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### RESEARCH ARTICLE

## A CROSS-SECTIONAL STUDY ON DETERMINANTS OF DOUBLE BURDEN OF MALNUTRITION AMONG WOMEN FROM DEVELOPING COUNTRIES OF SOUTH ASIA

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### Abstract

**Background:** This study aimed to explore sociodemographic factors affecting double burden of malnutrition (DBM) in Pakistani, Bengali, and Nepali women.

**Methods:** This cross-sectional study covers a total of 22,623 women from Nepal, Pakistan, and Bangladesh. Data were drawn from most recent Demographic and Health Survey (DHS) data sets. Frequencies, percentages, and multinomial logistic regression were conducted in SPSS version 22.

**Results:** Prevalence of overweight and obesity was much higher than undernutrition in all these countries. Most of Pakistani women had >3 'children ever born'. Chi-square tests and multinomial regression showed that increasing age, urban residence, higher education, better wealth status, >3 children, owning a mobile, and watching TV were associated with increased BMI in all countries, while reverse was true for undernutrition.

**Conclusion:** The findings of this study show that overweight/obesity among South Asian women has continuously increased over time and exceeds the frequency of underweight. Determinants of both undernutrition and over-nutrition were women's age, education, urban city, wealth, number of offspring, and use of media.

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**Introduction:-**

The undernutrition-obesity link shows that the major double burden of malnutrition (DBM) is being fueled by an accelerated growth in the incidence of overweight and obesity in low- and middle-income countries (LMICs).<sup>1</sup> Prevalence of DBM in children is widespread in LMICs, especially when considering the entire population.<sup>2</sup> There were notable variations in the trajectory of height and body mass index (BMI) in school-age children and adolescents by age in a meta-analysis of 2,181 population-based studies across various countries and regions.<sup>3</sup> Developing South Asian countries have a double DBM.<sup>4-10</sup> DBM is defined as “the coexistence of undernutrition along with overweight, obesity or diet-related non-communicable diseases, within individuals, households, and populations, and across the life course” by the World Health Organization (WHO).<sup>9</sup> Their undernutrition and over-nutrition is damaging to a country's future.

Malnutrition has historically been researched and treated in two ways: one focuses on energy insufficiency, micronutrient deficiencies, and chronic or acute undernutrition, while the other focuses on overweight, obesity, and nutritional excess.<sup>8</sup> The DBM, or diet-related non-communicable illnesses, is defined by the WHO as the co-occurrence of undernutrition, overweight, and obesity in people, households, and populations at different stages of life.<sup>9</sup> One of the most important variables influencing the beginning and course of pubertal development is nutrition.<sup>10</sup> Nutritional status in childhood has a substantial impact on pubertal growth. Some of the most important indicators of a population's nutritional status are based on anthropometric data.<sup>11</sup> Child malnutrition is a global issue with far-reaching consequences for survival rates, the prevalence of acute and chronic illnesses, healthy development, and individual and community economic productivity.<sup>12</sup> In addition, prolonged and severe malnutrition might cause a lasting delay in intellectual development.<sup>13</sup> Recognizing this double burden should reveal chances to treat both concerns concurrently, as they impair health over time.

The impact of undernutrition over the last four to five decades will have long-term consequences for human health.<sup>8</sup> Child stunting has numerous short-term and long-term effects, such as heightened morbidity and mortality rates, impaired child growth and learning ability, heightened susceptibility to infections, lowered fat oxidation, lowered energy expenditure, insulin resistance, lowered working capacity, and negative maternal reproductive outcomes during adulthood.<sup>13</sup> Conversely, overweight and obesity during infancy often extend into adulthood, raising the possibility of acquiring non-communicable diseases at a younger age.<sup>14</sup> Nutritional assessment and management in children beyond the age of five are highlighted and handled less than in newborns and children under the age of five.<sup>15</sup> School-age children and adolescents require additional attention and support since they are also vulnerable to the effects of starvation.<sup>16</sup> Thus, this study identifies the size of the DBM and to explore its socio-demographic correlates among 15- to 49-year-old women from Pakistan, Nepal, and Bangladesh.

**Materials and Methods:-**

The Demographic and Health Surveys (DHS) program provided ethical approval letters from Pakistan reference No. 4-87/NCB-285//17/1438, given on November 17, 2017, from Bangladesh BMRC/NREC/2019-2022/156, given on June 6, 2022, and from Nepal 678, given on September 30, 2021. All these ethical approval letters were obtained from National Bioethics Committee of all three countries. This study employed large-scale, nationally representative data from three South Asian countries: Bangladesh, Nepal, and Pakistan, collected between 2017 and 2022 as part of the DHS program.<sup>17</sup> The surveys are intended to be nationally representative, and more than 300 surveys in over 90 countries have collected cross-sectional data on population, health, reproduction, and nutrition.

**Procedure:-**

Weight was recorded using solar-powered balances that were precise to 0.1 kg, and height was recorded using standardized measuring boards that were accurate to 0.1 cm. The BMI was calculated as weight (kg) divided by height (m<sup>2</sup>). Asian-specific BMI cut-offs designated underweight as <18.5 kg/m<sup>2</sup> and overweight and obese (high BMI) as ≥23 kg/m<sup>2</sup>.<sup>18</sup> Since obesity was not as common in some nations, the terms overweight and obesity were combined to become overweight/obesity. For ensuring the samples were typical of the teenage population in the nation where they were taken, the occurrence of underweight and overweight/obesity was determined by weighing the data that was gathered. This required the use of primary sampling units and strata at the national level. In this regard, weighted prevalence was presented per nation along with matching 95% CIs. Pregnant women at the time of the survey were excluded. Independent variables used in this analysis were women's age, women's education level, household wealth, residence location (urban/rural), children ever born, mobile ownership, and TV viewing. Women's age was categorized in DHS into five-year age groups such as 15 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, and 45 to 49 years, which was recategorized by authors as 15-29, 30-39, and 40-49 years. Following this

approach streamlines analyses and increases statistical power through lowering the numbers of categories since the age groupings of women change from five-year bands (15-19, 20-24, etc.) to casual ranges (15-29, 30-39, and 40-49). Broader age groups correspond to meaningful life stages (early adulthood, mature adulthood, very late reproductive years), which permit relevant comparisons in the study of reproductive health or any other time-of-life behavior. Broader categories also clarify study findings and ensure consistency with similar studies, lending greater interpretability and comparability to existing research.

In DHS, literacy level was categorized into 'No education', 'primary', 'secondary', and 'higher education'. The wealth index was categorized into 'poorest', 'poorer', 'middle', 'richer', and 'richest', in DHS, which were recategorized by authors into three categories by combining 'poorest' with 'poorer' and 'richer' with 'richest'. Changing the wealth index from five categories - 'poorest', 'poorer', 'middle', 'richer', and 'richest' - to three categories such as 'poorest/poorer', 'middle', or 'richer/richest' makes the analysis easier and provides a stronger statistical power. All adjacent categories together reduce the sparsity of data and thus improves the comparison at higher end with larger samples sets because the differences may not be significant between those wealth groups. Thus, this method retains a difference in wealth but at the same time serves the purpose of simpler, more understandable, applicable classification to broad accounts of wealth or health outcome as well as being consistent with other similar studies done by this demographic.

DHS categorized residences into 'Urban' and 'rural'. The DHS data had 'children ever born' in numerical form. Authors recategorized the number of children ever born into ' $\leq 3$ ' and ' $> 3$ '. This categorization was done following a study that found overweight and obesity in mothers with  $> 3$  children.<sup>14</sup> Owning a mobile was categorized as 'No' and 'Yes'. Watching TV was categorized into four categories in DHS, which were recategorized into 'No' and 'Yes' by combining the last three categories into 'Yes'. DHS segregates women into 'not pregnant/unsure' and 'currently pregnant'. Data was analyzed by excluding 'currently pregnant' from the data because pregnancy can affect BMI. Double burden of malnutrition was treated as a dependent variable.

#### Statistical Analysis:-

Microsoft Excel and SPSS (Statistical Package for the Social Sciences) software version 26.0 were employed for analyzing data of this research. To investigate the association between the DBM and other biological and sociodemographic parameters, descriptive statistics were used. The mean, SD, and percentage distributions of the study population were summarized using descriptive statistics. It was determined how common stunting, obesity, and the DBM were in children of various ages, and genders. A statistically significant relationship between the DBM and the particular factor under investigation was defined as a p-value less than 0.05. The correlation between the DBM and several independent variables was evaluated using multivariate logistic regression.

#### Results:-

##### Demographics:

Data from 22,623 women from three different South Asian countries were presented in Table 1. The majority of the sample came from Bangladesh (n = 9946, 44%) followed by Nepal (n = 7352, n = 33%), and Pakistan (n = 5325, 22%). Approximately 65% of Bangladeshi women and 50% of Pakistani and Nepalese women resided in rural regions. Approximately 50% of Pakistani women were illiterate, compared to just roughly 16% and 27% of Bangladeshi and Nepalese women, respectively. About 50% of Nepali women fell into the "poor" category, whereas 40% of women were from Bangladesh and Pakistan. Approximately 84% of Nepali women, 85% of Bangladeshi women, and 57% of Pakistani women had  $\leq 3$  "children ever born." Approximately 40% of Nepali women, 55% of Bangladeshi women, and 67% of Pakistani women had a BMI of  $\geq 23$ . However, a BMI of less than 18.5 was present in around 7.5% of Pakistani women, 10% of Bangladeshi women, and 14% of Nepali women (Table 1).

##### Chi-Square and Multinomial Regression Analysis:

Chi-square tests and multinomial regression analysis showed that increasing age was correlated with increased BMI in all three countries. Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) can be defined as the statistical methods to determine associations between one variable (also called predictors) and another outcome: in this study, malnutrition status—either underweight or overweight. COR is the measure of the strength of association and direction of the association of a predictor variable such as age and level of education with the outcome of interest, namely malnutrition status, without adjustment for any other confounding variables. The AOR is then defined as the measure of association adjusted for possible confounders by incorporating other variables in the model. Residence in urban areas was associated with increased BMI in Pakistani and Bengali women, but not in Nepal. BMI was lower

in those with lower education in Pakistan, Nepal, and Bangladesh. BMI also seemed to be higher in women with  $\leq 3$  children in Bangladesh and Nepal, but no such relationship was found in Pakistan. Owning a mobile seemed to be associated with high BMI in Pakistan and Bangladesh, but not in Nepal. Watching TV seemed related to high BMI in Bangladesh and Nepal but not in Pakistan (Table 2).

**Tables:-**

**Table 1: General Characteristics of the Study Population**

|                                            | Pakistan  |         | Bangladesh |         | Nepal     |         |
|--------------------------------------------|-----------|---------|------------|---------|-----------|---------|
|                                            | Frequency | Percent | Frequency  | Percent | Frequency | Percent |
| <b>Pregnancy status:</b>                   |           |         |            |         |           |         |
| Not pregnant or unsure*                    | 4681      | 87.9    | 9348       | 94.0    | 7045      | 95.8    |
| Pregnant                                   | 644       | 12.1    | 598        | 6.0     | 307       | 4.2     |
| Total:                                     | 5325      | 100.0   | 9946       | 100.0   | 7352      | 100.0   |
| <b>Age groups:</b>                         |           |         |            |         |           |         |
| 15-29                                      | 1776      | 38      | 4148       | 41.7    | 3599      | 51.1    |
| 30-39                                      | 1777      | 38      | 3396       | 34.1    | 1981      | 28.1    |
| 40-49                                      | 1128      | 24.1    | 2402       | 24.2    | 1465      | 20.8    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Residence:</b>                          |           |         |            |         |           |         |
| Urban                                      | 2278      | 48.7    | 3473       | 34.9    | 3750      | 53.2    |
| Rural                                      | 2403      | 51.3    | 6473       | 65.1    | 3295      | 46.8    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Education level:</b>                    |           |         |            |         |           |         |
| No education                               | 2353      | 50.3    | 1351       | 13.6    | 1914      | 27.2    |
| Primary                                    | 668       | 14.3    | 2567       | 25.8    | 2254      | 32.0    |
| Secondary                                  | 953       | 20.4    | 4518       | 45.4    | 2620      | 37.2    |
| Higher                                     | 707       | 15.1    | 1510       | 15.2    | 257       | 3.6     |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Wealth status:</b>                      |           |         |            |         |           |         |
| Poor                                       | 1872      | 40.0    | 3686       | 37.1    | 3364      | 47.8    |
| Middle                                     | 917       | 19.6    | 2022       | 20.3    | 1416      | 20.1    |
| Rich                                       | 1892      | 40.4    | 4238       | 42.6    | 2265      | 32.2    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Number of total children ever born:</b> |           |         |            |         |           |         |
| $\leq 3$                                   | 2663      | 56.9    | 8485       | 85.3    | 5917      | 84.0    |
| $> 3$                                      | 2018      | 43.1    | 1461       | 14.7    | 1128      | 16.0    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Owens a mobile:</b>                     |           |         |            |         |           |         |
| No                                         | 2566      | 54.8    | 3074       | 30.9    | 1453      | 20.6    |
| Yes                                        | 2115      | 45.2    | 6872       | 69.1    | 5592      | 79.4    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>Watches TV:</b>                         |           |         |            |         |           |         |
| No                                         | 1827      | 39.0    | 5135       | 51.6    | 3089      | 43.8    |
| Yes                                        | 2854      | 61.0    | 4811       | 48.4    | 3956      | 56.2    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |
| <b>BMI categories:</b>                     |           |         |            |         |           |         |
| $< 18.5$                                   | 354       | 7.6     | 963        | 9.7     | 976       | 13.9    |
| 18.5-23.0                                  | 1205      | 25.7    | 3468       | 34.9    | 3261      | 46.3    |
| $\geq 23$                                  | 3122      | 66.7    | 5515       | 55.4    | 2808      | 39.9    |
| Total                                      | 4681      | 100.0   | 9946       | 100.0   | 7045      | 100.0   |

\*Population used for analysis

Table 2: Odds Ratio for Sociodemographic Factors Affecting Malnutrition

| Variables<br>:                       | Pakistan:               |                    |                       |                    | Bangladesh:             |                    |                       |                    | Nepal:                  |                    |                       |                    |
|--------------------------------------|-------------------------|--------------------|-----------------------|--------------------|-------------------------|--------------------|-----------------------|--------------------|-------------------------|--------------------|-----------------------|--------------------|
|                                      | <18.5 kg/m <sup>2</sup> |                    | ≥23 kg/m <sup>2</sup> |                    | <18.5 kg/m <sup>2</sup> |                    | ≥23 kg/m <sup>2</sup> |                    | <18.5 kg/m <sup>2</sup> |                    | ≥23 kg/m <sup>2</sup> |                    |
|                                      | COR <sub>d</sub>        | AOR <sub>e</sub>   | COR                   | AOR                | COR                     | AOR                | COR                   | AOR                | COR                     | AOR                | COR                   | AOR                |
| <b>Age categories:</b>               |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| 15-29 years                          | 1.505 <sub>c</sub>      | 1.614 <sub>c</sub> | 0.346 <sub>a</sub>    | 0.346 <sub>a</sub> | -----                   | 1.262 <sub>a</sub> | 0.584 <sub>a</sub>    | 0.452 <sub>a</sub> | 1.337 <sub>a</sub>      | 1.722 <sub>a</sub> | 0.315 <sub>a</sub>    | 0.231 <sub>a</sub> |
| 30-39 years                          | -----                   | -----              | 0.732 <sub>b</sub>    | 0.728 <sub>a</sub> | 0.808 <sub>a</sub>      | -----              | -----                 | 0.794 <sub>a</sub> | -----                   | -----              | -----                 | 0.764 <sub>b</sub> |
| 40-49 years                          | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Type of residence:</b>            |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| Urban                                | -----                   | -----              | 1.263 <sub>b</sub>    | 1.237 <sub>b</sub> | 0.804 <sub>b</sub>      | -----              | 1.603 <sub>b</sub>    | 1.149 <sub>a</sub> | -----                   | -----              | -----                 | -----              |
| Rural                                | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Education level:</b>              |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| No education                         | 1.624 <sub>c</sub>      | -----              | 0.543 <sub>a</sub>    | -----              | 1.548 <sub>a</sub>      | 1.384 <sub>b</sub> | 0.444 <sub>a</sub>    | 0.488 <sub>a</sub> | 2.188 <sub>b</sub>      | 2.991 <sub>a</sub> | 0.457 <sub>a</sub>    | 0.467 <sub>a</sub> |
| Primary                              | -----                   | -----              | 0.746 <sub>c</sub>    | -----              | 1.434 <sub>a</sub>      | -----              | 0.577 <sub>a</sub>    | -----              | 2.417 <sub>c</sub>      | 2.474 <sub>b</sub> | 0.535 <sub>a</sub>    | -----              |
| Secondary                            | -----                   | -----              | 0.761 <sub>c</sub>    | -----              | 1.447 <sub>b</sub>      | -----              | 0.695 <sub>a</sub>    | -----              | 2.050 <sub>c</sub>      | 1.874 <sub>b</sub> | 0.405 <sub>a</sub>    | 0.717 <sub>b</sub> |
| Higher                               | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Wealth status:</b>                |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| Poor                                 | 1.439 <sub>c</sub>      | -----              | 0.311 <sub>a</sub>    | 0.308 <sub>a</sub> | 1.756 <sub>a</sub>      | 1.413 <sub>a</sub> | 0.335 <sub>a</sub>    | 0.381 <sub>a</sub> | 2.700 <sub>a</sub>      | -----              | 0.368 <sub>a</sub>    | 0.398 <sub>a</sub> |
| Middle                               | -----                   | -----              | 0.585 <sub>a</sub>    | 0.594 <sub>b</sub> | -----                   | -----              | 0.579 <sub>a</sub>    | 0.613 <sub>b</sub> | 2.324 <sub>a</sub>      | -----              | 0.530 <sub>a</sub>    | 0.554 <sub>a</sub> |
| Rich                                 | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Number of children ever-born:</b> |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| ≤3                                   | -----                   | -----              | -----                 | -----              | -----                   | -----              | 1.149 <sub>b</sub>    | 1.256 <sub>b</sub> | -----                   | -----              | 1.355 <sub>a</sub>    | 1.323 <sub>a</sub> |
| >3                                   | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Owns mobile:</b>                  |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| No                                   | -----                   | -----              | 0.862 <sub>b</sub>    | 0.828 <sub>b</sub> | 1.623 <sub>b</sub>      | 1.459 <sub>b</sub> | 0.554 <sub>b</sub>    | 0.680 <sub>b</sub> | -----                   | -----              | -----                 | -----              |
| Yes                                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |
| <b>Watches TV:</b>                   |                         |                    |                       |                    |                         |                    |                       |                    |                         |                    |                       |                    |
| No                                   | -----                   | -----              | -----                 | -----              | 1.263 <sub>b</sub>      | -----              | 0.640 <sub>b</sub>    | 0.829 <sub>b</sub> | -----                   | -----              | 0.868 <sub>b</sub>    | -----              |
| Yes                                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  | 1                       | 1                  | 1                     | 1                  |

<sup>a</sup>p<0.001, <sup>b</sup>p<0.01, <sup>c</sup>p<0.05, <sup>d</sup>Crude Odds Ratio, <sup>e</sup>Adjusted Odds Ratio

All models: p&lt;0.001

Reference category in regression analysis: 18.5-22.9 kg/m<sup>2</sup>**Discussion:-**

This research adds significant value to DBM discussions about women in South Asian countries. This study establishes national and subnational evidence regarding women nutritional status (underweight and overweight) while examining their association with socioeconomic factors. These countries' national datasets as part of DHS enable this study to provide good quality evidence. The findings of this study show that overweight/obesity among South Asian women has continuously increased over time and currently exceeds the frequency of underweight in practically all countries. We found subnational variation in underweight and overweight/obesity in all countries. Other studies have also documented significant heterogeneity in the prevalence of underweight and overweight/obesity at the national and regional levels, which is consistent with our findings.<sup>14</sup> Undernutrition in

pregnant women is associated with intrauterine growth retardation and low birth weight in infants.<sup>15, 16</sup> These underweight individuals become increasingly burdened by obesity and hence NCDs later in life.<sup>17,18</sup> These people are more likely to develop NCDs in the future<sup>8,9</sup>. This shows that obesity and severe malnutrition in the mother and infant's early life are associated with a higher risk of NCDs in adulthood.<sup>9</sup>

In our study, the average underweight was about 12%, and the average overweight and obesity were 50% for women from all these countries. Being underweight is a major issue among poor women in poor countries; however, overweight and obesity are important problems among privileged women in these countries.<sup>19</sup> Biswas et al.<sup>4</sup> have identified a pooled prevalence of 22% in underweight women and of 23% overweight. Moreover, socioeconomic growth caused a reduction in underweight in these nations over time while increasing weight gain.<sup>4</sup> The consumption of meals high in calories and a decline in physical activity are the causes of this weight gain. Obesity and micronutrient deficiencies frequently co-occur,<sup>20</sup> and "hidden hunger" is the term used to characterize the existence of micronutrient deficiencies without apparent energy shortage.<sup>21,22</sup> This finding was in agreement with the literature. Underweight was more prevalent in women of the youngest age group i.e., 15–19 years in studies from South Asia. Undernutrition in younger women requires nutrition programs to target younger women according to a Nepali study.<sup>4</sup> However, being overweight was prevalent in older women.<sup>4</sup> In a national survey in India, the highest prevalence of underweight was found among the youngest women i.e., 18–24 years.<sup>23</sup> Reasons for being underweight at a young age might be food unavailability and fear of becoming obese.<sup>24</sup> Bamji et al.<sup>24</sup> also showed that older women were at risk of being overweight. A higher intake of energy-rich food and low physical activity might be the reason for obesity with increasing age. There is a development of non-communicable diseases and an increase in parity with older age.<sup>25,26</sup> However, a decrease in the prevalence of obesity was found in Korea in women in the age group 40–69 years.<sup>9</sup>

Our research revealed that approximately 50% of Pakistani and Nepali women, while 65% of Bangladeshi women resided in rural areas. Urban dwelling was found to be linked with rising BMI in Pakistani women, but no such influence was observed in Bangladesh and Nepal. Yet, an excess of overweight was observed in urban women in a Bengali study.<sup>8</sup> Certain Indian research also identified a correlation between rural dwellers with underweight and urban dwellers with obesity.<sup>23,24</sup> This urban-rural difference in weight gain is likely to be the result of the lifestyle of rural women who engage in numerous physical activities such as agriculture.<sup>8</sup> Surprisingly, the urban poor are leading sedentary lifestyles as a result of improved technology and transportation<sup>28</sup> and are thus also prone to becoming overweight. Our study found that about 50% of Pakistani women were illiterate, whereas only about 17%, and 27% of women from Bangladesh, and Nepal respectively had not obtained any education. High BMI was found in women with higher literacy in all these countries.

Bengali studies have shown that educated women are overweight.<sup>9,25</sup> Indian studies also found an association between illiteracy with being underweight and higher education with being overweight.<sup>23,24</sup> Probably higher education helps women to get better and sedentary jobs.<sup>7, 25, 26</sup> About 40% of women from Pakistan, and Bangladesh, and about half of the women from Nepal were from the 'poor' class. Our study found that women from the poor class had lower BMI compared to the rich class in all these countries. This finding was per the literature, where being underweight was commoner among women from the lowest socioeconomic status, and being overweight was commoner among those from the higher status.<sup>4</sup> Some Bengali studies showed that rich women in poor countries have better food availability and low physical activity levels, which lead to being obese.<sup>9, 25</sup> Rich women in these countries prefer Western food and lifestyle.<sup>13</sup> Indian studies showed that poor socioeconomic status was related to food insecurity and harder physical work.<sup>23,24</sup> Intake of energy-rich foods increases with an increased income.<sup>25</sup> An Iranian study also showed the prevalence of overweight and obesity among the rich class.<sup>29</sup> It is expected of the poor class to become overweight and obese when a country progresses.<sup>12</sup> Interestingly, this was not so in Korea, where a decline in obesity was observed in women from the rich class while an increase was found in the poor.<sup>27</sup> This was probably because wealthier people have better access to resources that help to maintain a healthy lifestyle.<sup>27</sup> Korean women were less obese because they experienced strong social pressure that demanded a thin body.<sup>28</sup> Hence, wealth status has different effects on BMI, between developed and developing countries.<sup>29</sup> However, these two forms of malnutrition can co-occur as stunting and obesity within populations.<sup>11</sup>

In our study, about 60% of Pakistani women, whereas only about 40% of women in Bangladesh, and about 30% from Nepal had  $\geq 3$  children. Pakistani women are typically restricted to their homes after marriage and marry at a younger age. They are overweight because they engage in less physical exercise.<sup>30</sup> The limitations of this study were that it could not infer causality between dependent variables and nutritional status as the data was observational and

cross-sectional. All data were collected from countries in different years, hence limiting authors' ability to compare between countries. Another limitation was that the authors only analyzed the sociodemographic determinants of DBM, not dietary intake and physical activity level. Although BMI can predict increased fat mass, it might mislead information about central body fat, which is usually higher in Asians compared to Caucasians, at the same BMI.<sup>8</sup>

### Conclusion:-

In conclusion, determinants of both undernutrition and over-nutrition were women's age, education, urban city, wealth, number of offspring, and use of media. A consistent and regular data collection in all developing countries of South Asia is required to measure the progress of DBM. Factors resulting in within-country increase of overweight should be studied in detail and the inequalities in both types of malnutrition should be explained. Policies should be developed to counter the double burden of malnutrition rather than separately targeting undernutrition or over-nutrition.

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### Declarations

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