

# Trends in the Prevalence of Overweight and Obesity Among Women of Reproductive Age

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## ABSTRACT

**Background:** Information on trends in the prevalence of overweight and obesity and the high-risk groups helps plan health promotion programmes and health policy. This study examined trends in overweight and obesity from 2006 to 2016 and the associated socio-demographic factors in 2016 among 20 to 49-year-old women in Nepal.

**Methods:** Nationally representative cross-sectional data were used from three Demographic and Health Surveys conducted in 2006 (n=7809), 2011 (n=4561), and 2016 (n=4904) in Nepal. Bodyweight and height were measured by trained personnel. Overweight was defined as 23.0 to 27.5 kg/m<sup>2</sup> and obesity as >27.5 kg/m<sup>2</sup> based on Asian-specific criteria in the main analyses. Multinomial logistic regression models were adjusted for age, parity, education, and wealth index.

**Results:** The prevalence of overweight increased from 16.6% to 26.8% and obesity from 3.9% to 14.3% between 2006 and 2016. The adjusted odds ratios and 95% confidence intervals were 2.26 (2.06 to 2.49) for overweight and 5.26 (4.48 to 6.18) for obesity in 2016 compared with 2006. Age 30 to 49 years, higher wealth index, parity 1 to 3 and education were associated with a higher prevalence of overweight and obesity, whereas the association between the area of residence (urban/rural) and prevalence of overweight or obesity was not statistically significant.

**Conclusions:** The prevalence of overweight and obesity increased among Nepalese women of reproductive age between 2006 and 2016. More research is needed on how to prevent overweight and obesity among women, especially women aged 30 to 49 years or with higher wealth, in Nepal.

**Keywords:** Nepal; obesity; overweight; trend; women

## INTRODUCTION

Overweight and obesity are well-known risk factors for chronic diseases, such as cardiovascular diseases and type 2 diabetes, and are associated with pregnancy and childbirth-related complications in women.<sup>1-3</sup> The risks of these complications increase at a lower level of body mass index (BMI) in Asian populations than in other populations, making Asian people particularly vulnerable to the consequences of overweight and obesity.<sup>4,5</sup> Therefore, lower BMI-thresholds have been suggested for defining overweight (23.0 to 27.5 kg/m<sup>2</sup>) and obesity (<27.5 kg/m<sup>2</sup>) in Asian populations.<sup>4,5</sup> Information on trends in the prevalence of overweight/obesity should be regularly updated to inform the planning of public health interventions and policy.

This study examined trends in the prevalence of overweight and obesity from 2006 to 2016 in nationally representative samples of 20 to 49-year-old women in Nepal. In addition, associations between socio-

demographic factors and overweight and obesity in 2016 were explored.

## METHODS

Nationally representative cross-sectional Demographic and Health Survey (DHS) data from Nepal were used from the years 2006, 2011, and 2016.<sup>6-8</sup> The DHS surveys provide data on a wide range of indicators relating to population, health, and nutrition among women aged 15 to 49 years, men aged 15 to 59 years, and children <5 years of age. All participants provided verbal informed consent to participate in the study. The ethical clearances for the surveys were granted by the ethical review board of the Nepal Health Research Council. The permission to analyse the data was obtained from the DHS program.

In all these surveys, the participating households were sampled using a multistage stratified cluster sampling design. In 2011 and 2016, the anthropometric

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measurements were performed for women in every alternate sampled household only, and therefore, the sample size is lower than in 2006. The present study included all women except for women whose anthropometric data were not measured ( $n=0$ , 6495 and 6377 in 2006, 2011 and 2016, respectively) or were missing ( $n=55$ , 35 and 28), who were pregnant at the time of the survey ( $n=626$ , 614 and 536) or who had given birth less than a month before the data collection ( $n=53$ , 45 and 29). Women aged 15 to 19 years old ( $n=2267$ , 2173 and 1231) were excluded as the general BMI classification of adults does not apply to this age group. In total, 7809, 4561 and 4904 women were included in the analyses from each survey in 2006, 2011 and 2016, respectively.

The DHS uses standardized questionnaires and protocols to facilitate international comparison.<sup>6-8</sup> Height and weight were measured by trained personnel: weight was measured using solar-powered scales with accuracy to 0.1 kg and height was measured using standardized measuring boards with accuracy to 0.1 cm. BMI was calculated by dividing body weight (kg) by squared height ( $m^2$ ). BMI was categorized according to the Asian-specific classification:  $<18.5$  kg/ $m^2$  for underweight, 18.5-22.9 kg/ $m^2$  for normal weight, 23.0-27.5 kg/ $m^2$  for overweight and  $>27.5$  kg/ $m^2$  for obesity (WHO Expert Consultation, 2004). The standard WHO criteria of BMI were also used (underweight  $<18.5$  kg/ $m^2$ , normal weight 18.5-24.9 kg/ $m^2$ , overweight 25.0-29.9 kg/ $m^2$  and obesity  $\geq 30.0$  kg/ $m^2$ ).<sup>5</sup>

Information on socio-demographic variables was obtained by interviewing the participants.<sup>6-8</sup> The socio-demographic variables included age (20-29, 30-39, and 40-49 years), the number of previous births i.e. parity (zero, one, two, three, at least four), the place of residence (rural, urban), educational level (no education, primary, secondary, higher), and wealth index (poorest, poorer, middle, richer, and richest). The classification of urban and rural areas changed in 2015 and, therefore, the data on the place of residence is not comparable in 2016 (vs. 2006 and 2011).<sup>8</sup> The wealth index was calculated based on the household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities.<sup>8</sup>

Differences in the descriptive data between the survey years were tested by the  $\chi^2$  test. The sampling strategy of the surveys was addressed by using sample weights to estimate the distribution of the variables. Therefore, the descriptive data are representative at the national

level. The weighted distribution of BMI (as a continuous variable) was presented by survey year as a line graph.

Overweight and obesity were classified based on the Asian-specific criteria in the primary analyses and the WHO criteria in the secondary analyses. The trends in the prevalence of overweight and obesity from 2006 to 2016 were presented graphically using both criteria. These trends were studied further using multinomial logistic regression analyses. Odds ratios (OR) and 95% confidence intervals (CI) show the odds for being overweight and obese (vs. being normal weight or underweight, i.e. the reference). The year of survey was used as an independent variable and the first survey (year 2006) as the reference. Model I provided crude ORs and Model II was adjusted for age, parity (both as continuous variables), education, and wealth index (both as categorized).

The prevalence of overweight and obesity were presented separately in each category of age, parity, place of residence, education, and wealth index using data from the latest survey. Associations between these variables and overweight and obesity were then studied by multinomial logistic regression models. The ORs (95% CI) show the odds of being overweight and obese vs. being normal weight or underweight. Model I present crude ORs and Model II was adjusted for age, parity, place of residence, education, and wealth index as above. Data were analysed using the Stata version 15.

## RESULTS

Descriptive information on background characteristics of the study population by survey year is presented in Table 1. The percentages of women in different age groups and wealth index categories were quite similar in all three surveys. The percentages of women with no previous births were between 10.1 and 13.5% in all three surveys, whereas the percentage of women with at least 4 births was the highest (37.4%) in 2006. Most of the women (83.9 to 86.0%) resided in rural areas in 2006 and 2011, whereas 37.0% of women resided in rural areas in 2016. The percentage of women having no education decreased from 62.6% to 40.9% and the percentage of women with a higher education increased from 4.0% to 14.9% between 2006 and 2016.

Figure 1 shows changes in the overall distribution of the BMI values among the participants from 2006 to 2016. The distribution shifted towards right, indicating a transition towards higher BMI categories over the period.

Table 1. Background characteristics of the participants by year, weighted numbers and percentages.

Variables	Year of Survey						p-value
	2006		2011		2016		
	N=7809	%	N=4561	%	N=4904	%	
<b>Age (years)</b>							0.053
20-29	3344	42.8	1958	42.9	1988	40.5	
30-39	2456	31.5	1481	32.5	1700	34.7	
40-49	2009	25.7	1122	24.6	1217	24.8	
<b>Parity</b>							<0.001
0	791	10.1	590	12.9	661	13.5	
1	940	12.0	652	14.3	800	16.3	
2	1673	21.4	1111	24.4	1347	27.5	
3	1482	19.0	901	19.8	925	18.9	
4 or more	2920	37.4	1306	28.6	1171	23.9	
<b>Place of residence</b>							<0.001
Rural	6554	83.9	3922	86.0	1813	37.0	
Urban	1255	16.1	640	14.0	3092	63.0	
<b>Education</b>							<0.001
No education	4884	62.6	2160	47.4	2005	40.9	
Primary	1195	15.3	822	18.0	859	17.5	
Secondary	1417	18.1	1207	26.5	1309	26.7	
Higher	312	4.0	372	8.2	731	14.9	
<b>Wealth Index</b>							<0.001
Poorest	1414	18.1	726	15.9	809	16.5	
Poorer	1458	18.7	822	18.0	933	19.0	
Middle	1585	20.3	953	20.9	981	20.0	
Richer	1589	20.4	973	21.3	1084	22.1	
Richest	1763	22.6	1087	23.8	1096	22.4	

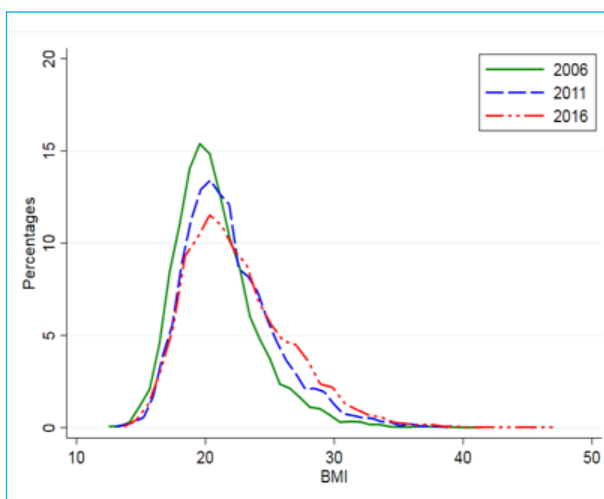
Figure 1. Distribution of body mass index (BMI, kg/m<sup>2</sup>) among women aged 20-49 years in Nepal from 2006 to 2016, weighted percentages.

Table 2. Prevalence of overweight and obesity based on the Asian-specific criteria by the year of survey, weighted numbers and percentages, and odd ratios (OR) with 95% confidence intervals (CI).

	Year of survey		
	2006	2011	2016
<b>Overweight vs. normal weight or underweight</b>			
n (%)	1293 (16.6)	1113 (24.4)	1313 (26.8)
Model I <sup>a</sup> , OR (95% CI)	Reference	1.75 (1.59 to 1.91)*	2.14 (1.96 to 2.34)*
Model II <sup>b</sup> , OR (95% CI)	Reference	1.69 (1.54 to 1.86)*	2.26 (2.06 to 2.49)*
<b>Obesity vs. normal weight or underweight</b>			
n (%)	306 (3.9)	330 (7.2)	699 (14.3)
Model I <sup>a</sup> , OR (95% CI)	Reference	2.52 (2.15 to 2.96)*	4.24 (3.66 to 4.91)*
Model II <sup>b</sup> , OR (95% CI)	Reference	2.49 (2.10 to 2.95)*	5.26 (4.48 to 6.18)*

\*Statistically significant at  $p < 0.05$  level, <sup>a</sup> Model I: Multinomial logistic regression model, crude ORs, <sup>b</sup> Model II: Multinomial logistic regression model, adjusted for age, parity, education and wealth index

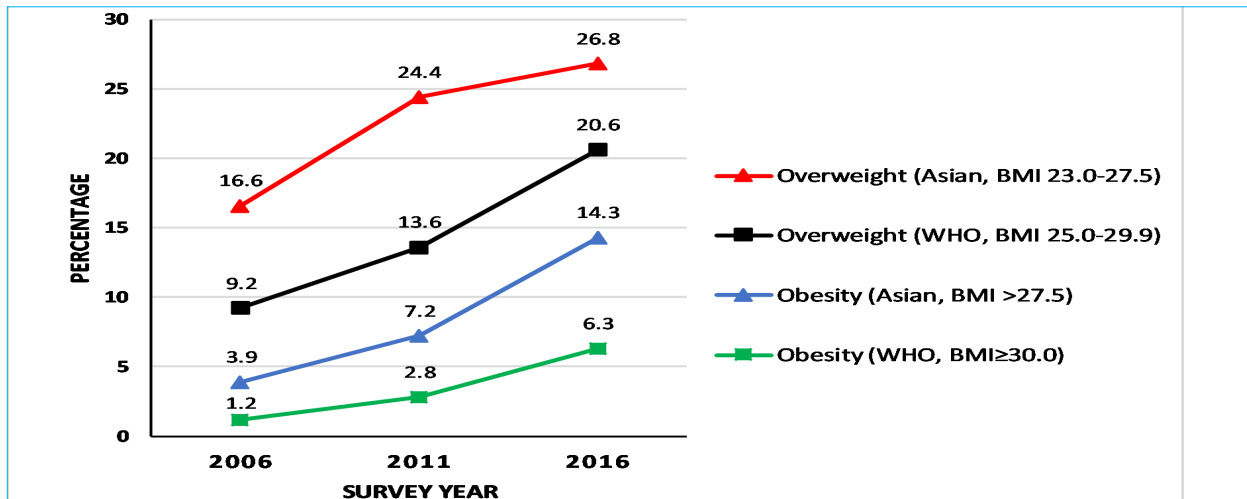


Figure 2. Trends in the prevalence of overweight and obesity among women aged 20 to 49 years in Nepal from 2006 to 2016 using the Asian-specific criteria and the WHO criteria, weighted percentages.

Table 3. Prevalence of overweight and obesity based on the Asian-specific criteria by socio-demographic characteristics in 2016. Weighted numbers and percentages, and crude and adjusted<sup>a</sup> odds ratios (OR) with 95% confidence intervals (CI) from multinomial logistic regression models.

	Overweight vs. normal weight or underweight			Obesity vs. normal weight or underweight		
	n (%)	OR (95% CI)	Adjusted OR (95% CI)	n (%)	OR (95% CI)	Adjusted OR (95% CI)
Survey year 2016, n=4904						
<b>Age (years)</b>						
20 to 29	446 (22.4)	Reference	Reference	161 (8.1)	Reference	Reference
30 to 39	504 (29.7)	1.75 (1.50 to 2.04)*	1.95 (1.63 to 2.34)*	303 (17.8)	2.85 (2.28 to 3.56)*	3.08 (2.36 to 4.01)*
40 to 49	363 (29.8)	1.80 (1.53 to 2.13)*	2.56 (2.06 to 3.18)*	235 (19.4)	2.94 (2.32 to 3.73)*	4.43 (3.25 to 6.03)*
<b>Parity</b>						
0	141 (21.3)	Reference	Reference	56 (8.5)	Reference	Reference
1	200 (25.0)	1.35 (1.04 to 1.74)*	1.35 (1.04 to 1.76)*	119 (14.9)	1.71 (1.17 to 2.50)*	1.68 (1.12 to 2.51)*
2	422 (31.3)	1.95 (1.55 to 2.46)*	1.67 (1.30 to 2.16)*	259 (19.2)	3.08 (2.20 to 4.33)*	2.19 (1.48 to 3.23)*
3	251 (27.2)	1.72 (1.35 to 2.19)*	1.50 (1.13 to 2.00)*	151 (16.3)	2.44 (1.70 to 3.48)*	1.96 (1.27 to 3.01)*
4 or more	299 (25.5)	1.26 (0.99 to 1.59)	1.15 (0.85 to 1.55)	114 (9.7)	1.30 (0.91 to 1.87)	1.31 (0.83 to 2.07)
<b>Place of residence</b>						
Urban	867 (28.0)	Reference	Reference	563 (18.2)	Reference	Reference
Rural	446 (24.6)	0.77 (0.67 to 0.88)*	1.02 (0.87 to 1.18)	136 (7.5)	0.42 (0.34 to 0.51)*	0.82 (0.65 to 1.04)
<b>Education</b>						
No education	467 (23.3)	Reference	Reference	198 (9.9)	Reference	Reference
Primary	269 (31.3)	1.68 (1.40 to 2.02)*	1.86 (1.53 to 2.27)*	141 (16.4)	2.33 (1.81 to 3.00)*	2.41 (1.82 to 3.19)*
Secondary	377 (28.8)	1.53 (1.30 to 1.80)*	1.72 (1.40 to 2.01)*	240 (18.4)	2.24 (1.79 to 2.80)*	1.95 (1.47 to 2.59)*
Higher	200 (27.4)	1.24 (1.01 to 1.52)*	1.39 (1.07 to 1.82)*	120 (16.4)	1.79 (1.36 to 2.35)*	1.44 (1.00 to 2.09)*
<b>Wealth Index</b>						
Poorest	187 (23.2)	Reference	Reference	29 (3.6)	Reference	Reference
Poorer	235 (25.2)	1.29 (1.04 to 1.59)*	1.21 (0.98 to 1.51)	72 (7.7)	2.45 (1.61 to 3.73)*	2.13 (1.39 to 3.27)*
Middle	230 (23.4)	1.23 (0.99 to 1.52)	1.14 (0.92 to 1.43)	77 (7.9)	2.67 (1.77 to 4.04)*	2.26 (1.48 to 3.46)*
Richer	291 (26.8)	1.67 (1.35 to 2.05)*	1.56 (1.25 to 1.94)*	162 (14.9)	4.87 (3.29 to 7.20)*	4.16 (2.76 to 6.26)*
Richest	370 (33.8)	3.35 (2.70 to 4.16)*	3.05 (2.36 to 3.93)*	359 (32.7)	18.35 (12.55 to 26.83)*	14.66 (9.61 to 22.37)*

\* Statistically significant at  $p < 0.05$  level, <sup>a</sup> Adjusted for age, parity, place of residence, education and wealth index (enter method)

The adjusted model shows increased odds for being obese (vs. the reference) among older women compared with 20- to 29-year-old women (Table 3). Women having one to three previous births had 1.7- to 2.2-fold adjusted odds of being obese (vs. the reference) compared with women with no previous births. The place of residence was not related to the odds of being obese when adjusted for other factors. Women with primary, secondary or higher education had higher adjusted odds of being obese (OR 1.4 to 2.4) (vs. the reference) than women with no education. The odds for being obese increased by increasing wealth index and women in the richest wealth index quintile had 14.7-fold adjusted odds for being obese (vs. the reference) compared with women in the poorest wealth index quintile. The same variables were associated with the odds of being overweight (vs. the reference), although the associations were weaker than those observed for obesity (Table 3).

## DISCUSSION

The prevalence of overweight and obesity has increased remarkably among 20 to 49-year-old women in Nepal between the years 2006 and 2016. When the Asian-specific criteria with the lower BMI cut-offs were applied, the prevalence of overweight increased from 16.6% to 26.8% (adjusted OR 2.26, 95% CI 2.06 to 2.49) and the prevalence of obesity from 3.9% to 14.3% (adjusted OR 5.26, 95% CI 4.48 to 6.18) during the same period. Higher age, higher relative wealth, having at least primary education, and having one to three children were associated with a higher prevalence of overweight and obesity in 2016.

Between 2001 and 2011, the prevalence of overweight/obesity (WHO criteria) increased from 6% to 14% among 15 to 49-year-old women in Nepal.<sup>9</sup> Based on the present study, the increase was even faster between 2011 and 2016 than between 2006 and 2011. The respective ORs were mainly slightly higher, when using the WHO criteria to define overweight and obesity (results not shown). Similar trends have been reported from comparable population-based studies from other South Asian countries. In Bangladesh, the prevalence of overweight/obesity (Asian-specific criteria) increased from 15% to 36% among 15 to 49-year-old women between 2004 and 2014 based on DHS data.<sup>10</sup> Another study from Bangladesh, using the same data, reported that the prevalence of overweight/obesity (WHO criteria) increased from 10% to 24% among 15 to 49-year-old women during the same period.<sup>11</sup> However, as they included only non-pregnant women who had given birth within five years, the results are not directly comparable to those of the present study. In India, the prevalence of overweight/

obesity (WHO criteria) increased between 2005-2006 and 2015-2016 among ever-married 15 to 49-year-old women.<sup>12</sup> The change was from 8% to 18% in rural areas and from 29% to 39% in urban areas. Thus, the trends in the combined prevalence of overweight and obesity in Nepal are quite close to those in Bangladesh and rural India. Of these studies, only one<sup>10</sup> reported the trends separately for overweight and obesity.

As in the present study, higher age and higher relative wealth were associated with a higher prevalence of overweight/obesity in Nepal in 2006 and 2011.<sup>13,9</sup> However, the respective results related to education were mixed, possibly because there were fewer women with high education in 2006 and 2011 than in 2016. In the present study, the ORs were often somewhat higher when overweight and obesity were defined using the WHO criteria (results not shown). Higher age, relative wealth, and education were associated with a higher prevalence of overweight and obesity also in Bangladesh in 2014<sup>10</sup> and in urban and rural India throughout the study period.<sup>12</sup> The relationship between the indicators of socioeconomic position and the change in the prevalence of overweight/obesity differed to some extent between urban and rural areas of India.<sup>12</sup> A higher socioeconomic position has been related to a higher prevalence of obesity in many low-income countries, which might be explained by better access to excess food, lower occupational physical activity levels, and preference for a larger body size.<sup>14</sup> In Bangladesh, the prevalence of overweight and obesity was higher among women in urban areas compared with rural areas.<sup>10</sup> The analyses were adjusted for age only, which may explain why the results were opposite to those of the present study. In the present study, the association between parity and the prevalence of overweight and obesity became weaker in all parity groups and statistically non-significant among women with three or more children when adjusted for age, wealth index, and the other covariates. The other studies<sup>10,11</sup> did not report the respective results.

Nutritional transition is likely to be the main driver of the upward trend in the prevalence of overweight/obesity in developing.<sup>15,16</sup> The typical Nepalese diet, comprising mainly agricultural staple-based foods, has begun to change in parallel with the increase in the prevalence of overweight/obesity.<sup>17</sup> The consumption of modern processed foods with high energy, fat and sugar content has increased, especially in urban populations based on country-level data.<sup>17</sup> Shrestha et al. identified four dietary patterns, which explained 40% of the variation in the total food intake among adults in a

suburban community in Nepal.<sup>18</sup> Being overweight/obese was associated with the 'refined grain-meat-alcohol' pattern (among all adults) and the 'fast food' pattern (among adults  $\geq 40$  years), whereas the 'solid fats-dairy' and the 'mixed' patterns were not associated with the prevalence of overweight/obesity. There is limited information on dietary intake or physical activity in young Nepalese women. Physical inactivity is generally another main cause of overweight/obesity. Almost half of all women were physically inactive in a population-based study near Kathmandu.<sup>19</sup> Socio-cultural factors and traditional beliefs that favour fatter bodies contribute significantly to the development of overweight/obesity in developing countries, particularly in South Asia.<sup>20</sup>

It is important to study how to prevent the development of overweight and obesity among women in reproductive age. The interventions carried out in women in Western countries are not directly applicable to South Asian countries e.g. due to cultural differences in dietary and physical activity habits in general and specifically during and after pregnancy.<sup>21</sup> Therefore, qualitative data on traditions, practices and perceptions related to diet, physical activity and weight gain are also needed to understand what kinds of interventions might or might not work in the South Asian context.

This study reported trends in the prevalence and the associated socio-demographic factors separately for overweight and obesity, unlike many previous studies. Two different criteria were used to define overweight/obesity. The Asian-specific criteria may be clinically more relevant for the Nepalese population.<sup>4,5</sup> The use of the WHO criteria allows comparison for studies in other countries. Another strength is that, it include nationally representative data with a 98% response rate among eligible women in each survey. The results can, therefore, be generalized to the 20 to 49-year-old women across Nepal. The data were collected using similar methods in each survey and are comparable with DHS data from other countries. Body weight and height were measured by trained study personnel.

The main limitation of the study was that it was not possible to study reasons for changes in the prevalence of overweight and obesity. No data were available on the diet or physical activity of all participants. It was also impossible to compare temporal trends in the prevalence of overweight and obesity between urban and rural areas as the definition of urban and rural areas differ in 2016 than before.<sup>8</sup> Additionally, no data on other indicators of overweight and obesity, such as high waist circumference, were available. However,

the prevalence of abdominal obesity is likely to have increased in Nepal like in other South Asian countries.<sup>22</sup> Finally, we cannot exclude the possibility that some unmeasured confounding variables have affected the results.

## CONCLUSIONS

The prevalence of overweight and obesity increased remarkably among 20 to 49-year-old women in Nepal between 2006 and 2016. Forty-one per cent of the women were either overweight or obese in 2016 based on the Asian-specific criteria and are therefore at increased risk for obesity-related diseases. Overweight and obesity are related to higher age and higher wealth in Nepal. More information is needed on effective ways to promote healthy body weight among women of reproductive age in Nepal.

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