FACTORS AFFECTING BODY MASS INDEX AND ITS CORRELATION WITH ANEMIA IN YOUNG FEMALES

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Abstract
Background: The body mass index of an individual is particularly important for the determination of several risk factors. Limited studies have been conducted on the association of body mass index with tea consumption and hemoglobin levels especially in females of reproductive age group.
Objective: To determine the factors associated with body mass index among women of reproductive age in the region of district Kech, Balochistan.
Methodology: A cross-sectional study was conducted at the Department of Obstetrics and Gynecology Mekran Medical College Turbat, Balochistan on 16-35-year-old, non-pregnant women during January - December 2021. Using convenient purposive sampling 356 participants were included in the study.
Results: The mean age of 356 included participants was 27.39 ±5.30. Among participants, 145 (40.7%) belonged to rural areas, 41(11.5%) participants belonged to nuclear families, and only 111(31.1%) participants were literate. Only 266 (74.7%) participants were regular tea drinkers. 44(12.3%) participants were underweight, 135(37.9%) had an ideal body mass index, 103(28.89%) were classified as overweight, and only 74(20.7%) participants were categorized as obese. A significant association was found between tea drinking and urban residence with BMI (p<0.05). A significant correlation was found between BMI and hemoglobin levels of study participants.
Conclusion: Among the women of reproductive ages, higher levels of BMI were found to be associated with daily milk tea consumption and Urban residence. Moreover, Higher BMI is correlated with higher hemoglobin levels.

Keywords: Body mass index, Hemoglobin, Obesity, Tea.

Introduction:
Body Mass Index is an important tool to assess health status. It is calculated as weight in kilograms divided by height in meters squared (kg/m2). A Body Mass Index below 18.5 kg/m2 is classified as underweight and a Body Mass Index above 22.9 kg/m2 is classified as overweight. Whereas values

in between these are considered normal [1]. Obesity is defined as the accumulation of excessive fat in the body when an increase in energy intake exceeds its consumption [2]. Obesity has grown into a worrisome global epidemic over the last few decades posing socio-economical, and medical burdens on society. The evidence strongly shows that women tend to be more affected by obesity than their counterparts. A significant Pakistani adult population faces the issue of overweight and obesity with higher prevalence among women, ever-married individuals, and urban residents [3]. Obesity puts the person at a higher risk of developing obesity-related non-communicable diseases such as hypertension, insulin resistance, type-2 diabetes mellitus, atherosclerosis, dyslipidemia, inflammations, nonalcoholic steatohepatitis, stroke, and cancers [2]. In obese females during the reproductive age release of adipokines especially leptin from adipocytes disturbs the normal menstrual cycle and hormonal balance resulting in delayed conception, increased risk of miscarriages, and reduced outcomes of assisted conception along with other obesity-related systemic complications [4-5]. A study reported that 15% of girls were overweight and obese than their ages from Balochistan [6].

Multiple foods are associated with an increase in body mass index. Among the adult population; these items include a high intake of snacks fried in oil, processed food, seafood, organ meat, poultry, rice- or flour-based products, refined desserts, and sugary drinks. On the other hand, consuming vegetables, fruits, whole grain-based products, eggs, milk, and foods cooked without oil is negatively correlated with obesity [7].

Diet has an impact on someone's body mass index. The impact of tea consumption on body mass index has remained controversial. Except for water, tea is the most consumed beverage worldwide. Tea is one of the most commonly consumed beverages in Pakistan too. Tea is classified based on fermentation status into six types: green tea, white tea, yellow tea, oolong tea, black tea, and dark. There have been long debates on the anti-obesity properties of tea attributed to the polyphenols, polysaccharides, and caffeine contents [8].

Variation in body mass index leads to a change in various hormonal levels. Extensive research has investigated the link between BMI and haemoglobin levels, illuminating the intricate relationship between dietary intake, inflammation, hormonal influences, and preexisting diseases. People with lower body mass indexes tend to have lower haemoglobin levels, according to research [9]. People with lower body mass indexes are more likely to have deficiencies in iron, folate, and vitamin B12, all of which are critical for erythropoiesis. Haemoglobin levels have been associated with changes in body mass index (BMI), which is an indicator of obesity [10]. An increase in body mass index is associated with persistent low-grade inflammation, and it can affect iron metabolism and erythropoiesis. An increase in body mass index also leads to changes in various hormonal levels like insulin, leptin, and adiponectin levels, all of which can influence erythropoiesis and haemoglobin synthesis [11-12]. Reduced body mass index of adolescent females is associated with reduced hemoglobin levels in Pakistani university students.

Studies exploring the factors associated with BMI among young females and its correlation with anemia is very limited in Pakistan and especially in the province of Balochistan. So aim of the current study was to determine the factors associated with BMI and its correlation with hemoglobin levels among women of reproductive age in the region of district Kech, Balochistan

Methodology:
A cross-sectional study was conducted at the Department of Gynecology and Obstetrics Teaching Hospital Mekran Medical College Turbat (MMCT), Balochistan, from January to December 2021. The female patients of age group 16-35, non-pregnant, willing to participate were included in the study. The ethical approval was obtained from the ethical review committee of MMCT. A sample size of 323 were calculated by using online sample size calculator openEpi by considering the prevelance of 30% anemia in young females and 95% confidence interval [13]. We did convininet purposive sampling technique and our current sample size of 356 exceeds the minimum required sample size. The informed consent was taken from the participants. Initially sociodemographic data of the participants were recorded. Participants were asked about amount of tea consumed by them.

The anthropological measurements of weight, height, hip, and waist circumference were taken and body mass index of the participants were measured. Height of the study participants were measured using stadiometer while waist and hip circumference were measured using non strechable measuring tape. The participants were classified according to the general classifications of BMI. A 3 ml of venous blood was drawn and hemoglobin level of the patient was measured using an automated analyzer machine. The qualitative parameters including residence, family type, education status and tea drinking was measured in terms of frequencies and association of these parameters with BMI was measured by applying Chi-square test. Mean difference of BMI among tea drinkers and non-tea drinkers and rural and urban participants was calculated by applying independent sample t-test. Correlation of Body mass index with Hemoglobin Level was measured by appling pearsons correleation. All the data was analyzed by using SPSS software version 26. $P < 0.05$ was considered significant.

Results:

The mean age of participants was 27.39 ±5.30 years. The mean BMI of the study participants was 25.11 $\pm$ 5.75 kg/m2. Out of 356 study participants, 145 (40.7%) belonged to rural areas while 211 (59.3%) were residents of urban areas. 41(11.5%) participants belonged from the nuclear families, and only 111(31.1%) participants were literate. Among the participants, 266 (74.7%) reported to be regular tea drinkers. Among the study participants 44(12.3%) were underweight, 135(37.9%) had an ideal BMI, 103(28.89%) were classified as overweight, and only 74(20.7%) participants were categorized as obese. A significant association was found between tea drinking and higher BMI in the study participants (p<0.05) (Table I). Residents of urban areas have significantly higher BMI (p<0.05) (Table II). A positive significant correlation was found between the BMI of study participants and the Hemoglobin level of study participants (Table-III).

Table I: Association of Body mass index with Residence, Family Type, Educational Status & Tea Drinking.

Variable	Underweight (n = 44)	Ideal (n = 135)	Overweight (n = 103)	Obese (n = 74)	Chi-square X^2	p - Value
Residence						
Rural	23 (6.5%)	65 (18.3%)	40 (11.2%)	17 (4.8%)	15.32	**0.002***
Urban	21 (5.9%)	70(19.7%)	63 (17.7%)	57 (16%)		
Family Type						
Nuclear	6 (1.7%)	12 (3.4%)	13 (3.7%)	10 (2.8%)	1.52	.677
Combined	38 (10.7%)	123 (34.6%)	90 (25.3%)	64 (18%)		
Educational Status						
Literate	11 (3.1%)	44 (12.4%)	33 (9.3%)	23 (6.5%)	0.944	0.815
ill literate	33 (9.3%)	91 (25.6%)	70 (19.7%)	51 (14.3%)		
Tea Drinking						
Tea Drinkers	26 (7.3%)	100 (28.1%)	84 (23.6%)	56 (15.7%)	8.32	**0.040***
Non-Tea Drinkers	18 (5.1%)	35 (9.8%)	19 (5.3%)	18 (5.1%)		

Table II: Mean difference of BMI among tea drinkers and non-tea drinkers and rural and urban participants.

	Rural Mean $\pm$ S.D (n = 145)	Urban Mean $\pm$ S.D (n = 211)	p-value
BMI	23.77 $\pm$ 5.59	26.02 $\pm$ 5.69	**0.000***
	Tea Drinkers Mean $\pm$ S.D (n = 266)	**Non-Tea Drinkers Mean $\pm$ S.D (n = 90)**	
	25.49 $\pm$ 5.58	23.95 $\pm$ 6.12	**0.02***

Table III: Pearson's Correlation of Body mass index with Hemoglobin Level.

Variable	r	p-value
BMI - Hb	0.126*	0.017*

Discussion:

The metabolic effect of tea on obesity has been a controversial debate over the decades. Some studies have shown the anti-obesity effects of long-term consumption of green tea but others found no significant association [5]. A two-sample Mendelian study reported only 0.2% reduced obesity risks in tea drinkers compared to non-consumers in the general population. The effects of tea consumption were statistically significant but medically weak on obesity control [8]. The anti-obesity mechanisms of green tea include increased energy expenditure, decreased digestion and absorption, modification of gut microbiota, enhancing lipolysis with reduced lipogenesis, and possible modulation of adipocytes and neuroendocrine functions, while other studies only reported the improvement of obesity-related indicators [5].

The combined effects of milk and tea on overall BMI and weight gain remain under-reported. The results indicate a significant association between milk tea consumption and overweight and obesity among study participants. However, there have been studies reporting a direct association between tea consumption and overweight and obesity. A study reported that the consumption of iced tea results in overweight and obesity among women with a significant increase in waist circumference and BMI along with a decrease in serum HDL [9]. Another study reported that the dietary pattern including tea with other food items was found to be associated with increased BMI and waist circumference among adult women [6].

Satija. A. *et al*. reported that dietary plans with plain milk tend to reduce the risk of obesity among adults. However, a strong association was reported between daily tea consumption and the increased risk of obesity in the Indian adult population along with odds of increased waist circumference [11]. A similar association with obesity was reported among girls consuming tea in their daily breakfast in Balochistan [5]. Another prospective cohort study reported increased odds of weight gain in women consuming milk in tea/coffee conflicting with the studies reporting anti-obesity properties of tea. Furthermore, adding milk to tea or coffee increases the odds of excessive gestational weight gain in females during pregnancy [11].

The widely accepted explanation of the mechanism is that the milk proteins pose an inhibitory effect on the diet-induced thermogenesis of tea. It may be attributed to the formation of protein-polyphenol complex formation thus reducing the absorption of free polyphenols. The milk proteins increase the gastric pH; the reduced absorption of polyphenols could be the result of an increased gastric pH alternating the ionization of polyphenols therefore affecting the overall absorption of these compounds [12]. The increase in BMI may also be attributed to the consumption of tea with higher sugar content [08]. Even the presence of ±4 tablespoons of sugar in beverages like juices, tea, coffee, milk, and energy drinks is reported to cause higher BMI and central obesity among women in their reproductive age [13].

The results also indicated a significant association between rural area residents and overweight or/ obesity. The possible cause of this association could be the lack of awareness, poor education, access to health facilities, and nutritional deficiencies in the diet. This has been documented that the population residing in urban and rural areas faces the issue of being obese and malnourished at the same time in South Africa, putting a double burden on the health care system [14].

Our study shows a significant positive correlation between body mass index and hemoglobin levels of the study participants which is in line with the study conducted by Khakurel et al which also concluded a positive correlation of hemoglobin and BMI levels [15]. Similarly, an uphill linear correlation between BMI and hemoglobin level has been reported by Singh et al [16].

The possible confounders and recall bias from participants of the study cannot be overlooked. The overweight and obese tend to under-report the daily dietary intake which could have caused the bias in the results. However, tea and its potential effects as an obesity or/ anti-obesity agent remain debatable. The combined effect of milk and tea tends to have decreased anti-obesity potential and is

associated with increased BMI among women of reproductive age. It is recommended to conduct further studies in the region to assess and determine other possible factors causing higher BMI among women of reproductive age in the region.

Conclusion:
Among the women of reproductive years, a significant association between higher BMI and daily milk tea consumption was found, as well as residence in rural areas was found to be associated with overweight and obesity among study participants.

Conflict of interest: Authors have no conflict of interest

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