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Comparison of Body-Mass-Index using Standard WHO and Modified BMI Criteria: An Assessment of Nutritional Status among Premenopausal and Postmenopausal Bhil Women of Nandurbar District in Maharashtra, India

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Abstract: Menopause is defined as the period of transition where a women's body undergoes numerous transformations post their menstruation ceases. In India, health status of the tribal women has been a growing concern among researchers especially with respect to their nutritional status. Undernutrition and obesity have been linked with multiple health complications and similarly, vulnerability to chronic diseases like osteoporosis, cardiovascular disease, breast cancer, diabetes have been associated with menopause. Therefore, to access the nutritional status of post-menopausal Bhil women using anthropometric measurements like weight-height, body mass index (BMI), a cross-sectional study was undertaken among 397 participants, out of that 183 women were premenopausal and 214 women were postmenopausal to determine the prevalence of undernutrition and obesity among premenopausal and postmenopausal women from the Bhil tribe in Nandurbar district of Maharashtra within the age group of 35-64 years. The two criteria were used for assessing nutritional status namely, Standard WHO guidelines and modified WHO consensus for Asian population that were assessed and compared to identify the burden of undernutrition, overweight and obesity among

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premenopausal and postmenopausal women from Bhil tribe. The study results heighted that more than 34% of the women study participants from Bhil tribe falls under the underweight category that is extremely alarming from health status point of view requiring intervention the revised consensus for Asian population identifies the Bhil women who are in the obese category that are not recognized under standard WHO-BMI values. Therefore, it becomes extremely important to assess the population through population specific cut off values to avoid underreporting of nutritional status. The findings also reveal that more than 30% of the Bhil women from both the groups are underweight. This puts them at risk of various health disorders and therefore, an intervention design focused to improve their health awareness and nutritional outcomes is required especially among the aging Bhil women.

Keywords: Menopausal health, Nutritional status, Bhil tribe

Introduction

The Bhil tribe, is one of the largest scheduled tribes of Maharashtra in India and is the second largest tribal group in India predominantly found in the states of Rajasthan, Gujarat, Madhya Pradesh, and Maharashtra. As per the census of 2011, Bhil Tribe alone comprises 25.04% out of all the tribal groups in Maharashtra majorly found in districts of Nandurbar, Dhule and Nashik [1]. Scheduled tribes are categorized under socio-economically backward groups and are often seen to share characteristics of lower literacy, geographical isolation. In India, tribal communities face several health challenges and have poorer health outcomes compared to the overall population. Most of the research and policies account for the women in their reproductive years. However, it is important to assess the women especially from these isolated groups in their post reproductive years as far as health status is concerned. The present study tries to evaluate the nutritional status of Bhil women who are in their reproductive years as well as those who have attained menopause. The World Health Organization (WHO) defines natural menopause as the permanent cessation of menstruation resulting from the loss of ovarian follicular activity without a known intervening cause and is confirmed only after twelve consecutive months of amenorrhea. Worldwide, natural menopause varies between the ages of 45 and 55 years [2]. Presently, the average age of women at menopause is about 51 years in industrialized countries, whereas in the developing countries, it ranges from 41 to 49 years [3]. Tribal people often struggle with inadequate access to nutritious

food, leading to high rates of malnutrition, particularly elderly people where lack of sufficient healthy food and consumption practices among ST women causes poor health and severe health consequences [4]. According to the latest National Family Health Survey report (2019–21), nearly 13% of Indian women are underweight, while 33.2% are overweight. Almost 17.4% of tribal reproductive women belong to underweight [5].

Materials and Method

A cross-sectional study was carried out among the premenopausal and postmenopausal women in the *Akklakuwa* taluka of the Nandurbar district of Maharashtra, India among the Bhil women. The Bhil tribe has been declared as one of the Scheduled Tribes (ST) of India based on characteristics like geographical isolation, low level of literacy, declining or stagnant population growth. These characteristics not only make this assessment important but also draws the need to access their nutritional status from informing the policy design to address their actual health status and associated needs.

Data Collection

The anthropometric measurements with respect to height (in centimeter) and weight (in kilogram), were conducted among both the group of participants that is, premenopausal and postmenopausal Bhil women to access their nutritional status and evaluate the distribution of underweight, normal, overweight, and obese women among the study participants. The height was recorded using a calibrated stadiometer and the weight of the participants was measured using a digital weighing scale with a precision of 0.1 kg.

Methodology

A cross-sectional study design was applied where the anthropometric variables (height and weight) among the premenopausal and postmenopausal Bhil women within the age group of 35-64 years was were assessed to calculate the body mass index and further comparatively analyze the difference in nutritional status among both the participant groups of Bhil women using standard WHO guidelines and consensus guidelines for Asian population. Frequency based on BMI cut off values from both guidelines was calculated and compared among both categories of respondents from the Bhil tribe

Sample Method

A total of 397 participants where 183 premenopausal women and 214 postmenopausal women form Bhil tribe were included in the study using purposive sampling method.

Selected Geography for the Study

The present study was conducted in Nandurbar District of Maharashtra. It is situated in the northern region of Maharashtra, bordered by the state of Gujarat in the west and Madhya Pradesh in the north. It is bordered by the *Satpuda* Range, that gives the district a rugged terrain with hills and forests around the region. The geographical location of the study site also highlights the constraints with which the Bhil tribe resides along with lack of resources and infrastructure for sustenance.

Selection Criteria

The study has proposed Inclusion criteria and exclusion criteria's for recruiting participants from both the groups of Bhil women that is premenopausal Bhil women and postmenopausal Bhil women. For premenopausal Bhil women, the inclusion criteria were women participants from Bhil tribe who reported minimum two menstrual cycle in last 3 months; are in their reproductive phase and for postmenopausal participants were the women from Bhil tribe who reported absence of menstruation for more than one year (above 12 months); Natural menopause. The exclusion criteria for premenopausal participants were the women who have surgical removal of uterus, existing health conditions (irregular menstruation) and for postmenopausal participants; the women who had undergone hysterectomy or induced menopause or are in the transition phase (have had menstruation after a gap of 12 months).

Data Analysis

The primary information of the participants such as name, tribe name, age, sex, and other family information was recorded in a structured format. Standard techniques were followed while taking all the anthropometric measurements where the standing height and weight was measured to the nearest of 0.1 cm and 0.1 kg respectively. Stature was measured using a movable anthropometer (stadiometer). Anthropometric variables such as weight, height, age, and marital status of a participant were recorded and observed for analysis.

Calculation of Body Mass Index (BMI)

The BMI was calculated as weight in kilogram (kg) divided by height in meter squared (m^2): kg/m^2. To assess the nutritional status, reference values(cut-offs) from both standard WHO guidelines as well as consensus guidelines for Asian population were evaluated. According to the World Health Organization (WHO), individuals with BMI<18.5 kg/m^2 are considered as underweight; ≥18.5 kg/m^2 but <24.9 kg/m^2as normal; ≥25 kg/m^2 but <29.5 kg/m^2 as overweight; ≥30kg/m^2as obese [6]. However, according to the revised consensus guidelines for Asian population, individuals with BMI <18.5 kg/m^2 are underweight; BMI between 18.5–22.9 kg/m^2 were normal and 23.0 –24.9 kg/m^2 as overweight while BMI ≥25 kg/m^2 are considered as obese [7]. The consensus guidelines for Asian population outlines reporting of overweight criteria among Asian population from BMI values above 23.0 kg/m^2 as against the larger BMI range outlined by the standard WHO guideline where, individuals up to 24.9 kg/m^2 BMI cut-off fall in the normal weight category. The table below evaluates the distribution of BMI among premenopausal and postmenopausal Bhil women as per the standard WHO guideline

Table 1: BMI Distribution among the Premenopausal and Postmenopausal Bhil Women According to WHO Criteria

BMI (WHO)	*Pre-Menopause*	*%*	*Post-Menopause*	*%*
Underweight: BMI < 18.5	*66*	*36.1*	*74*	*34.6*
Normal weight: 18.5 ≤ BMI < 24.9	*102*	*55.7*	*126*	*58.9*
Overweight: 25 ≤ BMI < 29.9	*15*	*8.2*	*10*	*4.7*
Obesity: BMI ≥ 30	*0*	*0.0*	*4*	*1.9*
Total	*183*	*100.0*	*214*	100.0

The anthropometric assessment of BMI among premenopausal and postmenopausal Bhil women in study, revealed that according to the standard WHO guidelines for BMI cut-off range, out of 183 premenopausal women; 36.1% were underweight, 55.7% were of normal weight and 8.2% of the premenopausal women were overweight and none were having obesity. Whereas, out of 214 postmenopausal women from all the three age groups; 34.6% were underweight, 58.9% were of normal weight and 4.7% of the postmenopausal women were overweight and 1.9% were obese. To assess further, in the Table 2; BMI among premenopausal and postmenopausal Bhil women was evaluated from the reference BMI cut-off values as per the revised consensus guidelines for the Asian population.

Table 2: BMI Distribution among the Pre-menopausal and Post-menopausal Women as per the Revised Consensus Guidelines for Asian Population

BMI as per the revised consensus guidelines for Asian population	*Pre-Menopause*	*%*	*Post-Menopause*	*%*
Underweight: <18.5 kg/m²	*66*	*36.1*	*74*	*34.6*
normal BMI:18.5–22.9 kg/m²	*75*	*41.0*	*102*	*47.7*
overweight: 23.0 –24.9 kg/m²	*27*	*14.8*	*24*	*11.2*
obese: ≥25 kg/m²	*15*	*8.2*	*14*	*6.5*
Total	*183*	*100.0*	*214*	*100.0*

The findings from the revised consensus for Asian population BMI cut off range, it was revealed that among the premenopausal Bhil women, 36.1% participants were underweight; 41.1% were of normal weight; 14.8% were overweight and 8.2% were obese whereas, among the postmenopausal Bhil women, 34.6% of the participants were uunderweight; 47.7% were of normal weight; 11.2% were overweight while, 6.5% of the participants were obese.

Comparison of BMI findings as per standard WHO guidelines and revised consensus guidelines for Asian population

The comparative findings after referring BMI values from standard WHO guidelines and revised consensus guidelines for Asian population revealed that among the both participants from the Bhil group there are notable variations in nutritional status of the Bhil women as influenced by age and physiology among both the groups. The comparison of BMI values from both reference criteria is to understand the weight categories in this tribal population from a nuanced perspective.

As per the standard WHO classification, among 183 premenopausal Bhil women, 36.1% were underweight, 55.7% were of normal weight, and 8.2% were overweight, with no cases of obesity observed or reported. Whereas, among 214 postmenopausal Bhil women, 34.6% were underweight, 58.9% were of normal weight, 4.7% were overweight, and 1.9% were obese. These findings indicate that normal weight was dominantly reported in both groups. However, premenopausal women had a slightly higher percentage of overweight participants and obesity appeared only in the postmenopausal group but at a lower rate. When the Asian specific BMI cut-offs values that are more sensitive when it comes to evaluate health risks among Asian populations was applied to the present study, the distribution of nutritional status showed change in classification values. Among the premenopausal

Bhil women, 36.1% were underweight, but only 41.1% were in the normal category, while 14.8% were overweight and 8.2% were obese. In postmenopausal Bhil women, 34.6% remained underweight, but 47.7% reported normal weight, with 11.2% overweight and 6.5% obese.

The findings from these adjusted BMI values reveal a considerable increase in the prevalence of overweight and obesity among both women participant groups from Bhil tribe when compared to the standard WHO classification. These differences highlight an importance aspect that if only WHO criteria were used then vulnerable participants would be overlooked and left underreported as in the case of premenopausal Bhil women participants, obesity reporting raised from 0% (WHO) to 8.2% (Asian cut-offs), and among postmenopausal Bhil women participants, obesity reporting raised from 1.9% (WHO) to 6.5% (Asian cut-offs). Within both BMI classification systems, undernutrition is the prominent concern among the Bhil women, with over one-third of Bhil women in both premenopausal and postmenopausal categories were classified as underweight. These findings are indicative of challenges in food security, dietary diversity, and health services access in tribal regions lacking resource access. The reporting of overweight and obesity in a substantial proportion of women when Asian specific cut-offs are applied, indicates double burden of malnutrition where underweight and overweight conditions coexist within the same population.

Observed age-related trend based on categorial difference; premenopausal and postmenopausal Bhil woman

The findings from the above BMI comparison, also reflect age-related trend as both the category of participants are divided as per their reproductive markers, the postmenopausal Bhil women, though slightly less overweight compared to their premenopausal counterparts under WHO cut-off criteria, showed higher obesity rates under Asian population cut-off criteria. These findings align with known physiological changes associated with menopause that include hormonal shifts, reduced metabolism, and fat redistribution, especially around the waist-hip region, increasing the risk of various cardio-metabolic disorders among aging women. These age-related trends are also important markers of rising non-communicable diseases (NCDs) among tribal populations that are often underreported. The higher prevalence of obesity and overweight among postmenopausal women among the Bhil women indicates increased risk for hypertension, type-2 diabetes, and various

cardiovascular conditions. While, the major reporting of underweight status in both groups highlights risks of anaemia, compromised immunity, and poor health outcomes among the Bhil women.

Conclusion

Scheduled tribes are marginalized groups with lack of access to various resources like food, healthcare, and education. This is reflected in their poor health outcomes. The reproductive transition into menopausal phase or aging as addressed in most communities that includes physiological and social milestone, for marginalized communities as the Bhil tribe, this transition often goes unrecognized in the public health discourse. With the increase in life expectancy in India, women especially from the tribal communities are reported to spend a substantial part of their lives in the postmenopausal phase. This demographic status highlights the needs to address the associated health issues in the transition phase, especially as early menopause is linked with increased risks of osteoporosis, cardiovascular disease, and other chronic conditions.

The present study underscores dual burden of malnutrition among both premenopausal and postmenopausal Bhil women. A major percentage of the study participants reported to be underweight, indicating existing nutritional deficiencies, while a rising prevalence of overweight and obesity, particularly among postmenopausal women, hinting a shift towards the risk of non-communicable disease. The use of revised BMI cut-offs value for Asian populations revealed a more accurate status of overweight and obesity among the Bhil women, which would have otherwise remain unnoticed using global WHO classifications. This highlights the need for localised health metrics especially from the focus of tribal health research.

The study findings highlight the need for an integrated, culturally centred health promotion strategies that combine nutritional support, lifestyle interventions, and routine health screening. Public health policies must address both the biological and socio-cultural dimensions of tribal health especially among women in their post-reproductive years. Also, there is a pressing need for improved data infrastructure for sub-national, gender-disaggregated, and tribe-specific to monitor the health progress and ensure equitable policy implementation.

Lastly, this findings from the present study calls for future research that not only captures intergenerational and geographical variations among scheduled tribes but also explores linkages between BMI, diet, physical activity, and their chronic

health outcomes. Addressing the double burden of malnutrition through both, inclusive and informed strategies can help bridge the gap in tribal women's health ensuring their well-being throughout the life course from pre-reproductive to post-reproductive phase. Addressing the health status and needs of women from the tribal communities will help design policies and plan intervention to support its effective implementation. This shall reduce the burden of disease incidence among tribal communities and prevent future health challenges.

Ethical considerations

Ethical clearance was obtained to conduct the study by the Chairman, Institutional Ethics Committee Savitribai Phule Pune University (Ref. No.: SPPU/IEC/2020/93). The participants were informed about the study and the interviews were conducted upon receiving voluntary consent from the participant.

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