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Correlation of Haemoglobin Level with BMI and WHR among Young Adult Females in Selected Areas in the Southern Province of Sri Lanka

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Abstract: *Haemoglobin (Hb) level is considered as a best indicator for assessing anemia condition. Anaemia is a global health problem and its impact is felt in Sri Lanka as well. Anaemia is characterized by less than the normal quantity of hemoglobin in the blood. The recent study attempts to find the association between haemoglobin level and different anthropometric indices such as Body Mass Index (BMI) and Waist to Hip Ratio (WHR) years among the women belongs to 20-50 age groups. In this study haemoglobin level of 304 study subjects residing in Hiththatiya middle and Hungama administrative areas in the Southern province of Sri Lanka was measured. Analysis of the data revealed a no significant ($p<0.05$) correlation between haemoglobin level in this group of women with their corresponding anthropometric parameters (BMI and WHR). The overall prevalence of anaemia (Hb<12.00 g/dl) is 9.21% and 12.50% for Hiththatiya middle and Hungama grama niladhari areas, respectively. Mean BMI values were 23.2kg/m2 & 23.8kg/m2 in Hiththatiya middle and Hungama areas, respectively while mean WHR value was 0.85 which is common for both areas.*

Key words: *Body Mass Index, Haemoglobin level, Waist-Hip ratio*

1. Introduction

Anaemia continues to be a major public health problem worldwide [1]. According to estimates of the World Health Organization (WHO), 2 billion people suffer from anaemia in the world [2]. It occurs as a consequence of deficiencies in the production of mature circulating red blood cells or of excessive loss or destruction of these cells [3]. Anaemia is primarily defined in terms of the level of oxygen carrying pigment haemoglobin in the blood. Existence of a lower haemoglobin level than the normal level signifies anaemia. Other measures such as red blood cell count and packed cell volume can only be regarded as indicative of possible anaemia [3]. However, the World Health Organization (WHO) recommends that 13g/dl and 12g/dl as the cut-off points of haemoglobin for males and females respectively [4].

Anaemia is one of most prevalent pathological conditions in Sri Lanka. According to many recent studies, more than one fourth of Sri Lankan people is suffering from anaemia [5]. Out of them, women are more likely to be anaemic due to their menstrual bleeding, poor nutritional status and delivery. Therefore, it would be more benefieial in studying anaemia among a female population. There may be a relationship between anaemia, body mass index and waist-hip ratio. Individuals who are obese (BMI > 25kgm^{-2}) could be anaemic, despite of their high calorie intake. Although obesity is a sign of over nutrition, some obese people may belong to anaemic population. This can be due to the deficiency of micronutrient amount in their diet. On the other hand, the individuals who are malnourished might not be anaemic.

BMI is a parameter that is useful in assessing obesity and malnutrition. It is calculated as "weight in kilograms divided by height in meters squared (kg/m^2)" [6]. WHO has recommended classifications of bodyweight that include degrees of underweight and gradations of excess weight that are associated with increased risk of some non-communicable diseases [6]. As a measure of relative weight, BMI is easy to obtain. And it has a direct relationship with health risks and death rates in many populations. BMI cut-off points for overweight and obesity have many uses, all of which are applicable to Asian countries. For epidemiological purposes, associations

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between BMI and health outcomes within and across populations are used to help ascertain the cause of diseases [6]. BMI cut-off points are also used clinically to identify high-risk individuals for screening, to identify individuals for absolute risk assessment, to determine the type and intensity of treatment and to monitor the individuals for effects of treatment [6]. According to the WHO, cut-off points for BMI are, <16 kg/m^2 (severe underweight), 18·5–24·9 kg/m^2 (normal range), >30 kg/m^2 (obesity).

WHR is the waist circumference divided by the hip circumference and it has been suggested as an additional measure of body fat distribution. It looks at the proportion of fat stored on the body around the waist and hip [7]. Most people store their body fat in two distinct ways: around the middle (apple shaped) and around the hips (Pear shaped). Most people, who have an apple shaped abdomen (carrying extra fat around the abdomen), are at a higher health risk category than those having a pear shaped body that carry extra weight around the hips or thighs [7]. Abdominal obesity is defined as waist to hip ratio above 0.90 for males and above 0.85 for females [8]. The cut-off points for waist circumference values for Asians are 85 cm and 80 cm, and those of waist–hip ratio values are 0.90 and 0.80 for men and women, respectively [9].

Abdominal obesity or increased visceral adipose tissue is a more common condition among female population. Both generalized and abdominal obesity are associated with increased risk of morbidity and mortality. The main cause of obesity-related deaths is cardio vascular disease, for which abdominal obesity is a predisposing factor [6]. Because of that, abdominal adiposity reflected by waist-hip ratio may be an important parameter in assessing health risk of Asian population. BMI is a traditional indicator which is used to measure body size and composition and to diagnose underweight and overweight. However, alternative measures that reflect abdominal adiposity, such as waist circumference, waist–hip ratio and waist–height ratio, have been suggested as being superior to BMI. Hence, the present study will be undertaken to assess the relationship among those three parameters.

2. Methods

2.1. Subjects

The study was conducted in two administrative areas named as Hungama and Hiththatiya middle situated in the Southern Province of Sri Lanka. All healthy females in the age group of 20-50 years who gave consent were taken into the study and pregnant women, females who have chronic diseases (e.g. Diabetes Mellitus, Hypertension) and females who were suffering from acute infections (e.g. fever) were excluded.

2.2. Sampling

Every third house in the administrative area list was selected by following systematic random sampling method. Subsequently, from each household, one to three healthy individuals in the age group of 20-50 years were selected randomly by visiting those selected homes. The number of healthy females selected from each administrative area was 152. A sample of 304 healthy females representing both Hiththatiya middle and Hungama areas were recruited to this study.

2.3. Data collection

Informed consent was obtained from all individuals selected for the study before withdrawing blood and taking body measurements. Body measurements were taken at their home in a private place without disclosing to outsiders with minimal contact. For the calculation of BMI, height (m) and weight (kg) and for the calculation of WHR, waist circumference (WC) and hip (HC) circumference of each individual were measured. Waist Circumference was measured at the approximate midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape and Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor following WHO criteria.

Later, Two milliliters (2ml) of venous blood was withdrawn from each subject by a qualified nurse, under aseptic conditions using disposable syringes. Blood was collected into vacutainer tubes and transported within 24 hours of collection in a cold box at about 4 centigrade for laboratory analysis of haemoglobin. Disposable syringes/needles were used in blood withdrawing & wastes were disposed in a proper way.

2.4. Laboratory analysis

The concentration of haemoglobin was measured by photometric cyanmethaemoglobin method. Formation of cyanmethaemoglobin complex is directly proportional to the haemoglobin content of whole blood, when measured at 540 nm. Absorbance was read using UV spectrophotometer at 540 nm wave length. Quality control was performed to ensure accuracy of data and unknown samples from another laboratory was assayed as a further way of

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ensuring quality. The biochemical tests were conducted at the research laboratory, Faculty of Medical Sciences, University of Sri Jayewardenepura.

2.5. Ethical approval

The study protocol was approved by the Ethical Review Committee of the Faculty of Medical sciences, University of Sri Jayewardenepura, Sri Lanka. The privacy of the research participants and the confidentiality of data provided by them were completely protected. Data was securely stored and was available only to the investigator/supervisor and data is not divulged to any third party. Participants were entirely free to clarify any problems they had regarding the study at any time.

2.6. Statistical Analysis

Data analysis was done using a computer based statistical package, SPSS (version 15). Data was expressed as means and standard deviations. Pearson correlation test and chi-square test were used as significant tests as when required. A p-value of <0.05 was taken as the significant probability level.

3. Results

Overall, 304 participants in the age group of 20-50 years from two administrative areas were examined for the haemoglobin level while taking body measurement for the BMI and WHR.

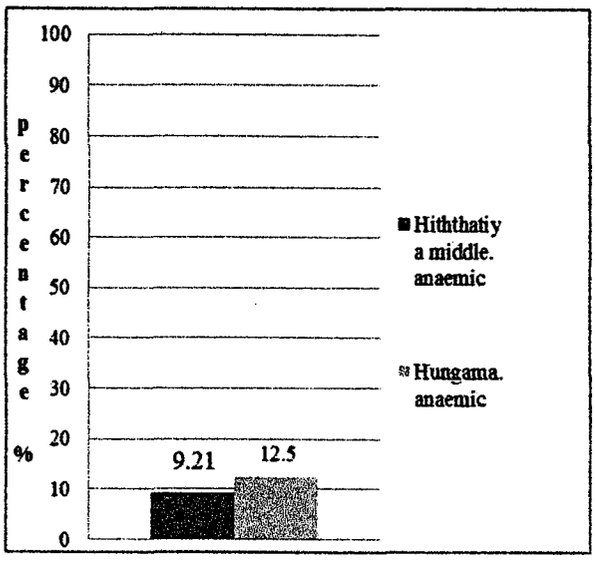

Figure 1. Prevalence of anaemia in two administrative areas

The overall prevalence of anaemia (Hb<12.00 g/dl) is 9.21% and 12.50% for Hiththatiya middle and Hungama grama niladhari areas, respectively.

Table 1. Anthropometric characteristics and Haemoglobin concentrations of participants in two grama niladhari areas

Variable	Hiththatiya middle	Hungama	p-value
BMI			
Mean	23.21	23.78	0.666
SD	3.90	4.07	
WHR			
Mean	0.85	0.85	0.909
SD	6.52	5.85	
Haemoglobin con: (g/dl)			
Mean	13.21	12.98	0.584
SD	0.87	0.97	

Mean BMI values were 23.2kg/m2 & 23.8kg/m2 in Hiththatiya middle and Hungama grama niladhari areas, respectively. Mean Hb concentration is higher in Hiththatiya Middle than Hungama grama niladhari area. There are no statistically significant differences in any of the above variables between Hungama and Hiththatiya Middle.

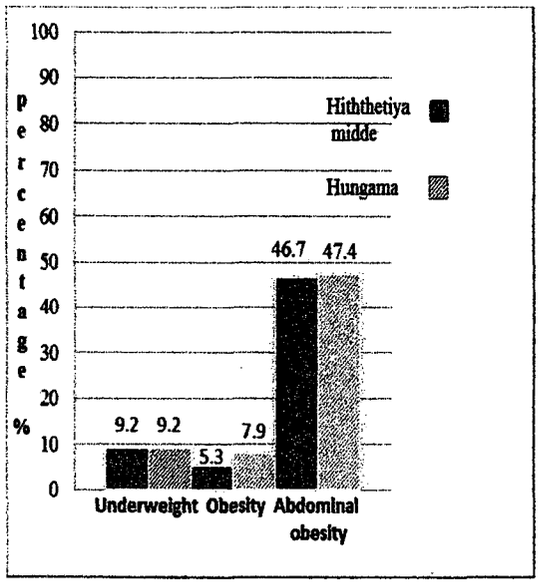

Figure 2. Distribution of BMI and WHR in two administrative areas

Prevalence of underweight (0-18.49 kg/m2) and obesity (>30kg/m2) were evaluated considering BMI values. Obesity is higher in Hungama (7.9%), than Hiththatiya middle (5.3%). Prevalence of

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underweight (9.2%) is common for both areas. Abdominal obesity is defined by the WHR. Persons with abdominal obesity as well as obesity as defined by WHR and BMI were comparatively less in Hiththatiya Middle than Hungama. The population with abdominal obesity is comparatively higher in Hungama (47.4%) than Hiththatiya Middle (46.7%).

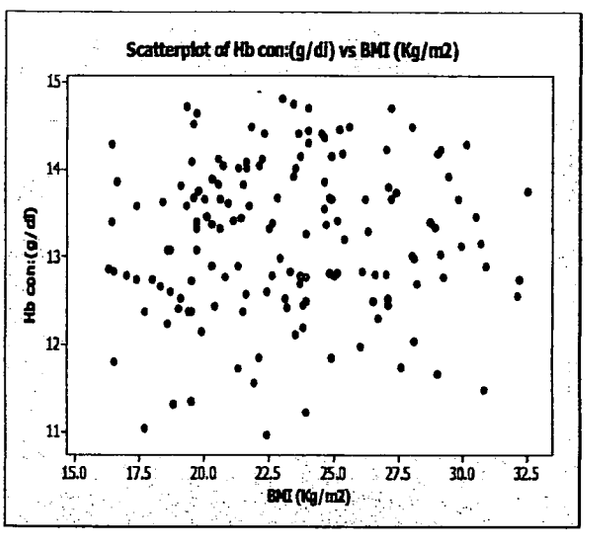

Figure 3. Correlation between BMI and Hb level among females in the total study population

There is no statistically significant difference between BMI and Hb concentration in the total population (p=0.493), according to the Pearson correlation. This shows that most of the females are having Hb concentration above 12 g/dl. Hb concentration shows wide distribution around 12-14 g/dl. There is an even scatter in BMI with Hb level among the study population.

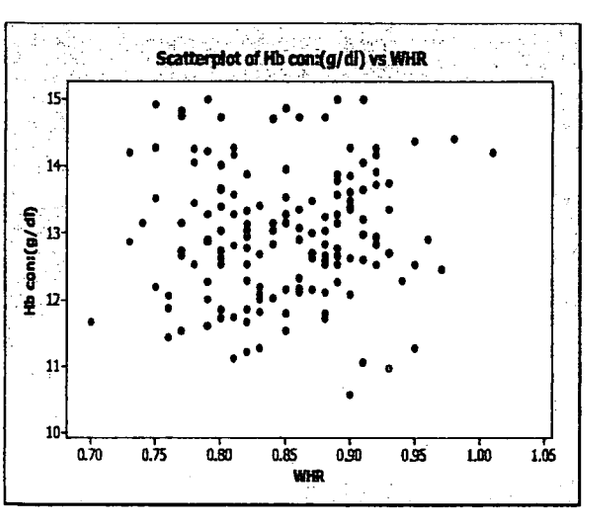

Figure 4. Correlation between WHR and Hb level among females in the total study population

There is no statistically significant difference between WHR and HB concentration in the total study population (p=0.644), according to the Pearson correlation. This shows that most of the females are having Hb concentration above 12 g/dl. Hb concentration shows wide distribution around 12-14 g/dl and WHR scatters mostly around mean WHR (0.85) among the study population.

4. Discussion

This study primarily focused on anaemia, Body Mass Index (BMI) and Waist-Hip Ratio (WHR) in a female population in two administrative areas in the southern province of Sri Lanka.

According to present study, the mean Hb concentration in Hiththatiya was somewhat greater than mean Hb level in Hungama (13.21g/dl in Hiththatiya & 12.98g/dl in Hungama). But, there was no significant statistical difference between the prevalence of anaemia among two grama niladhari areas, according to Chi-Square test (P value = 0.584 > 0.05). When considering the results obtained from the study, the prevalence of anaemia in both administrative areas was low (12.5% in Hungama and 9.21% in Hiththatiya-Middle). These values are comparable with similar studies carried out in Sri Lanka and shows considerably very low prevalence than those findings.

According to a study conducted in Galle District, in the Southern province of Sri Lanka, 64.7% of total study population were females and the prevalence of anemia (Hb <120.0 g/L) was 58.1% among them [10]. When it compares with the values obtained from the present study shows very low prevalence. However that study has been conducted among adolescents of age 12-16 years.

The mean BMI value in Hungama (23.78 kgm^{-2}), was higher than that of Hiththatiya (23.20 kgm^{-2}). But, both mean BMI values are within the healthy range of BMI, as mentioned by WHO (18 kgm^{-2}-24.9kgm^{-2}) [6]. There was no significant difference between mean WHR in two administrative areas when considered to the nearest second decimal point (0.85 in both Hiththatiya middle and Hungama). According to the BMI values prevalence of both over weight and obese are higher in Hungama than those of Hiththatiya. Percentage of people, who are having a healthy value, is greater in Hiththatiya (61.2%). Prevalence of underweight shows to be common for both areas and it is less than 10%. This is somewhat different when compared with the prevalence of underweight (33.4%) among adolescent females as described by a study carried out in Galle [10].

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In the present study, Hb concentration had no statistically significant association with BMI and WHR in both areas. This differs from the results obtained from a study in India, in which a higher prevalence of adolescent girls had anaemia (82.4%) with a lower BMI than 18.5 kg/m^2 as compared to those with BMI more than 18.5 kg/m^2 (79.7%) [11].

But another study carried out in Saudi Arabia, contains a similar result as the present study, which showed that there is no significant relationship between Hb level and total obesity as defined by BMI (obesity defined as BMI $\geq$ 30). On the other hand, there was a significant and positive relationship between Hb level and abdominal obesity as defined by waist circumference in that particular study. Waist circumference highly correlated with visceral adipose tissue accumulation especially in females (abdominal obesity defined as > 88 cm) [12]. But that study included a broader age group (18-65 years) of female population than the present study. Some differences among findings may be due to differences in age, race, geographical area of study population and cut-off points used for anthropometric parameters.

According to a study conducted in female adolescents in the NHANES 2003-2004 data set, heavier-weight girls had an increased prevalence of iron deficiency compared those with normal weight [13]. Because iron deficiency can lead to a decrease in Hb level, this is somewhat different with some findings in present study which shows that there is no significant relationship between Hb level and total body weight.

5. Conclusion

BMI and WHR had no correlation with hemoglobin concentration. Nutritional status and intake of high iron foods by persons should be considered in the future studies. Some differences among other studies may be due to differences in age, race, geographical area of study population and cut-off points used for anthropometric parameters.

Since WHR is an indicator of health risk associated with excess fat around the waist, these data support a potential benefit in reducing the risk of obesity related cardiovascular diseases. As total study population contains nearly 47% of abdominally obese women, proper control of body fat distribution by means of regular exercise or by having a balanced diet should be encouraged.

The prevalence of anaemia in both study areas is significantly less compared to national data. Individuals detected with low haemoglobin concentration (anaemia) were referred for medical advice for the management of the condition. There was no significant difference between prevalence of anaemia in the two administrative units ($P > 0.05$). Thus there may be pockets in Sri Lanka where anaemia may not be a major health problem as compared to the rest of the country.

6. Acknowledgement

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7. References

[1] Raghuram V, Manjula A, Jayaram S, "Prevalence of anaemia amongst women in the reproductive age group in a rural area in South India", Int J Biol Med, 2012, 3(2): 1482-1484.

[2] Underwoo B, "The extent and magnitude of iron deficiency and anaemia. In: Anna Verster (Ed.): Guidelines for the Control of Iron Deficiency in Countries of the Eastern Mediterranean, Middle East and North Africa. Alexandria": World Health Organization Regional Office for the Eastern Mediterranean, 1996, pp. 14-18.

[3] Campbell K, "Anaemia- causes and treatment"; Nursing Times; 2003, 99(43): 30.

[4] Wallace R B, Penninx B W J H, Guralnik J M, Onder G, Pahor M, Ferrucci L,"Anaemia and decline in physical performance among older persons"; American Journal of Medicine; 2003, 115(2): 104-110.

[5] Kankanamge SU, Ariyarathna S, Perera RRP, "Prevalence of Anaemia Among Young Adult Females in Two Selected Grama Niladhari Areas in the Southern Province of Sri Lanka", Science Journal of Public Health. Vol. 4, No. 6, 2016, pp. 430-434.

[6] World Health Organization (WHO), "Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies"; Report of a WHO Expert Consultation, The Lancet;2004, 363.

[7] Al-Hilli M N and Al-Shalah H H, "Procalcitonin as a Mediator of Chronic Inflammation in Obese Women with PCOS"; Medical Journal of Babylon; 2010, 7: 3-4.

[8] World Health Organization (WHO),"Obesity: Preventing and managing the global epidemic";

Imperial Journal of Interdisciplinary Research (IJIR)
Vol-2, Issue-12, 2016
ISSN: 2454-1362, http://www.onlinejournal.in

Report on a WHO consultation on obesity; WHO, Geneva, 1998, 154.

[9] Diaz V A, Mainous A G, Baker R, "How does ethnicity affect the association between obesity and diabetes?"; Diabetic Medicine, 2007, 24 (11): 1199-1204.

[10] Hettiarachchi M, Liyanage C, Wickremasinghe R, David C, Steven A, "Prevalence and severity of micronutrient deficiency: a cross-sectional study among adolescents in Sri Lanka"; Asia Pacific Journal of Clinical Nutrition; 2006, 15 (1): 56-53.

[11] Verma A, Rawal V.S, Kedia G, Kumar D, Chauhan J, "Factors influencing anaemia among girls of school going age (6-18 years) from the Slums of Ahmedabad city"; Indian Journal of Community Medicine; 2004, 29 (1).

[12] Al-Hashem FH, "Is it necessary to consider obesity when constructing norms for hemoglobin or when screening for anemia using hemoglobin levels?", Saudi medical journal. 2007; 28(1):41-5.

[13] Liang H, Tussing-Humphreys L M, Nemeth E, Freels S, "Excess adiposity, Inflammation and Iron Deficiency in female adolescents"; Journal of the American Dietetic Association; 2009, 109(2): 297-309.

[14] Jayathissa R, National Food Security Survey (NFSS),"Current Nutritional status of children in Sri Lanka", Sri Lanka Nutrition Bulletin; 2009; 1: 5.

[15] National Health and Nutrition Examination Survey III (NHANES III), 2006.

[16] Salazar J J E, Pompilio T O, Martinez-Salgado H, "Coexistence of obesity and anemia in children between 2 and 18 years of age in Mexico"; Bulletin Medical Hospital Infant Mexico, 2011, 68(6):431-437.

[17] Seidell J C, "Waist circumference and waist/hip ratio in relation to all-cause mortality, cancer and sleep apnea"; European Journal of Clinical Nutrition; 2010, 64(1):35-41.

[18] Bentley ME, Griffiths PL, "The burden of anemia among women in India", European Journal of Clinical Nutrition, 2003, 57: 52-60.

[19] Ulijaszek SJ, Kerr DA 1999. "Anthropometric measurement error and the assessment of nutritional status", British Journal of Nutrition, 1999, 82: 165-177.

[20] Agrawal P et al, "Role of lifestyle and diet in emerging obesity among Indian women and its impact upon their health status", International Union for the Scientific Study of Population Paper, 25th International Population Conference, France, 2005.