obesity and boost the risk of cardiovascular disease and/or acute pancreatitis whenever the patient's triglyceride levels are very high [22].

In the present study, 5.8% of the adolescent girls showed abnormally low levels of HDL-C, well known as a protective factor against cardiovascular disease and coronary artery disease (CAD) [23,24]. Other reports have shown that CAD risk is decreased by 2–3% if HDL-C is increased by 1 mg/dL; however, there was no direct correlation between CAD and LDL-C, total cholesterol or triglyceride levels [25]. HDL-C as a pivotal defense mechanism against atherosclerosis has been substantiated by population studies, showing the level of HDL-C to be a powerful and independent inverse predictor of premature coronary heart disease [26–28]. Moreover, low levels of HDL-C are the most commonly encountered dyslipidemia in cases of premature myocardial infarction with up to 40% overall prevalence [29], and multivariate regression analysis

showed increased HDL-C to be the only lipoprotein change predicting benefit [30]. Besides, both low HDL-C and high BMI are associated with increased postmenopausal breast cancer risk [31].

Raised serum uric acid levels purportedly increase the incidence of acute gout and renal calculi, and also predict increased risk of vascular events [32]. It was not a good sign when abnormally high levels of uric acid were found in 4.6% of the 15-year-old adolescents in our study. While there might be no symptoms throughout life in such people, risk of gouty arthritis and urolithiasis rises with degree and duration of hyperuricemia [33]. A recent study further revealed hyperuricemia as likely to play a prominent role in adolescent-onset essential hypertension [34] and in cardiovascular disease [35]. It is worthy to note that people, especially adolescents, with high levels of uric acid should decrease the excessive intake of food containing high purine levels.

Childhood obesity is associated with major health problems (e.g. hypertension, dyslipidemia, diabetes) and is an important early risk factor for adult obesity, morbidity and all-cause mortality [16,36]. In addition, atherosclerosis reportedly begins in childhood; hence, early detection and treatment of dyslipidemia can noticeably decrease the risk of cardiovascular diseases [37,38]. Rising prevalence of overweight and obesity, and their adverse effects, most notably increased cardiovascular risk, should elevate concern about this condition in teenagers. Decreasing BMI may help to promote health in adolescents. Clinical preventive measures are urgently needed to address the current epidemic of adolescent obesity and reduce its hemodynamic consequences.

In conclusion, the present data imply that interventions promoting a healthy lifestyle should be started at an early age to prevent or delay the development of atherosclerotic lesions and, ultimately, to minimize premature coronary heart disease in adults. It is also suggested that more food containing HDL-C should be taken by adolescents with lower blood HDL-C levels.

Study limitations

First, we did not measure abdominal circumference. Such data would provide more detailed information, and using BMI may fail to distinguish increased fat mass from increased fat-free mass. However, BMI is the preferred measure for detecting overweight in children and adolescents because of its feasibility, reliability and tracking with adult obesity measures [39]. Second, we did not assess puberty maturation, which may be significant given the age range of our subjects. However, we used each population within a narrow age range of 1 year in order to obtain a population with homogeneous sexual maturation. Third, we have no data about other cardiovascular risk factors like blood sugar. Fourth, information on smoking, exercise and diet is lacking. These may strengthen our data and will be tasks for the future.

Acknowledgments

This study was supported by a NTCNC (National Taichung Nursing College, Taiwan) 2005 grant.

References

1. Hedley AA, Ogden CL, Johnson CL, et al. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *JAMA* 2004;291: 2847–50.
2. Weiss R, Dziura J, Burgert TS. Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med* 2004;350:2362–74.
3. Rocchini AP. Childhood obesity and a diabetes epidemic. *N Engl J Med* 2002;346:854–5.
4. Baba R, Iwao N, Iwao S, et al. Risk of obesity enhanced by poor physical activity in high school students. *Pediatr Int* 2006;48:268–73.
5. Ogden CL, Flegal KM, Carroll MD, et al. Prevalence and trends in overweight among U.S. children and adolescents, 1999–2000. *JAMA* 2002;288:1728–32.
6. Freedman DS, Dietz WH, Srinivasan SR, et al. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1999;103:1175–82.
7. Must A, Jacques PF, Dallal GE, et al. Long term morbidity and mortality of overweight adolescents: a follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med* 1992;327:1350–5.
8. Rimm IJ, Rimm AA. Association between juvenile onset obesity and severe adult obesity in 73,532 women. *Am J Public Health* 1976;66:479–81.
9. Genovesi S, Giussani M, Pieruzzi F, et al. Results of blood pressure screening in a population of school-aged children in the province of Milan: role of overweight. *J Hypertens* 2005;23:493–7.
10. He Q, Ding ZY, Fong DY, et al. Blood pressure is associated with body mass index in both normal and obese children. *Hypertension* 2000;36:165–70.

11. Paradis G, Lambert M, O'Loughlin J, et al. Blood pressure and adiposity in children and adolescents. *Circulation* 2004;110:1832–8.
12. Nawrot TS, Hoppenbrouwers K, Den Hond E, et al. Prevalence of hypertension, hypercholesterolemia, smoking and overweight in older Belgian adolescents. *Eur J Public Health* 2004;14:361–5.
13. Hayman LL, Williams CL, Daniels SR, et al. Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Cardiovascular health promotion in the schools: a statement for health and education professionals and child health advocates from the Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2004;110:2266–75.
14. Freedman DS, Khan LK, Dietz WH, et al. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatrics* 2001;108:712–8.
15. Berenson GS, Srinivasan S, Bao W, et al. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. *N Engl J Med* 1998;338:1650–6.
16. Ogden CL, Yanovski SZ, Carroll MD, et al. The epidemiology of obesity. *Gastroenterology* 2007;132: 2087–102.
17. Koenigsberg J, Boyd GS, Gidding SS, et al. Association of age and sex with cardiovascular risk factors and insulin sensitivity in overweight children and adolescents. *J Cardiometab Syndr* 2006;1:253–8.
18. Stamler J, Stamler R, Neaton JD. Blood pressure, systolic and diastolic, and cardiovascular risks. US population data. *Arch Intern Med* 1993;153:598–615.
19. Bao W, Threefoot SA, Srinivasan SR, et al. Essential hypertension predicted by tracking of elevated blood pressure from childhood to adulthood: the Bogalusa Heart Study. *Am J Hypertens* 1995;8:657–65.
20. Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: the muscatine study. *Pediatrics* 1989;84:633–41.
21. Paradis G, Lambert M, O'Loughlin J, et al. Blood pressure and adiposity in children and adolescents. *Circulation* 2004;110:1832–8.
22. Yuan G, Al-Shali KZ, Hegele RA. Hypertriglyceridemia: its etiology, effects and treatment. *CMAJ* 2007;176: 1113–20.
23. Birjmohun RS, Hutten BA, Kastelein JJ, et al. Increasing HDL cholesterol with extended-release nicotinic acid: from promise to practice. *Neth J Med* 2004;62:229–34.
24. Mooradian AD, Haas MJ, Wong NC. The effect of select nutrients on serum high-density lipoprotein cholesterol and apolipoprotein A-I levels. *Endocrine Reviews* 2006;27:2–16.
25. Toth PP. High-density lipoprotein as a therapeutic target: clinical evidence and treatment strategies. *Am J Cardiol* 2005;96:50–8.
26. Jacobs DR Jr, Mebane IL, Bangdiwala SI, et al. High density lipoprotein cholesterol as a predictor of cardiovascular disease mortality in men and women: the follow-up study of the Lipid Research Clinics Prevalence Study. *Am J Epidemiol* 1990;131:32–47.
27. Gordon T, Castelli WP, Hjortland MC, et al. High density lipoprotein as a protective factor against coronary heart disease. The Framingham Study. *Am J Med* 1977; 62:707–14.
28. Genest J Jr, Martin-Munley SS, McNamara JR, et al. Familial lipoprotein disorders in patients with premature coronary artery disease. *Circulation* 1992;85:2025–33.
29. Genest J Jr, Bard JM, Fruchart JC, et al. Familial hypoalphalipoproteinemia in premature coronary artery disease. *Arterioscler Thromb* 1993;13:1728–37.
30. Robins SJ, Collins D, Wittes JT, et al. Relation of gemfibrozil treatment and lipid levels with major coronary events. VA-HIT: a randomized controlled trial. *JAMA* 2001;285:1585–91.
31. Furberg AS, Veierod MB, Wilsgaard T, et al. Serum high-density lipoprotein cholesterol, metabolic profile, and breast cancer risk. *J Natl Cancer Inst* 2004;96:1152–60.
32. Daskalopoulou SS, Tzovaras V, Mikhailidis DP, et al. Effect on serum uric acid levels of drugs prescribed for indications other than treating hyperuricaemia. *Curr Pharm Des* 2005;11:4161–75.
33. Li EK. Gout: a review of its aetiology and treatment. *Hong Kong Med J* 2004;10:261–70.
34. Feig DI. Uric acid and hypertension in adolescents. *Semin Nephrol* 2005;25:32–8.
35. Masseoud D, Rott K, Liu-Bryan R, et al. Overview of hyperuricaemia and gout. *Curr Pharm Des* 2005;11: 4117–24.
36. Dietz WH. Health consequences of obesity in youth: childhood predictors of adulthood disease. *Pediatrics* 1998;101:518–25.
37. Becque MD, Katch VL, Rocchini AP, et al. Coronary risk incidence of obese adolescents: reduction by exercise plus diet intervention. *Pediatrics* 1988;81:605–12.
38. Cresanta JL, Burke GL, Downey AM, et al. Prevention of atherosclerosis in childhood. *Pediatr Clin North Am* 1986;33:853–8.
39. US Preventive Services Task Force. Screening and interventions for overweight in children and adolescents: recommendation statement. *Pediatrics* 2005;116:205–9.

中臺灣地區某大專院校青少年女性之肥胖盛行率及其與心血管疾病危險因子之相關性

盧冠霖[1,2]　江大雄[3]　周守民[1]　侯承伯[4]
賴宗鼎[1]　王祥齡[1]
[1]國立臺中護理專科學校
[2]臺北醫學大學醫學院
[3]行政院衛生署疾病管制局應用流行病學訓練班
[4]行政院衛生署臺中醫院

過去研究結果知道肥胖與多種疾病有密切關係，但在臺灣關於青少年女性之肥胖情形與心血管疾病之關係的研究較少。本研究之目的乃研究青少年女性之肥胖與過重的盛行率及其與相關心血管疾病危險因子之關係。研究方法是針對中部某國立大專院校某年全部新生體檢之結果資料，進一步分析研究，這些研究對象分別為 **15** 歲年齡層 (五專新生) 及 **18** 歲年齡層 (大一新生)。測量項目包括身高、體重、收縮壓、舒張壓、尿酸、膽固醇、三酸甘油脂及高密度脂蛋白。為較清楚表達，我們將肥胖 (**BMI ≥ 25.3**) 及過重 (**22.7 ≤ BMI ≤ 25.2**) 合併並重定義為過重 (**BMI ≥ 22.7**)。研究結果顯示在 **291** 位女生中過重 (**BMI ≥ 22.7**) 的盛行率為 **21.31%**，並且發現過重與較高的收縮壓、舒張壓、尿酸值、三酸甘油脂及較低的高密度脂蛋白有相關，具有統計學上明顯的差異。另外發現 **15** 歲年齡層女生之尿酸、總膽固醇、三酸甘油脂與高密度脂蛋白之平均值高於 **18** 歲年齡層者，且具有統計學上明顯的差異。此外分別有 **3.1%**、**15.12%** 及 **2.1%** 的女生其尿酸、總膽固醇及三酸甘油脂值異常過高，而且亦具統計學上顯著差異。另外有 **5.84%** 的女生其高密度脂蛋白膽固醇值過低。本研究結果顯示需對於肥胖的青少年女生減重，鼓勵適當的飲食習慣以增加高密度脂蛋白膽固醇的血中濃度，並降低尿酸、低密度脂蛋白膽固醇及三酸甘油脂的血中濃度。

關鍵詞：青少年，心血管疾病，女性，肥胖，過重
(高雄醫誌 **2008;24:144－51**)

收文日期：**96** 年 **8** 月 **1** 日
接受刊載：**96** 年 **10** 月 **30** 日
通訊作者：盧冠霖醫師
國立臺中護理專科學校
台中市**403**三民路一段**193**號