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Research Article

Analysis of Triglyceride and High-Density Lipoprotein Levels in Overweight Adolescents

[1]Nurhaedar Jafar, [2]Yessy Kurniati, [1]Rahayu Indriasari, [1]Aminuddin Syam, [1]Ade Arviani and [1]Mustapa Patintingan

[1]Nutrition Science Study Program, Faculty of Public Health, Hasanuddin University, Makassar 90245, Indonesia
[2]Department of Public Health, Faculty of Medicine and Health Sciences, Alauddin State Islamic University, Makassar 90245, Indonesia

Abstract

Background and Objectives: The incidence of obesity in adolescents has increased over the last decade. Obesity is associated with higher levels of triglycerides (TGs) and high-density lipoprotein (HDL). This study evaluated TG and HDL levels in overweight adolescents at a senior high school in Makassar. **Materials and Methods:** This study used an analytic survey with a cross-sectional design to collect data from 53 adolescents. TG and HDL measurements were carried out through laboratory evaluation. Data was processed and analyzed using univariate analysis. **Results:** Abnormal TG levels were found in 20.8% of obese adolescents and in 17.2% of over weight adolescents. A higher percentage of obese adolescents (47.8%) had abnormal HDL levels compared to overweight adolescents (43.3%). **Conclusion:** Obese adolescents are more likely to have higher abnormal TG and HDL levels compared to overweight adolescents.

Key words: Adolescents, HDL, obesity, overweight, school, students, triglycerides

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Corresponding Author: Nurhaedar Jafar, Department of Nutrition, Faculty of Public Health, Hasanuddin University, Jln. Perintis Kemerdekaan X, Tamalanrea, Makassar 90245, Indonesia

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The incidence of obesity in adolescents has increased over the last decade. Based on survey data from 2011-2014, the incidence of obesity in children and adolescents in the US aged 2-19 years was 17% (2-5 years: 8.9%, 6-11 years: 17.5%, 12-19 years old: 20.5%)[1]. In Indonesia, results from the Basic Health Research (Riskesdas) study showed an increase in the prevalence of obesity in adolescents aged 16-18 years from 1.4% in 2010 to 7.3% in 2013[2,3]. Additionally, in 15 provinces, obesity rates were higher than the national prevalence in adolescents aged 16-18 years (DKI Jakarta: 4.2%, Yogyakarta Special Region: 4.1%, Bangka Belitung: 3.4%, South Sulawesi:1.7%)[4].

Obesity in adolescents is an indication of poor health in the future, as it associated with increased levels of triglycerides (TGs) and high-density lipoproteins (HDL)[5]. TGs are fats formed from food and their levels increase if caloric intake is higher than needed[6]. TGs are the most efficient form of fat for storing heat required for energy-dependent processes in the body; extra TGs are stored in the liver and in adipose tissue[7]. HDL, which is commonly referred to as "good" cholesterol, is one of five main lipoproteins in the body. HDL is the smallest and densest lipoprotein, containing the highest proportion of protein to cholesterol[8].

TG levels increase in obesity due to an increase in the release of free fatty acids from adipose tissue, as TGs are synthesized from fatty acids that form and bind to glycerol[8]. Elevations in TG levels in the blood increases the viscosity of red blood cells, which can lead to coronary heart disease and fatty liver and result in a decrease in HDL levels due to fat accumulation, which prevents adipose cells from storing triglycerides adequately[8,9].

Kusoy *et al.*[10] found that obese women in the Minahasa District of Indonesia had higher TG levels compared to obese men[11]. Additionally, Kusoy *et al.*[10] found that 58% of obese students in Manado had normal HDL levels and 42% had high HDL levels[1]. Previous studies have evaluated TG and HDL levels in obese adolescents but separately in different individuals. Additionally, no studies have examined TG and HDL levels in the same participants or compared TG and HDL levels in overweight and obese participants. Therefore, this study evaluated TG and HDL levels in overweight and obese adolescents in Makassar City.

MATERIALS AND METHODS

Experimental site: This study was conducted in one senior high school in Makassar city, the capital city of South Sulawesi Province Indonesia. The study lasted for 3 months from May to July 2018.

Materials and research tools: The population in this study included 53 students from classes X and XI of the Senior High School XIV Makassar (SMAN 16), who were overweight or obese. Exhaustive sampling techniques were used.

Research procedures and data collection: Nutritional screening was only conducted on prospective participants who were clinically obese or overweight or willing to have their height and weight recorded. Weight and height measurements were taken directly by the researcher using scales and microtoise to calculate Body Mass Index according to age (BMI/A). Nutritional screening was carried out on 100 students out of 700 students (54 students in class X and 46 students in class XI). A total of 75 students were found to be over weight with a BMI/U>1 SD. Of the 75 students, 53 students were included in the study. These students were willing to have blood samples taken and received permission from their parents.

Experimental design: This was an observational study with across-sectional design. Nutritional status, TGs and HDL-cholesterol levels were collected at the same time point.

Parameters measured: HDL-cholesterol levels were obtained using the Hypergamy venipuncture method. Materials and tools included syringes, 70% alcohol, tourniquet, needle, vacuum tube, blood container and plaster. Nutritional status was assessed by using BMI for age and was calculated from measurements of body weight (kg) and height (m).

Statistical analysis: Data was analyzed using univariate analysis.

RESULTS

Overweight prevalence based on gender: A higher percentage of adolescent girls (58.5%) were overweight compared to adolescent boys (41.5%) (Table 1).

Table 1: Characteristics of overweight sample

Characteristics	No.	Percentage
Class		
X	31	58.5
XI	22	41.5
Gender		
Female	31	58.5
Male	22	41.5
Age (years)		
14	1	1.9
15	8	15.1
16	26	49.0
17	16	30.2
18	2	3.8

TG and HDL levels in overweight adolescents: A higher percentage of adolescent boys (22.7%) had high TG levels compared to adolescent girls (3.2%) in the overweight population (Table 2). In contrast, a higher percentage of adolescent girls (48.3%) had abnormal HDL levels compared to adolescent boys (40.9%) (Table 3).

Triglyceride and HDL levels in overweight and obese adolescents: There was a higher percentage of obese adolescents (20.8%) with high TGs levels compared to overweight adolescents (17.2%) (Table 4). Similarly, there was a higher percentage of obese adolescents (47.8%) with abnormal HDL levels compared to overweight adolescents (43.3%) (Table 5).

DISCUSSION

The incidence of obesity is increasing in adolescents. This study found a higher percentage of obesity in adolescent girls compared to adolescent boys. These results are similar to those observed by Kusoy *et al.*[10], who examined the prevalence of obesity in adolescents in the Minahasa District.

Table 2: Distribution of triglyceride levels across participants

	Normal		Medium		High		Total	
Characteristics	No.	Percentage	No.	Percentage	No.	Percentage	No.	Percentage
Class								
X	23	74.2	3	9.7	5	16.1	31	58.5
XI	20	90.9	1	4.5	1	4.5	22	41.5
Gender								
Male	14	63.6	3	13.6	5	22.7	22	41.5
Female	29	93.5	1	3.2	1	3.2	31	58.1
Age								
14-16	15	78.9	3	15.8	3	15.8	19	35.8
17-18	28	82.4	1	2.9	3	8.8	34	64.2
Total	43	81.1	4	7.6	6	11.3	53	100.0

Table 3: Distribution of HDL levels across participants

	Normal		Abnormal		Total	
Characteristics	No.	Percentage	No.	Percentage	No.	Percentage
Class						
X	20	64.5	11	35.5	31	58.5
XI	9	40.9	13	59.1	22	41.5
Gender						
Men	13	59.1	9	40.9	22	41.5
Women	16	51.6	15	48.3	31	58.5
Age						
14-15	2	66.7	1	33.3	3	5.7
16-18	27	54.0	23	46.0	50	94.3
Total	29	54.7	24	54.3	53	100.0

Table 4: Triglyceride levels according to nutrition status

	Normal		Abnormal		Total	
Nutrition status	No.	Percentage	No.	Percentage	No.	Percentage
Overweight	24	82.8	5	17.2	29	54.7
Obesity	19	79.2	5	20.8	24	45.3
Total	43	81.1	10	18.9	53	100.0

Table 5: HDL levels according to nutrition status

	Normal		Abnormal		Total	
Nutrition status	No.	Percentage	No.	Percentage	No.	Percentage
Overweight	17	56.7	13	43.3	30	56.6
Obesity	12	52.2	11	47.8	23	43.4
Total	29	54.7	24	45.3	53	100

The prevalence of obesity among female adolescents was 22.03% and was 4.30% in male adolescents. Another study found that the prevalence of obesity in young adults aged 19-26 years was higher in women (23.2%) compared to men (21.2%)[12].

Mexitalia *et al.*[13], who conducted research on metabolic syndrome in junior high schools in Semarang, found a higher prevalence of obesity in adolescent boys. In 2005, 17.4% of this population was obese (males:68.6%; females: 31.4%) and in 2007, 17.9% of this population was obese (males: 82.2%, females: 17.8%)[13]. These results are consistent with a study of obesity in Indian adolescents and in children in Spain that found a higher prevalence of obesity among adolescent boys[14,15].

The cause of obesity in adolescents includes various factors. High energy, fat and carbohydrate intake, fast food consumption and low breakfast intake contribute to the incidence of obesity in adolescents in Indonesia. Adolescents who consume excessive macro nutrients and fast food intake, are physically inactive, do not eat breakfast and have obese parents are at higher risk of obesity[4]. Consuming snack foods that contain more than 300 kcal, as well as only participating in mild physical activity, also contribute to the risk of obesity in adolescents[16]. In urban areas such as Makassar, snack frequency and physical activity are risk factors associated with overnutrition in adolescents[17].

This study found that male overweight adolescents had higher TG levels compared to female overweight adolescents. These results differ from a study of obese adolescents in the Minahasa District, which found that obese girls had higher levels of elevated TGs compared to obese boys[11]. Another study found that, in young men, truncal fatty was negatively associated with HDL levels, whereas, in adolescent girls, abdominal fatty tissue was positively associated with TG levels[18].

High TG and low HDL levels were found in adolescents and children in Turkey and low HDL levels (85.4%) were found in adolescents aged 7-24 years in Mexico[19,20]. Jago *et al.*[21] found that, in 8th grade adolescents of various ethnicities,17.2% had high TGs and 13.3% had low HDL levels. While a study found that fat intake is associated with TG levels, there was no significant association between omega 3 and omega 6 levels with TG levels[22]. Putri *et al.*[23] (2017) found a significant relationship between carbohydrate, protein and fat intake and TG levels in obese adolescents; however, there was no relationship between fiber intake and TG levels. Carbohydrate intake accounted for 28.5% in elevated triglyceride levels.

The present study also found that a higher percentage of obese adolescents had high TG levels compared to overweight adolescents. A study conducted on stunted but obese adolescents aged 15-18 years in Semarang City found that 26.93% of sample had high TG and 75% had low HDL levels[24]. Wardanah[25] found a significant relationship between nutritional status (obese and non-obese) and TG levels and similar studies conducted in Lampung found a significant association between obesity and HDL levels[25,26]. The findings of a study conducted in West Bolangitang found no significant differences in total TG and LDL cholesterol levels; however, significant differences in TG and HDL levels were identified[27].

CONCLUSION

Obese adolescents are more likely to have higher abnormal TG and HDL levels compared to overweight adolescents.

SIGNIFICANCE STATEMENT

This study provides information about TG and HDL levels in overweight and obese adolescents. The results obtained show that obese adolescents are more likely to have TG and HDL disorders. Therefore, it is necessary to prevent the overweight adolescents from becoming obese to avoid increasing TG and HG levels, which can cause metabolic disorders later in life.

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REFERENCES

1. CDC., 2017. National health and nutrition examination survey, 2017. National Center for Health Statistics, Centers for Disease Control and Prevention, Atlanta, GA., USA. https://www.cdc.gov/nchs/nhanes/index.htm.
2. Depkes Republik Indonesia, 2010. Laporan hasil riset kesehatan dasar nasional tahun 2010. Badan Penelitian dan Pengembangan Depkes RI., Jakarta, Indonesia.
3. Depkes Republik Indonesia, 2013. Laporan hasil riset kesehatan dasar nasional tahun 2013. Kementerian Kesehatan Republik Indonesia, Jakarta, Indonesia.

4. Kurdanti, W., I. Suryani, N.H. Syamsiatun, L.P. Siwi, M.M. Adityanti, D. Mustikaningsih and K.I. Sholihah, 2015. [Risk factors for obesity in adolescent]. Jurnal Gizi Klinik Indonesia, 11: 179-190, (In Indonesian).
5. Herlina, S.E. and M. Kes, 2016. Hubungan aktivitas fisik remaja dengan kejadian obesitas di SMKN 1 sibolga tahun 2012. Jurnal Ilmiah Integritas, Vol. 2, No. 1.
6. Putri, S.R. and A.D. Isti, 2015. [Obesity as risk factor of higher triglyceride level]. Jurnal Majority, 4: 78-82, (In Indonesian).
7. Hardisari, R. and B. Koiriyah, 2016. Gambaran Kadar Trigliserida pada Sampel Serum dan Plasma EDTA. Jurnal Teknologi Laboratorium, 5: 27-31.
8. Kasim, S., M. Arief, A. Sulaeman and J. Widodo, 2012. [Relationship between obesity and hypertriglyceridemia on fatty liver in patients at Makassar]. Jurnal Farmasi Klinik Indonesia, 1: 136-146, (In Indonesian).
9. Tsalissavrina, I., D. Wahono and D. Handayani, 2006. [The influence of high-carbohydrate diet administration in comparison with high-fat diet toward triglyceride and hdl level in blood on *Rattus novergicus strain wistar*]. Jurnal Kedokteran Brawijaya, 22: 80-89, (In Indonesian).
10. Kusoy, K., Fatimawali and B. Kepel, 2013. Prevalensi obesitas pada remaja di kabupaten minahasa. Jurnal e-Biomedik, 1: 981-985.
11. Damanik, A.I., A.E. Manampiring and Fatimawali, 2013. Gambaran kadar trigliserida pada remaja obes di kabupaten minahasa. Jurnal e-biomedik, 1: 537-542.
12. Gordon-Larsen, P., L.S. Adair, M.C. Nelson and B.M. Popkin, 2004. Five-year obesity incidence in the transition period between adolescence and adulthood: The national longitudinal study of adolescent health. Am. J. Clin. Nutr., 80: 569-575.
13. Mexitalia, M., A. Utari, M. Sakundarno, T. Yamauchi, H.W. Subagio and A. Soemantri, 2009. [The metabolic syndrome among obese adolescents]. Media Medika Indonesiana, 43: 300-305, (In Indonesian).
14. Chhatwal, J., M. Verma and S.K. Riar, 2004. Obesity among pre-adolescent and adolescents of a developing country (India). Asia Pac. J. Clin. Nutr., 13: 231-238.
15. Pizarro, J.V. and M.A. Royo-Bordonada, 2012. Prevalence of childhood obesity in Spain; National health survey 2006-2007. Nutr. Hosp., 27: 154-160.
16. Pramono, A. and M. Sulchan, 2014. [Contributions of street food and physical activity to adolescent obesity in Semarang city]. Gizi Indonesia, 37: 129-136, (In Indonesian).
17. Aini, S.N., 2013. Faktor risiko yang berhubungan dengan kejadian gizi lebih pada remaja di perkotaan. Unnes J. Public Health, Vol. 2, No. 1.
18. Tresaco, B., L.A. Moreno, J.R. Ruiz, F.B. Ortega and G. Bueno *et al*., 2009. Truncal and abdominal fat as determinants of high triglycerides and low HDL-cholesterol in adolescents. Obesity, 17: 1086-1091.
19. Agirbasli, M., S. Cakir, S. Ozme and G. Ciliv, 2006. Metabolic syndrome in Turkish children and adolescents. Metabolism, 55: 1002-1006.
20. Castillo, E.H., G. Borges, J.O. Talavera, R. Orozco and C. Vargas-Aleman *et al*., 2007. Body mass index and the prevalence of metabolic syndrome among children and adolescents in two Mexican populations. J. Adolesc. Health, 40: 521-526.
21. Jago, R., J.S. Harrell, R.G. McMurray, S. Edelstein, L. El Ghormli and S. Bassin, 2006. Prevalence of abnormal lipid and blood pressure values among an ethnically diverse population of eighth-grade adolescents and screening implications. Pediatrics, 117: 2065-2073.
22. Nisa, F.Z., E. Probosari and D.Y. Fitranti, 2017. Hubungan asupan omega-3 dan omega-6 dengan kadar trigliserida pada remaja usia 15-18 tahun. J. Nutr. Coll., 6: 191-197.
23. Putri, S.R., D.I. Anggraini and B. Kurniawan, 2017. [The correlation between food intake and triglyceride levels in obese student at Faculty of Medicine University of Lampung]. J. Agromed. Unila, 4: 222-237, (In Indonesian).
24. Afifah, Y.N., M. Sulchan and C. Nissa, 2017. Rasio trigliserida/*high density lipoprotein-cholesterol* pada remaja stunted obesity usia 15-18 tahun di kota Semarang. J. Nutr. Coll., 6: 172-179.
25. Wardanah, A.A., 2017. Kadar trigliserida pada mahasiswa fakultas kedokteran universitas sumatera utara yang obesitas dan non-onesitas tahun 2016. Graduate Thesis, Fakultas Kedokteran, Universitas Sumatera Utara, Medan, Indonesia.
26. Ercho, N.C., K. Berawi, T. Susantiningsih, 2013. [The relation of obesity with LDL and HDL level at preclinic student of Medical Faculty Lampung University 2013]. Med. J. Lampung Univ., 3: 87-92, (In Indonesian).
27. Tandra, H.J.R., W. Bodhi and B.J. Kepel, 2016. Perbedaan profil lipid pada remaja obes dan tidak obes di Kecamatan Bolangitang Barat. Jurnal e-Biomedik, Vol. 4, No. 2.