Double Burden of Malnutrition among Nepalese Ever Married Women: Findings from the Nepal Demographic and Health Survey, 2006, 2011, and 2016

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Abstract

The double burden of malnutrition, or the co-existence of overnutrition and undernutrition, is a public health concern in Nepal. This paper examines the prevalence and determinants of the double burden of malnutrition among ever married women of reproductive age using data from three consecutive Nepal Demographic Health Surveys (NDHS). Data on ever married women (N = 17,073) from the 2006, 2011 and 2016 NDHS were used. Under-weight (BMI < 18.5) and overweight/obesity (BMI ≥ 25) were measured based on WHO BMI cutoff scores. We fitted multinomial regression models weighted and adjusted for possible socio-economic confounders. The results confirm the existence of a double burden of malnutrition among ever married women in Nepal. Between 2006 and 2016, the prevalence of overweight/obesity increased from 10% to 27% and the prevalence of underweight decreased from 24% to 14%. Women with higher educational attainment were at lower risk of underweight and at higher risk of overweight/obesity (underweight adjusted relative risk [ARR] = 0.97, 95% CI 0.96, 0.99: overweight/obesity ARR = 1.03, 95% CI 1.01,1.05). Compared to the poorest women, the richest women were at a significantly lower risk of underweight (ARR = 0.34, 95% CI 0.27, 0.43) and higher risk of overweight/obesity (ARR = 10.75, 95% CI 8.01, 14.43). Women belonging to the Dalit caste were at risk of both underweight and overweight/obesity. Education, wealth quintile and caste/ethnicity are risk factors for the double burden of malnutrition among ever married women in Nepal. Considering these factors during the design and implementation of nutritional interventions could support reductions in the prevalence of underweight and overweight/obesity among this population.

Keywords: Underweight; Overweight/Obesity; Married Women; Double Burden of Malnutrition; Nepal

Background

The double burden of malnutrition, or the co-existence of overnutrition and undernutrition, is a serious public health concern in low- and middle-income countries (LMICs) [1,9,13]. In LMICs, overweight/obesity affects 30 to 40% of women of reproductive age (WRA; 15 - 49 years-old), and underweight affects over 15% of WRA [7]. Studies have indicated that overweight women, indicated by a body mass index (BMI) greater than or equal to 25, are

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at a higher risk for hypertension, cardiovascular and metabolic diseases, and cancer [23,26]. Similarly, women with a BMI less than 18.5 are categorized as underweight and are at an increased risk for anemia, asthma, infertility, and poor psychological health [4,6,7,26]. The nutritional status of women also influences pregnancy and birth outcomes. Overweight/obesity in women is associated with complications during pregnancy including gestational diabetes and preeclampsia [24,25], and children born to underweight women are more prone to low birth weight due to lack of nutrients in utero [10].

Nepal has achieved significant progress in maternal and child nutrition indicators, including a consistent decline in underweight among women. The prevalence of underweight among 15 - 49-year-old women declined from 24% in 2006 to 17% in 2016. In contrast, the prevalence of overweight in 15 - 49-year-old women increased from 9% in 2006 to 22% in 2016. Using nationally representative survey data from Nepal, previous studies have identified socio-economic risk factors for underweight and overweight/obesity: women's age, education, and wealth quintile [5,17,20,21]. However, most of these studies used single year data and only focused on either underweight or overweight/obesity among WRA, without considering marital status. Nepalese socio-cultural practices only allow women to bear a child after marriage. Since underweight and overweight/obesity are known risk factors for both WRA and their children's health and nutritional status, the existing research limits our understanding of potential risk factors associated with both underweight and overweight/obesity over time, particularly among ever married women.

In this study, we address the gaps in the literature by examining the prevalence of the double burden of malnutrition and investigating possible socio-economic risk factors over time among ever married WRA. We use nationally representative data from the Nepal Demographic and Health Surveys (NDHS) conducted in 2006, 2010, and 2016 to identify risk factors for the double burden of malnutrition. These data can be used to better understand high-risk groups and provide policy makers and planners with evidence to develop and implement effective and integrated nutrition sensitive programs.

Methods

This paper uses data from the 2006, 2011 and 2016 NDHS, a nationally representative cross-sectional household survey. This dataset includes a variety of health indicators, as well as socio-economic and demographic information. The NDHS used a two-stage selection process. Initially, enumeration areas (clusters) were selected with probability proportion-to-size (PPS) methodology. Households were then selected using an equal probability systematic selection process from each sample cluster. The sampling details for this survey have been documented in the full NDHS reports [15-17].

Out of 10,793 15 - 49-year-old WRA interviewed in 2006, BMI was collected for 10,739 women. In 2011, BMI was collected for 6,179 of 12,674 interviewed women, and in 2016, BMI was collected for 6,457 of 12,862 interviewed women. Due to changes in NDHS sampling procedures between survey years, the number of women with BMI data in 2006 was notably higher than in 2011 and 2016 [15,16]. Women were excluded from the analysis if they were currently pregnant, had a child under 2-months-old, were never married, or were outliers based on their BMI Z-score (≤ 5 or > 5). The final analysis (Table 1) included N = 17,073 WRA (N = 7,867 in 2006; N = 4,478 in 2011; N = 4,728 in 2016).

Year	Total women interviewed	BMI collected	Outliers	Currently pregnant	Child less than 2-months	Never married	Total women included in sample
2006	10,793	10,739	55	622	118	2,136	7,867
2011	12,674	6,179	35	297	53	1,322	4,478
2016	12,862	6,457	-	292	86	1,340	4,728
Total	36,329	23,375	90	1,211	257	4,798	17,073

Table 1: Sample Size distribution by demographic surveys (2006 - 2016).

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Two indicators of women's nutritional status were used as outcome variables: underweight and overweight/obesity. Based on the WHO definition, BMI status was calculated by dividing the woman's weight (kilograms) by height squared (meters). Women were categorized into three groups: underweight (BMI < 18.5), normal (BMI ≥ 18.5 and < 25), and overweight/obese (BMI ≥ 25) [14].

Based on prior studies, potential socio-demographic and economic confounders were selected. Nine independent variables were included in the adjusted models: the woman's age (in years), years of formal schooling, household size (number of family members residing in the household [1 - 4 or 5+]), caste/ethnicity (Brahmin/Chhetri [high caste], Janajati [indigenous group], Dalit [lower caste], other), wealth status (using original DHS wealth quintiles: poorest, second poorest, middle, second richest, richest), ecological zone (mountain, hill, tarai [plain area with fertile land and abundant production]), number of living children, place of residence (urban, rural), and household head (male, female).

First, the data from three consecutive surveys were pooled and sampling weights were applied to account for the non-proportional allocation of samples and differences in response rates. Descriptive analyses were conducted to summarize the sociodemographic characteristics of the study participants, and histograms of continuous variables were examined to determine normal distribution. Bivariate analyses were used to assess the prevalence of underweight and overweight/obesity among different sociodemographic groups, and multinomial logistic regression models were fitted to estimate the association between underweight and overweight/obesity and the independent variables. The independent variables were finalized by estimating the collinearity of these variables. Unadjusted and adjusted relative risk ratios and 95% confidence interval was calculated. All analyses were performed in Stata version 14 (StataCorp, College Station, Texas).

This study is a secondary analysis conducted using publicly available data. All three NDHSs used in this analysis were approved by the Nepal Health Research Council and the ethical review board of ICF international.

Results

Characteristics of the study population

The median age of the study participants was 32 years. Over half of the participants (54.9%) had no formal schooling and 46.5% had three or more children. Around 41.0% of the study participants belonged to the Janajati caste/ethnic group, and more than half were from the tarai ecological zone (52.0%). Most study participants were rural residents (72.8%) and the majority were from male-headed households (73.2%) (Table 2).

	N	%
Age (years)		
15 - 19	1,201	7.0
20 - 24	2,852	16.7
25 - 29	3,220	18.9
30 - 34	2,861	16.8
35 - 39	2,643	15.5
40 - 44	2,384	14.0
45 - 49	1,912	11.2
Education (years of formal schooling)		
No school	9,373	54.9
1 - 5 years	2,840	16.6
6 - 9 years	2,949	17.3
10+ years	1,912	11.2
Household size		
1 - 4	6,559	38.4
5+	10,514	61.6
Headship of the household		
Male	12,504	73.2
Female	4,570	26.8
Caste/ethnicity		
Brahmin/Chhetri	5,844	34.2
Janajati	6,926	40.6
Dalit	2,438	14.3
Other	1,866	10.9
Number of living children		
0 or 1 child	4,546	26.6
2 children	4,591	26.9
3 or more children	7,937	46.5
Place of residence		
Urban	4,645	27.2
Rural	12,429	72.8
Ecological zone		
Mountain	1,130	6.6
Hill	7,069	41.4

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Tarai	8,874	52.0
Wealth quintile		
Poorest	3,025	17.7
Second poorest	3,299	19.3
Middle	3,610	21.1
Second richest	3,573	20.9
Richest	3,568	20.9
Year		
2006	7,867	46.1
2011	4,478	26.2
2016	4,728	27.7

Table 2: Socio-demographic characteristics of respondent women (N = 17,073).

Bivariate analyses

The prevalence of underweight decreased from 24% in 2006 to 14% in 2016, whereas the prevalence of overweight/obesity increased by 17% during the same period (10% in 2006 to 27% in 2016). The proportion of underweight was higher among respondents in the 15 - 19-year-old age group (24.9%), among those with no formal education (24.5%), and among those from larger families (21.9%). Similarly, respondents from the Dalit caste/ethnic group (29.1%), those belonging to the second poorest wealth quintile (26.6%), and those residing in rural regions (22.0%) and tarai ecological zones (25.7%) had a higher prevalence of underweight than their counterparts. Alternatively, the prevalence of overweight/obesity was higher among women in the 40 - 44 year-old age group (21.5%), respondents with 10 or more years of schooling (30.0%), respondents from the Janajati caste/ethnic group (18.8%), respondents residing in urban regions (31.0%) and hill ecological zones (19.8%), and those belonging to the richest wealth quintile (38.6%). Other than ecological zone and wealth quintile, the groups with the highest prevalence of underweight had the lowest prevalence of overweight/obesity.

Multivariate analyses

The unadjusted and adjusted models estimating socio-economic predictors of underweight and overweight/obesity are presented in table 4. Women with higher educational attainment were at lower risk of underweight in both adjusted and unadjusted models (unadjusted relative risk [RR] = 0.92, 95% CI 0.90, 0.93, adjusted

	% Under-weight (BMI < 18.5)	% Normal weight (BMI 18.5 - 24.9)	% Over-weight/ obese (BMI ≥ 25.0)	N
Age (years)				
15 - 19	24.9	72.0	3.1	1,201
20 - 24	20.9	71.3	7.8	2,852
25 - 29	20.7	64.3	15.0	3,220
30 - 34	15.5	64.8	19.7	2,861
35 - 39	17.0	61.8	21.2	2,643
40 - 44	19.1	59.4	21.5	2,384
45 - 49	21.7	57.2	21.1	1,912
Education (years of formal schooling)				
No school	24.5	64.1	11.4	9,373
1 - 5 years	15.8	65.6	18.5	2,840
6 - 9 years	13.4	65.8	20.8	2,949
10+ years	9.6	60.4	30.0	1,912
Household size				
1 - 4	15.5	63.5	21.0	6,559
5+	21.9	64.7	13.3	10,514
Headship of the household				
Male	20.8	63.6	15.7	12,504
Female	15.9	66.0	18.0	4,570
Caste/ethnicity				
Brahmin/Chhetri	16.3	66.6	17.1	5,844
Janajati	16.2	64.9	18.8	6,926
Dalit	29.1	59.9	11.0	2,438
Other	28.7	59.8	11.5	1,866
Number of living children				
0 or 1 child	18.6	67.7	13.7	4,546
2 children	14.6	62.2	23.2	4,591
3 and more children	22.8	63.4	13.8	7,937
Place of residence				
Urban	12.6	56.4	31.0	4,645
Rural	22.0	67.2	10.8	12,429
Ecological zone				
Mountain	14.0	75.2	10.8	1,130
Hill	12.5	67.7	19.8	7,069

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Tarai	25.7	60.1	14.2	8,874
Wealth quintile				
Poorest	22.0	72.6	5.3	3,025
Second poorest	26.6	65.2	8.2	3,299
Middle	23.5	67.1	9.4	3,610
Second richest	18.7	63.5	17.7	3,573
Richest	7.4	54.1	38.6	3,568
Year				
2006	24.3	65.6	10.1	7,867
2011	16.4	67.7	15.8	4,478
2016	14.3	58.7	27.0	4,728
Total	19.5	64.2	16.3	17,073

Table 3: BMI in relation to socioeconomic characteristics among ever married Nepalese women of reproductive age.

relative risk [ARR] = 0.97, 95% CI 0.96, 0.99). However, educated women were at higher risk overweight/obesity compared to less educated women in both models (RR = 1.09, 95% CI 1.07, 1.11, ARR = 1.03, 95% CI 1.01, 1.05).

Women in the richest wealth quintile had a lower risk of underweight compared to women in the poorest quintile in unadjusted and adjusted models (RR = 0.45, 95% CI 0.36, 0.55, ARR = 0.34, 95% CI 0.27, 0.43); however, the richest women were at increased risk of overweight/obesity compared to the poorest women (RR = 9.71, 95% CI, 7.58 - 12.44, ARR = 10.75, 95% CI 8.01 - 14.43).

In the adjusted models, women belonging to the Dalit caste were at a higher risk of both underweight (ARR = 1.30, 95% CI 1.10, 1.53) and overweight/obesity (ARR = 1.51, 95% CI 1.22 - 1.88) compared to women belonging to the Brahmin/Chhetri caste/ethnic group. Elder women were at higher risk of overweight/obesity compared to younger women in both unadjusted and adjusted models (RR = 1.05, 95% CI 1.04 - 1.05, ARR = 1.06, 95% CI 1.05, 1.07); yet, age was not associated with underweight in either model. Women living in the tarai ecological zone were at a higher risk of underweight than women living in the mountainous ecological zone (RR = 2.30, 95% CI 1.82-2.90, ARR = 2.98, 95% CI 2.34, 3.79), and at a lower risk of overweight/obesity in the adjusted model (RR = 0.69, 95% CI 0.50, 0.95). Women living in female-headed households were less likely to be underweight than women living in male-headed

households in both models (RR = 0.74, 95% CI 0.64, 0.85, ARR = 0.81, 95% CI 0.71, 0.92). Household headship was not associated with overweight/obesity (Table 4).

	Normal vs. Underweight (BMI < 18.5)		Normal vs. Overweight/Obese (BMI ≥ 25.0)	
	RR (95% CI)	ARR (95% CI)	RR (95% CI)	ARR (95% CI)
Age (in years)	1.00 (0.99 - 1.01)	1.00 (0.99 - 1.01)	1.05*** (1.04 - 1.05)	1.06*** (1.05 - 1.07)
Education (in number of years of formal schooling)	0.92*** (0.90 - 0.93)	0.97*** (0.96 - 0.99)	1.09*** (1.07 - 1.11)	1.03** (1.01 - 1.05)
Family size (number of family members)	1.04*** (1.03 -1.06)	1.01 (1.00 - 1.03)	0.91 (0.89 -0.93)	0.97*** (0.95 - 0.99)
Number of children	1.09*** (1.06 - 1.12)	1.00 (0.97 - 1.04)	0.95** (0.92 -0.98)	0.96 (0.91 - 1.00)
Headship of the household				
Male (ref.)				
Female	0.74*** (0.64 - 0.85)	0.81*** (0.71 - 0.92)	1.11 (0.99 -1.25)	0.99 (0.88 - 1.12)
Caste/ethnicity				
Brahmin/ Chhetri (ref.)				
Janajati	1.00 (0.80 - 1.30)	0.70*** (0.60 - 0.81)	1.10 (0.95 - 1.34)	1.63*** (1.42 - 1.87)
Dalit	2.00*** (1.65 - 2.38)	1.30** (1.10 - 1.53)	0.70** (0.58 - 0.88)	1.51*** (1.22 - 1.88)
Other	2.00*** (1.66 - 2.31)	1.31** (1.10 - 1.56)	0.70* (0.58 - 0.97)	0.88 (0.70 - 1.11)
Place of residence				
Urban (ref.)				
Rural	1.46*** (1.24 - 1.73)	1.00 (0.87 - 1.16)	0.29*** (0.25 - 0.35)	0.82** (0.71 - 0.96)
Ecological zone				
Mountain (ref.)				

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Hill	0.99 (0.80 -1.24)	1.25* (1.00 - 1.56)	2.03*** (1.40 - 2.96)	0.91 (0.67 - 1.23)
Tarai	2.30*** (1.82 - 2.90)	2.98*** (2.34 - 3.79)	1.63*** (1.14 - 2.35)	0.69* (0.50 - 0.95)
Wealth quintile				
Poorest (ref.)				
Second poorest	1.35*** (1.16 - 1.56)	1.00 (0.87 - 1.15)	1.71*** (1.34 - 2.19)	1.79*** (1.41 - 2.28)
Middle	1.15 (0.96 - 1.38)	0.73*** (0.60 - 0.87)	1.90*** (1.46 - 2.48)	2.28*** (1.76 - 2.95)
Second richest	0.97 (0.80 - 1.17)	0.64*** (0.53 - 0.78)	3.79*** (2.96 - 4.87)	4.50*** (3.48 - 5.82)
Richest	0.45*** (0.36 - 0.55)	0.34*** (0.27 - 0.43)	9.71*** (7.58 - 12.44)	10.75*** (8.01 - 14.43)
Year				
2006 (Ref)				
2011	0.65*** (0.55 - 0.79)	0.64 (0.56 - 0.74)	1.51*** (1.21 - 1.90)	1.58*** (1.32 - 1.89)
2016	0.66*** (0.55 - 0.79)	0.61 (0.52 - 0.71)	2.97*** (2.36 - 3.74)	3.13*** (2.62 - 3.75)
*p < 0.05; **p < 0.01; ***p < 0.001; RR: Unadjusted Relative Risk; ARR: Adjusted Relative Risk; CI: Confidence Interval; ref.: Reference Category.				

Table 4: Socioeconomic characteristics associated with nutrition status among ever married Nepalese women of reproductive age (N = 17031).

Discussions

In the present study, we examined the associations between socioeconomic factors and nutrition status among ever married women in Nepal. The results document a double burden of malnutrition among this population, with the prevalence of overweight/obesity exceeding underweight by more than 12%. Considering the negative impacts of both overnutrition and undernutrition on women and their children's health and wellbeing [19], the double burden of malnutrition in this setting remains a public health concern.

Our findings suggest that wealth quintile, education status, and caste/ethnicity are common risk factors for both overweight/obesity and underweight among women. Additionally, younger women and women living in female-headed households are at a lower risk of underweight. Women living in the tarai ecological zone are at an increased risk of underweight and a decreased risk of overweight/obesity. Our findings on socio-economic status (SES) and education are consistent with findings from other studies conducted in South-East Asia [2,12]. In Nepal and other South-East Asian countries, women who have completed more years of schooling typically have higher SES. Women with higher SES may have higher purchasing capacity leading to consumption of energy-dense food and low levels of physical activity. Due to low purchasing capacity, women in lower wealth quintiles are at risk of having inadequate caloric intake and consuming foods with low nutritional value [2,8,12].

Similarly, our study found that ever married women belonging to the Dalit caste are at an increased risk of both underweight and overweight/obesity. A study from India found that individuals from the backward caste/ethnicity (comparable with Dalit in Nepal) were at a higher risk of underweight [3]. The 2011 NDHS also showed that Dalit women were at an elevated risk of underweight compared with the Brahmin/Janajati caste/ethnic groups [18]. The present finding indicating an increased risk of overweight/obesity among Dalit women in Nepal is novel. As suggested by previous studies, it is commonly believed that Dalit women are at higher risk of underweight due to low education and SES. However, the risk for overweight/obesity increases with rapid urbanization and dietary shifts from fruits and vegetables to more processed food [20]; recent increases in risk for overweight/obesity among Dalit women may reflect these factors. While the Dalit community traditionally made their livelihoods through farming, this has recently shifted toward labor work and remittance. This shift may have led to increased income and in turn, increased consumption of processed food and sedentary lifestyles leading to overweight/obesity.

While we found no association between age and underweight, our findings indicate that elder women are at a higher risk for overweight/obesity. This finding is consistent with similar studies conducted in India [3], Bangladesh [12] and Pakistan [11]. In contrast with our study, these studies show that younger women are at a higher risk of underweight. The study from India included all

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women of reproductive age. A sub-group analysis based on marital status showed no association between being married and risk of underweight [3]. The study from Bangladesh, however, showed that the risk of underweight significantly decreased among currently married women [12].

The finding that women living in urban areas are at a higher risk for overweight/obesity compared to women living in rural areas is consistent with other studies conducted in LMICs [3,8,12]. Changes in food habits, lifestyle, and occupation associated with living in urban areas may put these women at increased risk for overweight/obesity. However, we observed no rural/urban difference in risk for underweight. This finding is consistent with another study conducted in Nepal [20]. We observed significant ecological variance in the prevalence of underweight and overweight/obesity. Women living in the tarai ecological zone were at high risk of underweight and at a lower risk for overweight/obesity compared to women living in mountainous zones. A previous study from Nepal showed inequitable household food allocation in tarai ecological zones that may have resulted in inadequate caloric intake, leading to underweight status [22].

Limitation of the Study

Our study has several limitations. First, our study is cross sectional, thus limiting our ability to establish causal relationships between socio-economic factors and underweight and overweight/obesity. Second, some known associated predictors of underweight and overweight/obesity such as physical exercise and dietary patterns were not adjusted for in the models due to a lack of data.

Conclusion

Our findings confirm the existence of a double burden of malnutrition among Nepalese ever married women. Socio-demographic factors such as wealth, education, and caste/ethnicity are common risk factors for both underweight and overweight/obesity in this population. Nutrition programs aimed at reducing underweight and overweight/obesity need to target the full spectrum of women, including those with different socioeconomic characteristics and societal positioning. Multi-sectoral, nutrition programs alongside social and economic interventions have potential to play an important role in addressing the double burden of malnutrition among high risk groups in low resource settings such as Nepal.

Ethics Approval and Consent to Participate

The NDHS received ethical approval from the Nepal Health Research Council and ICF Institutional Review Board. The study involved secondary analysis of publicly available data. Thus, there was no need for independent ethical approval.

Availability of Data and Materials

The datasets used in this study are available from the corresponding author upon request.

Authors' Contributions

RPA designed the study and analyzed the data. RPA and AA prepared the first draft and ENS, KPA and NU revised the drafts. All authors reviewed multiple versions of the manuscript and read and approved the final version for submission.

Competing Interests

The authors declare that they have no competing interests.

Consent for Publication and Funding

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