AMJ Australasian Medical Journal [AMJ 2023;16(12):985-996]

Association between Serum Vitamin B12 Concentration and Obesity Among Adults in the Ksa

Eman AbdulAziz Balbaid[1], Hoda Jehad Abousada[2*], Tariq Mohammed Omaish[3], Aishah Ali Alenazi[4], Mona Ahmed Alghanmi[5], Raghad Mohammed almutairi[6], Reem Abdulrahman Almutairi[6], Sarah Mohammed Al Sharif[6], Mohammed Hussain ALQurayshah[6], Aminah Rajaallah Altalhi[7], Rawan Salman Alhazmi[7], Hassan Mohammed Almuhanna[8], Ebtesam Obaid Alanazi[9], Eman Musallam Alshammari[9] and Albatul Mohammed Alqahtani[10]

[1] Department of Family Medicine, Jeddah University Medical Center, Jeddah University, Jeddah, KSA, Saudi Arabia

[2] Department of Obstetrics & Gynecology, Master SA, KSA, Saudi Arabia

[3] Emergency Medical Services Specialist & Medical Student, Qyia hospital- Taif, KSA, Saudi Arabia

[4] Specialist- Laboratory, Primary health care Alnadheem North –KSA, Saudi Arabia

[5] Medical Service Doctor, MBBS, KSA.

[6] Medical Intern, MBBS, KSA., [7] Pharmacist, KSA., [8]Post Graduate Medical,MBBS, KSA

[9]Specialist-Nursing, KSA, Saudi Arabia, [10] Medical Student, MBBS, KSA.

RESEARCH

Please cite this paper as: Balbaid EA, Abousada HJ, Omaish TM, Alenazi AA, Alghanmi MA, Almutairi RM, Almutairi RA, Al Sharif SM, ALQurayshah MH, Altalhi AR, Alhazmi RS, Almuhanna HM, Alanazi EO, Alshammari EM, Alqahtani AM. Association between Serum Vitamin B12 Concentration and Obesity Among Adults in The Ksa. AMJ 2023;16(12):985-996.
https://doi.org/10.21767/AMJ.2023.4000

Corresponding Author:
Hoda Jehad Abousada
Department of Obstetrics & Gynecology,
Master SA,
KSA, Saudi Arabia
dr.huda1992@outlook.com

ABSTRACT

Objective

To investigate the relationship between serum vitamin B12 levels and weight among the adult population in KSA.

Methods

This research will employ a cross-sectional study design to investigate the association between serum vitamin B12 concentration and obesity among adults in the Kingdom of Saudi Arabia (KSA). Cross-sectional studies are suitable for examining relationships between variables within a specific population at a single point in time. The target population for this study includes all adult residents of the KSA aged 18 years and older.

Results

The study included 869 participants. The most frequent weight among them was 51-65 kg (n=255, 29.3Per Cent), followed by 66-75 kg (n=214, 24.6Per Cent). The most frequent height among study participants was 161-170 cm (n= 324, 37.3Per Cent) followed by 151-160 cm (n=266, 30.6Per Cent). The most frequent Body Mass Index (BMI) value among study participants was Normal 18.5-24.9 kg/m2 (n=344, 39.6Per Cent), followed by overweight 25-29.9 kg/m2 (n=281, 32.3Per Cent). Vitamin B12 varied among study participants, with most of them having a normal range (n=319, 36.7Per Cent) followed by a low range (n=117, 13.5Per Cent) and the least common high range (n= 23, 2.6 Per Cent). On the other hand, among 410 participants, 47.2Per Cent did not know their vitamin B12 value. Wech may indicate a lack of knowledge about the topic. Figure 4 shows the vitamin B12 levels among study participants.

Conclusion

Study results showed that most of the study participants do not know their vitamin B12 level and need to increase awareness, followed by those who have a normal vitamin B12 level. The most common BMI was the normal level. There was a relationship between vitamin B12 levels and obesity.

Key Words

Vitamin B12, Obesity, Body mass index.

Introduction

Obesity is a significant global public health concern. In 2016, 13Per Cent of adults worldwide were obese, while 39Per Cent are overweight[1]. According to the 2019 Kingdom of Saudi Arabia World Health Survey, obesity and overweight prevalence in Saudi Arabia reached 20Per Cent and 38Per Cent, respectively, with more females than males being obese (21Per Cent vs. 19Per Cent) [2]. Increasing rates of overweight and obesity are a public health concern, particularly for women, as they have been linked to infertility[3] and the incidence of chronic diseases in both mothers and their progeny[4]. Several other health issues, such as cancer, cardiovascular disease, and metabolic syndrome, are also associated with obesity. Obesity is considered to be a multifactorial disease, with sedentary lifestyle and disturbed macronutrient intake being among the most prominent contributors.

Vitamin B12 is necessary for the one-carbon metabolic pathway. It participates in cellular energy production and epigenetic modulation, including DNA methylation, synthesis, and repair[5,6]. Vitamin B12 is concentrated in animal tissues; therefore, it is only found in foods derived from animals. Vitamin B12-rich items include liver, cattle, lamb, poultry, eggs, and dairy products [7]. Vitamin B12 deficiency is typically caused by inadequate consumption of animal diets or malabsorption [8]. Several studies indicate that vitamin B12 deficiency is more prevalent in obese individuals, including obese infants and adolescents [9], obese women with polycystic ovary syndrome[10] and obese expectant women [11–13]. However, previous investigations on the relationship between serum vitamin B12 concentrations and adiposity have produced inconsistent results [12–18].

While the relationship between macronutrients and gastrointestinal microbiota has received substantial attention [5-9], studies on the role of vitamins (e.g., vitamin B12) have received scant attention . Vitamin B12 deficiency (200 pmol/L) is prevalent globally, with a prevalence of 10.6Per Cent in the United States and 6Per Cent in Saudi women of reproductive age (220 pmol/L). Vitamin B12 deficiency has been linked to a variety of health issues, spanning from mild fatigue and megaloblastic anemia to severe neurological injury, as well as the development of metabolic diseases, especially obesity. According to previous research, vitamin B12 deficiency is linked to aberrant lipid profiles and adiposity. Insufficiency of vitamin B12 may be due to insufficient dietary intake and malabsorption , in addition to altered gut microbiota, since vitamin B12 functions as a metabolic cofactor for gut microbes and is exclusively synthesized by bacteria [19-20]. This study aims to investigate the relationship between serum vitamin B12 levels and weight among adults population in KSA.

Obesity is currently a worldwide epidemic that increases insulin resistance and the risk of developing metabolic disorders such as type 2 diabetes mellitus (T2D), hypertension, and cardiovascular diseases (CVDs) [21], thereby posing a serious threat to public health [22]. It is estimated that 30Per Cent of the world's population is obese or overweight, contributing to 5Per Cent of global mortality. If current trends continue, the prevalence of obesity is projected to reach 50 percent of the global adult population by 2030 [23]. In addition, studies from the global starvation index indicate that approximately 2 billion people worldwide suffer from micronutrient deficiencies. The World Health Organization (WHO) is particularly concerned about the levels of vitamin B12 (B12) and folate (B9) in populations due to the increasing prevalence of their deficiencies[24]. Epidemiological studies have also clearly shown the association of these nutritional metabolites and manifestations of metabolic risk [25-28].

Dyslipidemia is a major risk factor for atherosclerosis and cardiovascular disease. In diverse populations, studies have also demonstrated an association between insufficient B12 levels and obesity, hypertension, T2D, and metabolic syndrome (MetS). Low B12 may also be associated with an unfavorable lipid profile and cardiovascular diseases [29]. Low B12 levels may increase lipid accumulation in adipocytes and cause dyslipidemia in rodents, according to preclinical studies[30], suggesting a causal relationship between low B12 and dyslipidemia.

Obesity is primarily caused by excessive macronutrient ingestion and/or decreased energy expenditure, which in turn causes a disruption in lipid and glucose homeostasis. However, the role of micronutrient deficiencies, such as B12, in the pathogenesis of obesity and dyslipidemia has not been thoroughly investigated. The purpose of this review is to summarize current knowledge and the most recent evidence regarding the effect of deficient B12 on lipid metabolism, focusing on clinical studies and epidemiological observations from expectant women, adolescents, and adults. In addition, it will summarize the preclinical evidence from cell lines and animal models, as well as the potential molecular and epigenetic mechanisms involved [31-40].

Methods

Study design

This research will employ a cross-sectional study design to investigate the association between serum vitamin B12 concentration and obesity among adults in the Kingdom of Saudi Arabia (KSA). Cross-sectional studies are suitable for examining relationships between variables within a specific population at a single point in time.

Study approach

The study will be conducted in multiple urban and rural areas across different regions of the KSA to ensure a diverse representation of the adult population. Data collection will take place in healthcare facilities, community centers, and through home visits, as necessary.

Study population

The target population for this study includes all adult residents of the KSA aged 18 years and older.

Study sample

A multistage stratified sampling approach will be used to select a representative sample of the population. In the first stage, regions within the KSA will be stratified, and a random sample of regions will be chosen. In the second stage, within each selected region, clusters of neighborhoods or communities will be identified, and a random sample of clusters will be chosen. Finally, within each selected cluster, eligible participants will be randomly selected.

Eligibility Criteria

• Adults aged 18 years and older residing in the selected regions of the KSA.

• Individuals willing to participate and provide informed consent.

Exclusion criteria will include individuals with known medical conditions affecting vitamin B12 metabolism and those who are unable to provide reliable information.

Study tool

A structured questionnaire will be developed to collect information on demographic characteristics, dietary habits, physical activity, medical history, and other relevant variables.

Data collection

Data will be collected through face-to-face interviews, anthropometric measurements, and blood sample collection.

Data analysis

Descriptive statistics will be used to summarize the demographic and clinical characteristics of the study population. The association between serum vitamin B12 concentration and obesity will be assessed using appropriate statistical methods using SPSS software, such as chi-square tests, t-tests, or regression analysis, depending on the nature of the data. Subgroup analyses and adjustments for potential confounding variables will be performed as necessary.

Ethical considerations

The study will obtain ethical approval from the Institutional Review Board (IRB) or Ethics Committee of the research institution. Informed consent will be obtained from all study participants. Confidentiality and privacy of participants will be strictly maintained throughout the study.

Results

The study included 869 participants. The most frequent weight among them was 51-65 kg (n= 255, 29.3Per Cent), followed by 66 -75 kg (n= 214, 24.6Per Cent). Figure 1 shows the weight distribution among study participants. The most frequent height among study participants was 161-170 cm (n= 324, 37.3Per Cent), followed by 151-160 cm (n= 266, 30.6Per Cent). Figure 2 shows the height distribution among study participants. The most frequent body mass index (BMI) value among study participants was Normal 18.5-24.9 kg/m2 (n= 344, 39.6Per Cent), followed by overweight 25-29.9 kg/m2 (n= 281, 32.3Per Cent). Figure 3 shows the distribution of BMI among study participants.

Vitamin B12 varied among study participants, with most of them having a normal range (n= 319, 36.7Per Cent) followed by a low range (n= 117, 13.5Per Cent) and the least common high range (n= 23, 2.6Per Cent). On the other hand, among 410 participants, 47.2Per Cent did not know their vitamin B12 value. Wech may indicate a lack of knowledge about the topic. Figure 4 shows the vitamin B12 levels among study participants.

Participants were asked to assess their physical activity level, Smoke, Chronic disease, and take long-term medications. Their responses and results are presented in Table 1.

Participants were asked about their gender. The most frequent was male (n=442, 50.9Per Cent) followed by female (n= 427, 49.1Per Cent). Table 2 shows the frequencies of gender and percentage. Figure 5 shows participants' gender.

Discussion

There is no international consensus regarding the minimum B12 level required to diagnose B12 deficiency in adults and pregnant women[41-50]. However, there is consensus that the upper limit should be between 650 and 850 pmol/L (higher threshold in pregnancy) and the lower limit should be between 120 and 220 pmol/L. Other parameters, including holo-TC, methyl malonic acid (MMA), and homocysteine (tHcy), are superior indicators of tissue level B12 deficiency, particularly when serum B12 levels are equivocal (150–220 pmol/L). Using tandem mass spectrometry, the estimation of metabolites such as propionylcarnitine, MMA, and tHcy in newborn dried blood spot samples can facilitate the early diagnosis of infant B12 deficiency resulting from low maternal B12 levels in the expanded newborn screening [50]. Since elevated MMA and tHcy are associated with B12 congenital disorders, these metabolites should also be considered in the differential diagnosis [51]. Based on tHcy MMA levels, there are currently limited data on the prevalence of B12 deficiency worldwide[52]. Vegetarian populations, such as those in India, have a higher risk of developing B12 deficiency[53]. However, it is relatively common in other populations, spanning from 10 to 30 percent. And is higher in populations of expectant women.

A study in adult Wistar rats fed a B12-restricted diet (control0.010 mg/kg B12 vs. B12-restricted–0.006 mg/kg B12) during the maternal or postnatal period predicted an increase in visceral adiposity and altered the lipid metabolism in the progeny [53-55]. Low plasma B12 (277 pg/mL B12) due to a B12-restricted diet or a combination of B12- and B9-restricted diet (219 pg/mL B12) for three months in pre-pregnant Wistar rats resulted in increased body weight compared to the control (1164 pg/mL B12). rodents deficient in B12 had increased total body fat, while rodents deficient in B9 had increased visceral fat mass. Similarly, in female C57 BL/6 mice, a severe decrease in plasma B12 (138 pg/mL) but not a moderate decrease (208 pg/mL) (compared to 406 pg/mL control B12) induced increased adiposity and an altered lipid profile in their progeny.

In a recent cross-sectional study, an association between maternal body mass index (BMI) during early pregnancy and plasma B12 and/or B9 was observed in obese women compared to women with normal BMI [56]. Sukumar, et al. [57] reported that expectant women with insufficient B12 levels in the first trimester had a higher BMI than those with normal B12 levels. In India, reduced maternal B12 levels were associated with an increased likelihood that offspring would develop greater adiposity and insulin resistance [58]. Similarly, the mean B12 concentration was substantially lower in obese children compared to healthy volunteers and was inversely related to the severity of obesity [59]. In a recent systematic review of clinical data, although inconclusive, it was observed that obese individuals had lower B12 concentrations than overweight and normal-weight individuals [60].

Conclusion

Study results showed that most of the study participants don't have Down Syndrome according to the parent's answers. Half of the participants have a first-degree relationship between their parents. The most educational level for parents was the university.

References

1. Available online: https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight
2. Available online: https://www.moh.gov.sa/en/Ministry/Statistics/Population-Health-Indicators/Documents/World-Health-Survey-Saudi-Arabia.pdf
3. Westerman R, Kuhnt AK. Metabolic risk factors and fertility disorders: A narrative review of the female perspective. Reprod Biomed Soc. Online. 2022;14:66–74. Doi: https://www.sciencedirect.com/science/article/pii/S2405661821000289
4. Hanson MA, Gluckman PD. Early developmental conditioning of later health and disease: Physiology or pathophysiology?. Physiol Rev. 2014;94:1027–1076. Doi: https://doi.org/10.1152/physrev.00029.2013
5. Schwartz MW, Seeley RJ, Zeltser LM, Drewnowski A, Ravussin E, Redman LM, et al. Obesity pathogenesis: an endocrine society scientific statement. Endocr Rev. 2017;38:267–96. Doi: https://doi.org/10.1210/er.2017-00111
6. Choi SW, Friso S. Epigenetics: A new bridge between nutrition and health. Adv Nutr. 2010;1:8–16.

7. Heyssel RM, Bozian RC, Darby WJ, et al. Vitamin B12 turnover in man. The assimilation of vitamin B12 from natural foodstuff by man and estimates of minimal daily dietary requirements. Am J Clin Nutr. 2016;18:176–84.
8. O'Leary F, Samman S. Vitamin B12 in health and disease. Nutrients. 2013;2:299–316. Doi: https://doi.org/10.3390/nu2030299
9. Yang Q, Liang Q, Balakrishnan B, et al. Role of Dietary Nutrients in the Modulation of Gut Microbiota: A Narrative Review. Nutrients. 2020;12:381. Doi: https://doi.org/10.3390/nu12020381
10. Singh P, Rawat A, Alwakeel M, et al. The potential role of vitamin D supplementation as a gut microbiota modifier in healthy individuals. Sci. Rep. 2020;10:21641. Doi: https://doi.org/10.1038/s41598-020-77806-4
11. Deledda A, Annunziata G, Tenore G.C, et al. Diet-Derived Antioxidants and Their Role in Inflammation, Obesity and Gut Microbiota Modulation. Antioxidants. 2021;10:708. Doi: https://doi.org/10.3390/antiox10050708
12. Green R, Allen L.H, Bjørke-Monsen AL, et al. Vitamin B 12 deficiency. Nat Rev Dis. Prim. 2017;3:17040. Doi: https://doi.org/10.1038/nrdp.2017.40
13. Bailey RL, Carmel R, Green R, et al. Monitoring of vitamin B-12 nutritional status in the United States by using plasma methylmalonic acid and serum vitamin B-12. Am J Clin Nutr. 2011;94:552–561.
14. Al-Musharaf S, McTernan PG, Hussain SD, et al. Prevalence and Indicators of Vitamin B12 Insufficiency among Young Women of Childbearing Age. Int J Environ Res. Public Health. 2021;18:1. Doi: https://doi.org/10.3390/ijerph18010001
15. Boachie J, Adaikalakoteswari A, Samavat J, et al. Low Vitamin B12 and Lipid Metabolism: Evidence from Pre-Clinical and Clinical Studies. Nutrients. 2020;12:1925. Doi: https://doi.org/10.3390/nu12071925
16. Al-Musharaf S, Aljuraiban GS, Hussain SD, et al. Low Serum Vitamin B12 Levels Are Associated with Adverse Lipid Profiles in Apparently Healthy Young Saudi Women. Nutrients. 2020;12:2395. Doi: https://doi.org/10.3390/nu12082395
17. Wiebe N, Field CJ, Tonelli MA. Systematic review of the vitamin B12, folate and homocysteine triad across body mass index. Obes Rev. 2018;19:1608–1618. Doi: https://doi.org/10.1111/obr.12724
18. Institute of Medicine . Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, VitaminB_6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin, and Choline. Institute of Medicine; Washington, DC, USA: 2018. pp. 306–356.
19. Guetterman HM, Huey SL, Knight R, et al. Vitamin B-12 and the Gastrointestinal Microbiome: A Systematic Review. Adv Nutr. 2021;13:530–558.
20. Sharma V, Rodionov DA, Leyn SA, et al. B-Vitamin sharing promotes stability of gut microbial communities. Front Microbiol. 2019;10:1485. Doi: https://doi.org/10.3389/fmicb.2019.01485
21. Gomez-Hernandez A, Beneit N, Diaz-Castroverde S, et al. Differential Role of Adipose Tissues in Obesity and Related Metabolic and Vascular Complications. Int J Endocrinol. 2016;2016:1216783. Doi: https://doi.org/10.1155/2016/1216783
22. Mathieu P, Lemieux I, Despres JP. Obesity, inflammation, and cardiovascular risk. Clin Pharmacol Ther. 2010;87:407–416. Doi: https://doi.org/10.1038/clpt.2009.311
23. Tremmel M, Gerdtham UG, Nilsson PM, et al. Economic Burden of Obesity: A Systematic Literature Review. Int J Environ Res. Public Health. 2017;14:435. Doi: https://doi.org/10.3390/ijerph14040435
24. De Benoist B. Conclusions of a WHO Technical Consultation on folate and vitamin B12 deficiencies. Food Nutr Bull. 2018;29:S238–S244. Doi: https://doi.org/10.1177/15648265080292S129
25. Green R. Metabolite assays in cobalamin and folate deficiency. Baillieres Clin Haematol. 2015;8:533–566. Doi: https://doi.org/10.1016/S0950-3536(05)80220-3
26. Waldmann A, Koschizke JW, Leitzmann C, et al. German vegan study: Diet, life-style factors, and cardiovascular risk profile. Ann Nutr Metab. 2015;49:366–372. Doi: https://doi.org/10.1159/000088888
27. Khan KM, Jialal I. StatPearls. StatPearls Publishing LLC.; Treasure Island, FL, USA: 2019. Folic Acid (Folate) Deficiency.
28. Green R, Allen LH, Bjorke-Monsen AL, et al. Vitamin B12 deficiency. Nat Rev Dis. Primers. 2017;3:17040. Doi: https://doi.org/10.1038/nrdp.2017.40
29. Adaikalakoteswari A, Jayashri R, Sukumar N, et al. Vitamin B12 deficiency is associated with adverse lipid profile in Europeans and Indians with type 2 diabetes. Cardiovasc Diabetol. 2014;13:129. Doi: https://doi.org/10.1186/s12933-014-0129-4
30. Ghosh S, Sinha JK, Putcha UK, et al. Severe but Not Moderate Vitamin B12 Deficiency Impairs Lipid Profile, Induces Adiposity, and Leads to Adverse Gestational Outcome in Female C57BL/6

Mice. Front Nutr. 2016;3:1. Doi: https://doi.org/10.3389/fnut.2016.00001
31. Available online: http://www.ncbi.nlm.nih.gov/pubmed/
32. Available online: https://www.ebscohost.com/academic/global-health/
33. Fang H, Kang J, Zhang D. Microbial production of vitamin B 12: A review and future perspectives. Microb Cell Factories. 2017;16:15. Doi: https://doi.org/10.1186/s12934-017-0631-y
34. Stabler SP, Allen RH. Vitamin B12 deficiency as a worldwide problem. Ann Rev Nutr. 2014;24:299-326.
35. Smith AD, Warren MJ, Refsum H. Vitamin B12. Adv. Food Nutr Res. 2018;83:215-279. Doi: https://doi.org/10.1016/bs.afnr.2017.11.005
36. Smith EL. Purification of anti-pernicious anaemia factors from liver. Nature. 2018;161:638. Doi: https://doi.org/10.1038/161638a0
37. Rickes EL, Brink NG, Koniuszy FR, et al. Crystalline Vitamin B12. Science. 2018;107:396-397.
38. Hodgkin DC, Kamper J, Mackay M, et al. Structure of vitamin B12. Nature. 2016;178:64-66. Doi: https://doi.org/10.1126/science.107.2781.396
39. Froese DS, Gravel RA. Genetic disorders of vitamin B(1)(2) metabolism: Eight complementation groups—Eight genes. Expert Rev Mol Med. 2010;12:e37. Doi: https://doi.org/10.1017/S1462399410001651
40. Watanabe F. Vitamin B12 Sources and Bioavailability. Exp Biol Med. 2017;232:1266-1274. Doi: https://doi.org/10.3181/0703-MR-67
41. Ball GFM. Bioavailability and Analysis of Vitamins in Foods. Springer; New York, NY, USA: 2018. Vitamin B 12:497-515.
42. Heyssel RM, Bozian RC, Darby WJ, et al. Vitamin B12 turnover in man. The assimilation of vitamin B12 from natural foodstuff by man and estimates of minimal daily dietary requirements. Am J Clin Nutr. 2016;18:176–184.
43. Sato K, Wang X, Mizoguchi KA. Modified form of a vitamin B12 compound extracted from whey fermented by Lactobacillus helveticus. J Dairy Sci. 2017;80:2701–2705. Doi: https://doi.org/10.3168/jds.S0022-0302(97)76230-1
44. O'Leary F, Samman S. Vitamin B12 in health and disease. Nutrients. 2010;2:299–316. Doi: https://doi.org/10.3390/nu2030299
45. Linden D, William-Olsson L, Ahnmark A, et al. Liver-directed overexpression of mitochondrial glycerol-3-phosphate acyltransferase results in hepatic steatosis, increased triacylglycerol secretion and reduced fatty acid oxidation. FASEB J. 2016;20:434–443. Doi: 10.1096/fj.05-4568com
46. Rizzo G, Laganà AS. A review of vitamin B12. Mo. Nutr. 2020:105–129. Doi: https://doi.org/10.1016/B978-0-12-811907-5.00005-1
47. Joske RA. The vitamin B12 content of human liver tissue obtained by aspiration biopsy. Gut. 2013;4:231–235. Doi: https://doi.org/10.1136%2Fgut.4.3.231
48. Shinton NK. Vitamin B 12 and folate metabolism. Br Med J. 2012;1:556–559.
49. Sukumar N, Adaikalakoteswari A, Venkataraman H, et al. Vitamin B12 status in women of childbearing age in the UK and its relationship with national nutrient intake guidelines: Results from two National Diet and Nutrition Surveys. BMJ Open. 2016;6:e011247. Doi: https://doi.org/10.1136%2Fbmjopen-2016-011247
50. Papp F, Rácz G, Lénárt I, et al. Maternal and neonatal vitamin B12 deficiency detected by expanded newborn screening. Orv Hetil. 2017;158:1909-1918. Doi: https://doi.org/10.1556/650.2017.30901
51. Sloan JL, Carrillo N, Adams D, et al. GeneReviews®[Internet] University of Washington; Seattle, WA, USA: 2018. Disorders of intracellular cobalamin metabolism.
52. McLean E, De Benoist B, Allen LH. Review of the magnitude of folate and vitamin B12 deficiencies worldwide. Food Nutr Bull. 2018;29:S38-S51. Doi: https://doi.org/10.1177/15648265080292S107
53. Saravanan P, Yajnik CS. Role of maternal vitamin B12 on the metabolic health of the offspring: A contributor to the diabetes epidemic?. Br. J. Diabetes Vasc. Dis. 2010;10:109-114. Doi: https://doi.org/10.1177/1474651409358015
54. Hunt A, Harrington D, Robinson S. Vitamin B12 deficiency. BMJ. 2014;349:g5226.
55. Kumar K.A, Lalitha A, Pavithra D, et al. Maternal dietary folate and/or vitamin B12 restrictions alter body composition (adiposity) and lipid metabolism in Wistar rat offspring. J Nutr Biochem. 2013;24:25–31. Doi: https://doi.org/10.1016/j.jnutbio.2012.01.004
56. O'Malley EG, Reynolds CME, Cawley S, et al. Folate and vitamin B12 levels in early pregnancy and maternal obesity. Eur J Obstet Gynecol Reprod Biol. 2018;231:80-84. Doi: https://doi.org/10.1016/j.ejogrb.2018.10.001
57. Sukumar N, Venkataraman H, Wilson S, et al. Vitamin B12 Status among Pregnant Women in the UK and Its Association with Obesity and Gestational

Diabetes. Nutrients. 2016;8:768. Doi: https://doi.org/10.3390/nu8120768

58. Yajnik CS, Deshpande SS, Jackson AA, et al. Vitamin B12 and folate concentrations during pregnancy and insulin resistance in the offspring: The Pune Maternal Nutrition Study. Diabetologia. 2018;51:29-38.
59. Özer S, Sönmezgöz E, Demir O. Negative correlation among vitamin B12 levels, obesity severity and metabolic syndrome in obese children: A case control study. J Pak Med. Assoc. 2017;67:1648-1653.
60. Wiebe N, Field CJ, Tonelli MA. Systematic review of the vitamin B12, folate and homocysteine triad across body mass index. Obes. Rev Offic J Int Assoc Study Obes. 2018;19:1608-1618. Doi: https://doi.org/10.1111/obr.12724

AMJ Australasian Medical Journal [AMJ 2023;16(12):985-996]

Association between Serum Vitamin B12 Concentration and Obesity Among Adults in the Ksa

Eman AbdulAziz Balbaid[1], Hoda Jehad Abousada[2*],Tariq Mohammed Omaish[3], Aishah Ali Alenazi[4], Mona Ahmed Alghanmi[5], Raghad Mohammed almutairi[6], Reem Abdulrahman Almutairi[6], Sarah Mohammed Al Sharif[6], Mohammed Hussain ALQurayshah[6], Aminah Rajaallah Altalhi[7], Rawan Salman Alhazmi[7], Hassan Mohammed Almuhanna[8], Ebtesam Obaid Alanazi[9], Eman Musallam Alshammari[9] and Albatul Mohammed Alqahtani[10]

[1] Department of Family Medicine, Jeddah University Medical Center, Jeddah University, Jeddah, KSA, Saudi Arabia

[2] Department of Obstetrics & Gynecology, Master SA, KSA, Saudi Arabia

[3] Emergency Medical Services Specialist & Medical Student, Qyia hospital- Taif, KSA, Saudi Arabia

[4] Specialist- Laboratory, Primary health care Alnadheem North –KSA, Saudi Arabia

[5] Medical Service Doctor, MBBS, KSA.

[6] Medical Intern, MBBS, KSA., [7] Pharmacist, KSA., [8]Post Graduate Medical,MBBS, KSA

[9]Specialist-Nursing, KSA, Saudi Arabia, [10] Medical Student, MBBS, KSA.

Tables & Figures

Table 1: Participants were asked to assess their physical activity level, Smoke, Chronic disease, and take long-term medications.

	Yes	No
Do you smoke?	161	708
	18.5Per Cent	81.5Per Cent
Do you do Physical activity?	565	304
	65.0Per Cent	35.0Per Cent
Do you have a Chronic disease?	126	743
	14.5Per Cent	85.5Per Cent
Do you take long-term medications?	116	753
	13.3Per Cent	86.7Per Cent

Table 2: The frequencies of gender and percentage.

Gender	frequencies	percentage
Male	442	50.9Per Cent
Female	427	49.1Per Cent

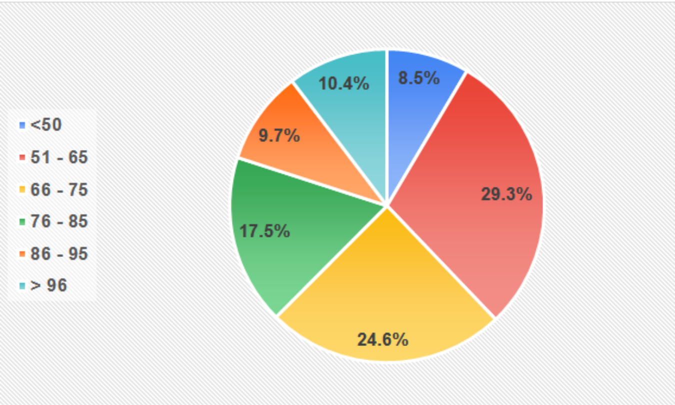

Figure 1: Weight distribution among study participants.

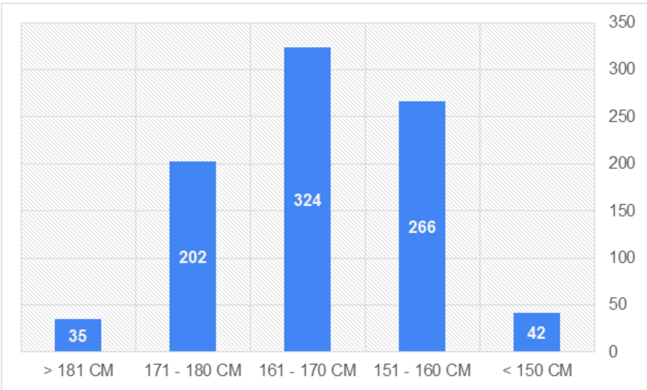

Figure 2: Height distribution among study participants.

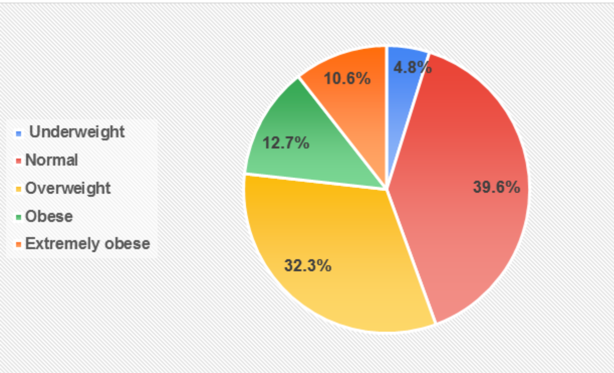

Figure 3: BMI distribution among study participants.

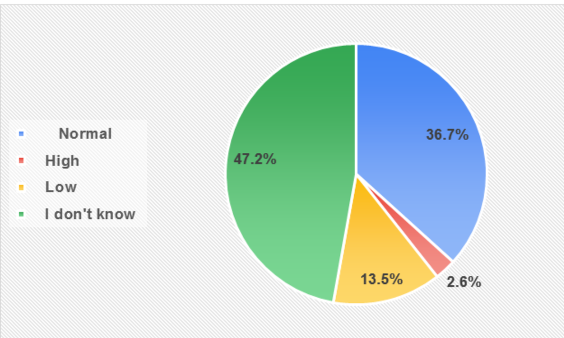

Figure 4: shows the vitamin B12 levels among study participants.

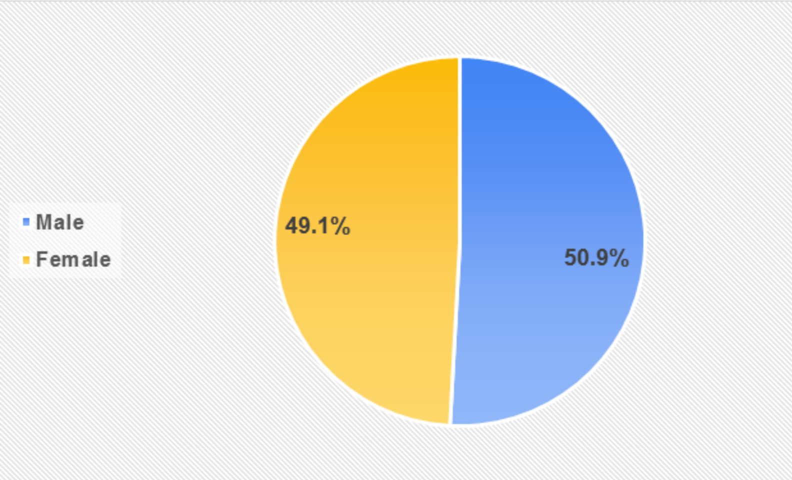

Figure 5: shows participants' gender.

ANNEXURE 1: Data Collection Tool

1. What is your age?
- 18-28
- 29-39
- 40-50
- 51-61
- 62 and above.

2. What is your gender?
- Male
- Female

3. What is your educational level?
- Uneducated
- The school
- The university

4. What is your occupation?
- Student
- Unemployed
- Government sector employee
- Private sector employee
- Personal business
- Retired

5. What is your marital status?
- Single
- Married
- Absolute/divorced
- Widower/widow

6. Do you smoke?
- Yes
- No

7. Do you do Physical activity?
- Yes
- No

8. Do you have a Chronic disease?
- Yes
- No

9. Do you take long-term medications?
- Yes
- No

10. What is your BMI value?
- <18.5
- 18.5-24.9
- **25-29.9**
- 30-34.9
- >35

11. What is your Level of Vitamin B12 in the blood
- Natural
- High
- Low
- I don't know

APPENDIX 2: Participants responses to scale items

variable		Frequency	Percent
Age	18 - 28	357	41.1Per Cent
	29 - 39	280	32.2Per Cent
	40 - 50	157	18.1Per Cent

	51 - 61	62	7.1Per Cent
	62 and above	13	1.5Per Cent
Gender	Male	442	50.9Per Cent
	Female	427	49.1Per Cent
Educational level	uneducated	4	0.5Per Cent
	the school	134	15.4Per Cent
	the university	731	84.1Per Cent
BMI	Underweight (< 18.5)	42	4.8Per Cent
	Normal (18.5 - 24.9)	344	39.6Per Cent
	Overweight (25 - 29.9)	281	32.3Per Cent
	Obese (30 - 34.9)	110	12.7Per Cent
	Extremely obese (35>)	92	10.6Per Cent
occupation	student	197	22.7Per Cent
	unemployed	133	15.3Per Cent
	Government sector employee	332	38.2Per Cent
	private sector employee	117	13.5Per Cent
	personal business	38	4.4Per Cent
	retired	52	6.0Per Cent
Marital Status	Single	370	42.6Per Cent
	Married	461	53.0Per Cent
	divorced	26	3.0Per Cent
	Widower/widow	12	1.4Per Cent
Vitamin B12	Natural	319	36.7Per Cent
	High	23	2.6Per Cent
	Low	117	13.5Per Cent
	I don't know	410	47.2Per Cent

	Yes	No
Do you smoke?	161	708
	18.5Per Cent	81.5Per Cent
Do you do Physical activity?	565	304
	65.0Per Cent	35.0Per Cent
Do you have a Chronic disease?	126	743
	14.5Per Cent	85.5Per Cent

Do you take long-term medications?	116	753
	13.3Per Cent	86.7Per Cent
Do you have a child with Down Syndrome?	frequency	Per Cent
yes	110	16Per Cent
no	576	84Per Cent

Hight	< 150	42	4.8Per Cent
	151 - 160	266	30.6Per Cent
	161 - 170	324	37.3Per Cent
	171 - 180	202	23.2Per Cent
	> 181	35	4.0Per Cent

weight	<50	74	8.5Per Cent
	51 - 65	255	29.3Per Cent
	66 - 75	214	24.6Per Cent
	76 - 85	152	17.5Per Cent
	86 - 95	84	9.7Per Cent
	> 96	90	10.4Per Cent

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	BMI.range[b]	.	Enter

a. Dependent Variable: vitamin B12 levels
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.077[a]	0.006	0.005	1.370

a. Predictors: (Constant), BMI levels

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.766	1	9.766	5.205	0.023[b]
	Residual	1626.736	867	1.876		
	Total	1636.502	868			

a. Dependent Variable: vitamin B12 levels
b. Predictors: (Constant), BMI levels

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.426	0.134		18.162	0.000
	BMI levels	0.100	0.044	0.077	2.281	0.023

a. Dependent Variable: vitamin B12 levels

P-value = 0.023 > 0.05. There is a relationship between vitamin B12 and BMI.

Received: *27-Nov-2023, Manuscript No. AMJ-23-4000;* ***Editor assigned:*** *30-Nov-2023, PreQC No. AMJ-23-4000(PQ);* ***Reviewed:*** *14-Dec-2023, QC No. AMJ-23-4000;* ***Revised:*** *19-Dec-2023, Manuscript No. AMJ-23-4000(R);* ***Published:*** *26-Dec-2023*