Original Research Article

Journal of College of Medical Sciences-Nepal, Vol-21, No.3, Jul-Sep 2025

ISSN: 2091-0657 (Print); 2091-0673 (Online) Open Access
DOI: 10.3126/jcmsn.v21i3.71939

Association Between Obesity and Metabolic Derangements in Children at Kanti Children's Hospital, Nepal: A Retrospective Study

Anupama Kumari Yadav[1], **Subhana Thapa Karki**[1], **Sumit Agrawal**[1]

[1]Department of Pediatrics, Kanti Children's Hospital, Maharajgunj, Kathmandu, Nepal.

ABSTRACT

Background

Childhood obesity is rising globally and is now an emerging concern in developing countries like Nepal, where both undernutrition and overnutrition coexist. Childhood obesity is a strong predictor of adult obesity and is associated with increased risk of metabolic and cardiovascular complications. Early detection and management are therefore essential. Body Mass Index (BMI) remains the most feasible tool in clinical practice to diagnose obesity. The objective of this study is to assess the association of BMI with biochemical and radiological parameters (TSH, cholesterol, triglycerides, HDL, LDL, vitamin D, calcium, and liver ultrasonography) in children with obesity.

Methods

A retrospective study from records of children visiting in Endocrine OPD at Kanti Children's Hospital from August 2021 to August 2022 with chief complain of increase in weight were included in this study. Association of BMI with level of TSH, cholesterol, triglyceride, HDL, LDL, vitamin D, calcium and ultrasonographic changes in liver were observed.

Results

After taking height and weight, BMI was calculated and its association with TSH, cholesterol, triglyceride, HDL, LDL, vitamin D, calcium level and ultrasonographic changes in liver were seen. There was significant association between BMI and hypercholesterolemia, hypertriglyceridemia and fatty changes in liver. However, HDL level was not found to be protective. No association between BMI and TSH, level of LDL, vitamin D and calcium were found.

Conclusions

Since, childhood obesity is significantly associated with dyslipidemia and fatty liver disease, early identification and lifestyle-based interventions are critical to prevent long-term morbidity.

Keywords: pediatric obesity; body mass index; metabolic syndrome; dyslipidemias.

Correspondence: Dr. Anupama Kumari Yadav, Department of Pediatrics, Kanti Children's Hospital, Maharajgunj, Kathmandu, Nepal. Email: anupamakyadav@gmail.com, Phone: +977-9843878829. **Article received**: 2025-04-16. **Article accepted**: 2025-08-14. **Article published**: 2025-09-15.

INTRODUCTION

Childhood obesity has emerged as a global epidemic with doubling of prevalence over the last two decades.[1] It is important to identify children with overweight and obesity so that counseling and treatment can be provided. Body Mass Index (BMI) should be used for diagnosing obesity after two years of age. It takes into account the weight and height of the individual.[2,3] BMI is the ratio between weight in kg and height in m^2. Body mass index (BMI) correlates well with body fat and complications in children, however it may incorrectly diagnose obesity in muscular individuals, while underestimating adiposity in sedentary children with reduced muscle mass.[4]

Normal weight: BMI between 5th and < 85th percentile for age and sex, Overweight: BMI ≥85th to <95th percentile for age and sex (BMI: <29.9 kg/m^2), Obese: BMI ≥ 95th percentile for age and sex (BMI: 30-34.9 kg/m^2), and Severe obesity: BMI ≥120 percentile of the 95th percentile (BMI: ≥35 kg/m^2).[5]

METHODS

This retrospective study was conducted in the Endocrine Outpatient Department of Kanti Children's Hospital, Kathmandu, from August 2021 to August 2022. Ethical approval was obtained from the institutional review committee (IRC Protocol Registration No. 47/2020–021). Records of children aged >2 years who presented with weight gain were reviewed. Cases with incomplete data were excluded. A total of 55 complete records were analyzed.

Anthropometric measurements included weight measured using a digital scale, and height measured with a stadiometer. Body Mass Index (BMI) was calculated and classified according to age and sex-specific percentiles. Laboratory investigations included measurements of thyroid stimulating hormone (TSH), calcium, vitamin D, total cholesterol, triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels. Additionally, liver ultrasonography was reviewed to evaluate the presence of fatty changes.

Statistical analysis of data was done using SPSS version 16. Categorical variables were compared using Chi-square test, with p-value<0.05 considered statistically significant. Association between BMI and serum thyroid stimulating hormone (TSH), calcium, vitamin D, total cholesterol, triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), changes in liver were seen. TSH level<4.5 mcg/dl is considered normal.[6]

The mentioned data in Table 1 were taken as reference range.[7] For vitamin D level 30 ng/dl or more is considered normal, level of 21-29.9 ng/dl is considered insufficiency, 20 ng/dl or less is considered deficiency.[8]

RESULTS

Among 55 children, 36(65.5%) were male and 19(34.5%) were female. Based on BMI, 39(70.9%) were overweight, 9(16.4%) obese, and 7(12.7%) severely obese. Vitamin D deficiency was seen in 38(69.1%), and hypocalcemia in 7(12.7%) (Table 2).

Table 3 shows there was significant association between BMI with hypercholesterolemia, hypertriglyceridemia and change in echotexture of liver in ultrasonography. HDL was not found to be protective. BMI showed significant association with hypercholesterolemia (p-value<0.001), hypertriglyceridemia (p-value<0.001) and fatty liver changes on ultrasonography (p-value<0.001). No

Table 1. Reference ranges for biochemical parameters in clinical evaluation. (n=55)

Investigation	Normal	Level of concern	Pathological level
TSH	<4.5 mcg/dl		>4.6 mcg/dl
Total cholesterol	<169.9 mg/dl	170-199.9 mg/dl	>200 mg/dl
Triglyceride (TG)	<89.9 mg/dl	90-129.9 mg/dl	>130 mg/dl
Low density lipoprotein (LDL)	<89.9 mg/dl	90-129.9 mg/dl	>130 mg/dl
High density lipoprotein (HDL)	≥ 45 mg/dl	40-45 mg/dl	≤ 40 mg/dl
Calcium	>8 mg/dl		<7.9 mg/dl

significant associations were found with TSH, LDL, HDL, Vitamin D and Calcium (Table 3).

Table 2. Frequency and percentage distribution of sex, BMI classification, vitamin D level and calcium level. (n=55)

Variables	Frequency (%)
Sex	
Male	36(65.5)
Female	19(34.5)
BMI classification (kg/m²)	
BMI <29.9	39(70.9)
BMI 30-34.9	9(16.4)
BMI >35	7(12.7)
Vitamin D level (mg/dl)	
Vit D >30	6(10.9)
Vit D 20-29.9	11(20.0)
Vit D <20	38(69.1)
Calcium level (mg/dl)	
Ca <7.9	7(12.7)
Ca >8	48(87.3)

DISCUSSION

Childhood obesity is increasingly recognized as a major contributor to metabolic syndrome, which includes a cluster of risk factors such as insulin resistance, dyslipidemia, hypertension, and fatty liver disease. While diagnostic criteria for metabolic syndrome in children are not standardized due to age, pubertal stage, and ethnic variations, several studies indicate that obesity in childhood is strongly linked to early metabolic alterations and increased cardiovascular risk in adulthood. Our findings of significant associations between obesity and dyslipidemia as well as fatty liver disease support this evidence.[9,10]

Obesity and sub-clinical hypothyroidism are inter-related,[11] sub-clinical hypothyroidism is common in children with obesity. Obese people with a normal thyroid gland tend to have activation of the hypothalamic-pituitary-thyroid axis with higher serum TSH and thyroid hormones in serum and

Table 3. Metabolic and radiological hepatic changes as per BMI classification. (n=55)

Parameters	Body Mass Index (BMI)			Total n(%)	p-value
	<29.9 kg/m² n(%)	30–34.9 kg/m² n(%)	>35 kg/m² n(%)		
TSH<4.5mcg/dl	20(36)	1(1)	-	21(38)	0.007
TSH >4.6 mcg/dl	19(34)	8(16)	7(12)	34(61)	
Vit D >30 mg/dl	5(9)	1(1)	-	6(10)	0.825
Vit D 20-29.9 mg/dl	8(14)	2(3)	1(1)	11(20)	
Vit D <20 mg/dl	26(47)	6(10)	6(10)	38(69)	
Chol<169.9 mg/dl	33(60)	2(3)	4(7)	39(70)	<0.001
Chol 170-199.9 mg/dl	5(9)	-	-	5(9)	
Chol >200 mg/dl	1(1)	7(12)	3(5)	11(20)	
TG <89.9 mg/dl	24(43)	3(5)	4(7)	31(56)	<0.001
TG 90-129.9 mg/dl	14(25)	-	-	14(25)	
TG >130 mg/dl	1(1)	6(10)	3(5)	10(18)	
HDL <40 mg/dl	12(21)	4(7)	1(1)	17(30)	0.432
HDL 40-45 mg/dl	27(49)	5(9)	6(10)	38(69)	
LDL <89.9 mg/dl	15(27)	4(7)	4(7)	23(41)	0.828
LDL 90-129.9 mg/dl	13(23)	2(3)	1(1)	16(29)	
LDL >130 mg/dl	11(20)	3(5)	2(3)	16(29)	
USG Normal	24(43)	3(5)	-	27(49)	<0.001
USG Grade 1	11(20)	3(5)	-	14(25)	
USG Grade 2	3(5)	2(3)	-	5(9)	
USG Diffuse	1(1)	1(1)	7 (12)	9(16)	

Note: thyroid stimulating hormone (TSH), vitamin D (Vit D), cholesterol (Chol), triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), ultrasound sonography (USG).

leading to sub-clinical hypothyroidism.[12,13] TSH level can be raised in obese children and may not be true hypothyroidism. Although there is no exact known cause for elevation of TSH level; it is described that obese children secrete inflammatory cytokines resulting in increase level of TSH level. Since raised TSH level is transient and it normalises after reduction in weight there is no added benefit in treating sub-clinical hypothyroidism in obese children, different studies have showed different results regarding association between obesity and deranged level of thyroid hormone, several studies show association between Obesity and sub-clinical hypothyroidism.[14,15] While some studies show no significant association between obesity and sub-clinical hypothyroidism.[16,17] A study conducted by Alon et al. obese children with hyperthyrotropenimia were treated with thyroid hormone and another group were only advised for disciplinary management; there was no significant benefit noted with the use of thyroid hormone in children with increased BMI.[18] A study conducted by Song et al. showed direct association of obesity with overt hypothyroidism, sub-clinical hypothyroidism, hasimoto's thyroiditis and positive thyroid peroxidase antibody.[19] In this study there is no significant association between BMI and thyroid disorder.

A study conducted by Lai et al., showed association between obesity and hyperlipedimia, [20]while no association between obesity and hyperlipidemia in study conducted by Michael et al.[21] This study demonstrated a significant association between obesity and both hypercholesterolemia (p-value<0.001) and hypertriglyceridemia (p-value<0.001). These findings are consistent with reports from Lai et al., who noted a strong link between obesity and hyperlipidemia. Interestingly, HDL was not protective in our study, which contrasts with its established cardioprotective role. This may indicate altered lipid metabolism in obese children, meriting further investigation. No significant association was observed between BMI and LDL levels (p-value=0.828). With increase in BMI fatty changes in liver increases.[22] A study conducted at western Pomerania showed every fourth child with obesity is at increased risk of fatty liver [23] emphasizing need of ultrasonography in children with obesity. Ultrasonography revealed that fatty liver changes were significantly associated with higher BMI (p-value<0.001). The majority of severely obese children had diffused fatty liver changes. Given the operator-dependent variability of ultrasonography, standardized imaging protocols and further validation through multicenter studies are necessary.

Vitamin D and calcium deficiency in children with obesity share common risk factors including poor diet and inactivity.[24] Several studies have shown association between obesity and decreased level of calcium and vitamin D[25,26] which contradict with our study results in association with obesity. Vitamin D deficiency was highly prevalent 69.1% in this study. However, no statistically significant association was observed between BMI and vitamin D levels (p-value=0.825). Similarly, calcium levels showed no association with BMI (p-value>0.05). These findings contrast with studies that report reduced vitamin D and calcium in obese children due to poor dietary intake, decreased physical activity, and sequestration of vitamin D in adipose tissue. Our results suggest that vitamin D deficiency may be a widespread issue in the general pediatric population in Nepal, not limited to obesity.

Limitations

As this was a retrospective study, single-center study with a small sample size, results cannot be generalized. Prospective multicenter studies with larger cohorts are needed.

CONCLUSIONS

Childhood obesity in Nepal is associated with significant metabolic derangements, particularly dyslipidemia and fatty liver disease, vitamin D deficiency is common but unrelated to BMI status. These findings highlight the importance of early screening and lifestyle interventions in children with obesity to prevent long-term complications. Development of national guidelines for diagnosis and management of pediatric obesity is warranted.

ACKNOWLEDGEMENTS

The authors would like to thank all the patients in the study and entire Department of Pediatric Endocrinology.

Conflict of interest: None

Funding: None

REFERENCES

1. Caballero B. The global epidemic of obesity: an overview. Epbu. 2007 Jun 13;29:1-5. [PubMed]
2. Sweeting HN. Measurement and definitions of obesity in childhood and adolescence: a field guide for the uninitiated. Nutr J. 2007 Oct 26;6:32. [PubMed]
3. Pietrobelli A, Faith MS, Allison DB, Gallagher D, et al. Body mass index as a measure of adiposity among children and adolescents: a validation study. J Pediatr. 1998 Feb;132(2):204-10. [PubMed]
4. Kelly AS, Barlow SE, Rao G, et al. Atherosclerosis, hypertension, and obesity in the young: AHA Committee on Cardiovascular Disease in the Young. Circulation. 2013 Oct 8;128(15):1689-712. [PubMed]
5. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253. [PubMed]
6. Spencer CA, LoPresti JS, Patel A, et al. Applications of a new chemiluminometric thyrotropin assay to subnormal measurement. Clin Endocrinol Metab. 1990;70:453. [PubMed]
7. Vaman K. IAP textbook on pediatric endocrinology. Jaypee Brothers Medical Publishers; 2019 Feb 6. [Link][Google Scholar]
8. Peterson C, et al. Vitamin D deficiency and childhood obesity: interactions, implications, and recommendations. Nutr Diet Suppl. 2015 Feb 20;7:29-39. [DOI]
9. Weiss R, Bremer AA, Lustig RH. What is metabolic syndrome, and why are children getting it? Natl Libr Med. 2013 Apr;128:123-40. [PubMed]
10. Al-Hamad D, Raman V. Metabolic syndrome in children and adolescents. Transl Pediatr. 2017 Oct;6(4):397-407. [PubMed]
11. Licenziati MR, Valerio G, Vetrani I, De Maria G, Liotta F, Radetti G. Altered Thyroid Function and Structure in Children and Adolescents Who Are Overweight and Obese: Reversal After Weight Loss. J Clin Endocrinol Metab. 2019 Jul 1;104(7):2757-2765. [PubMed]
12. Laurberg P, Knudsen N, Andersen S, et al. Thyroid function and obesity. Eur Thyroid J. 2012;1:159-167. [DOI]
13. Kara O. Influence of subclinical hypothyroidism on metabolic parameters in obese children and adolescents. Clin Exp Pediatr. 2020;63(3):110-114. [PubMed]
14. Wang B, Song R, He W, et al. Sex Differences in the Associations of Obesity With Hypothyroidism and Thyroid Autoimmunity Among Chinese Adults. Front Physiol. 2018 Oct 4;9:1397. [DOI]
15. Song RH, Wang B, et al. The Impact of Obesity on Thyroid Autoimmunity and Dysfunction: A Systematic Review and Meta-Analysis. Front Immunol. 2019 Oct 1;10:2349. [PubMed]
16. Strata A, Ugolotti G, Contini C, Magnati G, Pugnoli C, Tirelli F, Zuliani U. Thyroid and obesity: survey of some function tests in a large obese population. Int J Obes. 1978;2(3):333-40. [PubMed]
17. Duntas L, Hauner H, Rosenthal J, Pfeiffer EF. Thyrotropin releasing hormone (TRH) immunoreactivity and thyroid function in obesity. Int J Obes. 1991 Jan;15(1):83-7. [PubMed]
18. Eliakim A, Barzilai M, Wolach B, Nemet D. Should we treat elevated thyroid stimulating hormone levels in obese children and adolescents? Int J Pediatr Obes. 2006;1(4):217-21. [DOI]
19. Song RH, Wang B, Yao QM, Li Q, Jia X, Zhang JA. The Impact of Obesity on Thyroid

Autoimmunity and Dysfunction: A Systematic Review and Meta-Analysis. Front Immunol. 2019 Oct 1;10:2349. [PubMed]

20. Lai SW, Ng KC, Lin HF, Chen HL. Association between obesity and hyperlipidemia among children. Yale J Biol Med. 2001 Jul-Aug;74:205-210. [PubMed]
21. Brzeziński M, Metelska P, Myśliwiec M, Szlagatys-Sidorkiewicz A. Lipid disorders in children living with overweight and obesity-large cohort study from Poland. Lipids Health Dis. 2020 Mar 16;19(1):47. [PubMed]
22. Faienza MF, Chiarito M, Molina-Molina E, Shanmugam H, Lammert F, Krawczyk M, D'Amato G, Portincasa P. Childhood obesity, cardiovascular and liver health: a growing epidemic with age. World J Pediatr. 2020 Feb 4;16(4):438-445. [PubMed] [DOI]
23. Marcinkiewicz K, Horodnicka-Józwa A, Jackowski T, Strączek K, Biczysko-Mokosa A, Walczak M, Petriczko E. Non-alcoholic fatty liver disease in children with obesity: observations from one clinical center in the Western Pomerania region. Front Endocrinol. 2022 Oct 31;13:992264. [PubMed]
24. Adikaram SGS, Samaranayake DBDL, Atapattu N, Kendaragama KMDLD, Senevirathne JTN, Wickramasinghe VP. Prevalence of vitamin D deficiency and its association with metabolic derangements among children with obesity. BMC Pediatr. 2019 Jun 8;19(1):186. [PubMed]
25. Lenders CM, Feldman HA, Von Scheven E, Merewood A, Sweeney C, Wilson DM, et al. Relation of body fat indexes to vitamin D status and deficiency among obese adolescents. Am J Clin Nutr. 2009 Sep;90(3):459-67. [PubMed]
26. Vimaleswaran KS, Berry DJ, Lu C, Tikkanen E, Pilz S, Hiraki LT, et al. Causal relationship between obesity and vitamin D status: bi-directional Mendelian randomization analysis of multiple cohorts. PLoS Med. 2013;10(2):e100138. [PubMed]

Citation: Yadav AK, Karki ST, Agrawal S. Association Between Obesity and Metabolic Derangements in Children at Kanti Children's Hospital, Nepal: A Retrospective Study. JCMS Nepal. 2025; 21(3): 259-264.