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# BMJ Open

## Frequency of Television viewing and prevalence of overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide survey

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6 2 **obesity among women of the reproductive age group in Myanmar: Results**  
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8 3 **from a nationwide survey**  
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## 21 ABSTRACT

22 **Objectives:** This study aimed to find out the association between frequency of television  
23 viewing and overweight/obesity among reproductive age women of Myanmar.

24  
25 **Design:** This was a cross-sectional study.

26  
27 **Setting:** This study used Myanmar Demographic and Health Survey (2015-16) data.

28  
29 **Participants:** Total 12,020 women aged 15-49 years and were not pregnant or didn't deliver a  
30 child within two months prior to the survey were included.

31  
32 **Primary and secondary outcome measures:** The primary outcome was overweight (23.0 to  
33 <math>27.5 \text{ kg/m}^2</math>) and obesity ( $\geq 27.5 \text{ kg/m}^2$ ), which was measured by Asian BMI cut off.

34  
35 **Results:** The prevalence of overweight was 26.5% and obesity was 12.2% among the study  
36 participants. The odds of being obese were 33% higher (adjusted relative risk ratio (ARRR):  
37 1.334, 95% CI: 1.089- 1.635;  $p$ -value=0.006) among those who watched television at least once  
38 a week compared to those never watched television. Rural women who watched television at

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3 39 least once a week were 1.4 times more likely to be obese (ARRR: 1.399, 95% CI: 1.113- 1.759;  
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5 40  $p$ -value=0.004) compared to those who did not watch television at all.  
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12 42 **Conclusions:** Frequent television watching was associated with obesity among rural women of  
13  
14 43 reproductive age group in Myanmar.  
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21 45 **Key words:** Obesity, Overweight, Noncommunicable Disease, Myanmar  
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## 46 STRENGTHS AND LIMITATIONS OF THE STUDY

- 47 • This study utilized a nationally representative sample to investigate the relationship between  
48 the frequency of television viewing and prevalence of overweight/obesity among the women  
49 of the reproductive age group of Myanmar. So the findings of this study can be generalizable  
50 to the target population.
- 51 • The frequency of television viewing was measured in weeks, not in days/hours; the later  
52 could have given more precise information.
- 53 • In the multivariable analysis, food habit and duration of physical activity were not included  
54 because that information was not collected in MDHS.

## 55 INTRODUCTION

56 Both developed and developing countries are facing increasing burden of overweight and  
57 obesity, posing a major public health problem.<sup>1-3</sup> The prevalence of overweight and obesity  
58 increased by 27.5% among the global adult population and 47.1% among global children  
59 between 1980 and 2013.<sup>4</sup> During the same time period, globally, the prevalence of overweight  
60 and obesity rose from 29.8% to 38.0% among adult female.<sup>4</sup> Although this burden is lowest in  
61 South and South East Asia, countries of this region are experiencing a rising burden of  
62 overweight and obesity.<sup>5</sup> Historically, undernutrition was considered as the major nutritional  
63 problem in South and Southeast Asian countries like Bangladesh, India, Myanmar, and Nepal.<sup>6</sup>  
64 However, as a consequence of economic development and rapid urbanization, currently, these  
65 countries are going through a nutritional transition which brings forth nutritional excess  
66 (overweight and obesity) as an emerging public health problem.<sup>7</sup>

67  
68 Myanmar is a low-middle income country (LMIC) situated in the Southeast Asia region.  
69 After 50 long years of military rule, the country has recently reformed into the democratic  
70 government system.<sup>8,9</sup> In 2015-16, first Myanmar Demographic and Health Survey (MDHS) was  
71 conducted using a nationally representative sample across the country.<sup>10</sup> The survey found a high  
72 prevalence of overweight (28.1%) and obesity (13.1%) among reproductive age group women.<sup>11</sup>

73  
74 Overweight and obesity is an important risk factor for developing several  
75 noncommunicable diseases (NCDs) like type 2 diabetes mellitus (T2DM)<sup>12</sup>, hypertension<sup>13</sup>,



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3 76 cardiovascular diseases (CVDs)<sup>14</sup>, cancer<sup>15</sup> and chronic kidney diseases (CKD).<sup>16</sup> In addition,  
4  
5 77 overweight and obese women experience complications during pregnancy (gestational diabetes  
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7 78 mellitus (GDM), pre-eclampsia and eclampsia) more frequently than women having normal body  
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9  
10 79 weight.<sup>17-20</sup>  
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17 81 Physical inactivity along with consumption of high-calorie food is considered as the  
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19 82 reason for increasing trend of overweight and obesity in many studies.<sup>21-27</sup> Physical inactivity  
20  
21 83 was attributable to 13.4 million disability-adjusted life years (DALYs) lost worldwide in 2013.<sup>28</sup>  
22  
23 84 It has been found that energy expenditure is very low among people who spend leisure time  
24  
25 85 watching television rather than being involved in activities like playing games, gardening etc.  
26  
27 86 which ultimately increase their risk of gaining excessive body weight.<sup>29 30</sup> People who watch  
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29 87 television more frequently also intake more energy which sometimes is attributable to their  
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31 88 frequent exposure to the advertisements of foods and beverages broadcast at television and  
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33 89 subsequent consumption of the foods/beverages.<sup>31-35</sup>  
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42 91 Across the world, many studies have shown a positive association between the  
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44 92 increased frequency of television viewing and overweight/obesity. In USA and Australia, it has  
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46 93 been found that people who view television more frequently are at higher risk of being  
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48 94 overweight/obese.<sup>34 36-38</sup> This association has not been explored widely in South and South Asian  
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51 95 countries. Therefore, we conducted this study to determine the association between television  
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3 96 viewing and prevalence of overweight and obesity among reproductive age group women in the  
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5 97 context of Myanmar using the MDHS 2015-16 data.  
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## 11 99 **METHODS**

### 14 100 **study settings**

17 101 According to the 2014 census, the total population of Myanmar was 51.5 million with  
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19 102 population density of 76 persons per square kilometer (km<sup>2</sup>).<sup>39</sup> The country is the home to 135  
20  
21 103 ethnic groups.<sup>39 40</sup> The *Gross Domestic Product (GDP)* of Myanmar was 6.4% and per capita,  
22  
23 104 Gross National Income (GNI) was 1,455 USD in 2016-17. More than quarter (26.1%) of the  
24  
25 105 population was living under the poverty line in 2014. Myanmar has the lowest life expectancy at  
26  
27 106 birth (66.6 years) among the Association of Southeast Asian Nations (ASEAN) countries. High  
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29 107 Under-five mortality rate is also high in Myanmar.<sup>39 41</sup>  
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### 36 109 **study design**

39 110 This study analyzed the data of MDHS 2015-16, first Demographic and Health Survey  
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41 111 of Myanmar.<sup>10</sup> MDHS 2015-16 was a cross-sectional survey which used a nationally  
42  
43 112 representative sample and was conducted by a joint collaboration between the Ministry of Health  
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45 113 and Sports of Myanmar and ICF International. United States Agency for International  
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47 114 Development (USAID) and 3MDG provided financial support to the survey. Two-stage cluster  
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49 115 sampling technique was used for sample selection. The sample was stratified for each of the  
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51 116 seven states and eight regions of Myanmar. The detailed method has been published  
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53 117 previously.<sup>10</sup> In MDHS, 13,260 households were selected for the final sample. The target group  
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3 118 of this study was women of reproductive age group (15-49 years). The permanent residents and  
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5 119 the visitors who stayed in the selected households the night before the day of data collection  
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8 120 were included in the questionnaire survey. Around 96% eligible women agreed to participate in  
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10 121 the survey. Among them, 98% agreed for anthropometric measurement. However, pregnant  
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12 122 women and women who gave birth within preceding two months of the survey were excluded.  
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15 123 The final sample size of this study was 12,020 (Figure 1).  
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22 125 **survey tools and data collection**  
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25 126 A standard set of woman's questionnaire used by the DHS program was adopted according  
26  
27 127 to the local context and pre-tested to collect the socio-demographic information (e.g., age, sex,  
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29 128 household wealth index, place of residence) through face-to-face interview. A workshop was  
30  
31 129 conducted involving stakeholders from the government, nongovernment organizations (NGOs)  
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33  
34 130 and development partners to design the questionnaire. The MDHS Technical Committee  
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36 131 approved the final questionnaire. It was then translated into local language and back-translated  
37  
38 132 into English to maintain the quality. Trained field staffs carried out the interviews and  
39  
40 133 anthropometric measurements. Measuring boards specially made by Shorr Productions was used  
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43 134 for height measurement and lightweight SECA scales with digital screens were used for  
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45 135 measuring the weight of the respondents.  
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53 137 After training of the data collectors and pre-testing of the questionnaires, data were  
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55 138 collected with tablet computers using computer-assisted field editing (CAFE) procedures. The  
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139 MDHS core team provided the technical support. Data quality was monitored by weekly field  
 140 check tables and a mechanism was developed to provide immediate feedback to the data  
 141 collectors.<sup>10</sup>

### 143 **outcome and independent variables**

144 The main outcome variables of this study were overweight and obesity. To define these  
 145 variables, Asia specific body mass index (BMI) cut-off value was used,<sup>42</sup> that means we  
 146 considered women having BMI <23.0 kg/m<sup>2</sup> as normal weight and underweight, women having  
 147 BMI between 23.0 kg/m<sup>2</sup> and <27.5 kg/m<sup>2</sup> as overweight and women having BMI ≥27.5 kg/m<sup>2</sup>  
 148 as obese.

150 The main independent variable of interest for this study was the frequency of viewing  
 151 television. Data were collected as the following categories: (1) not viewing television at all, (2)  
 152 viewing television less than once a week, and (3) viewing television at least once a week.<sup>10</sup> The  
 153 other explanatory variables had been considered based on the literature review were age group,  
 154 place of residence , region of residence, education, wealth quintile, , current working status and  
 155 parity. The categories of the variables are mentioned in Table 1.

156 **Table 1: List of variables considered for the study**

Name of the Variables	Categories
<b>Outcome Variables:</b>	
Body Mass Index (BMI)	a) Normal weight and underweight (BMI < 23 kg/m <sup>2</sup> )

	<p>b) Overweight (BMI 23.0 kg/m<sup>2</sup> - &lt;27.5 kg/m<sup>2</sup>)</p> <p>c) Obesity (BMI ≥27.5 kg/m<sup>2</sup>)</p>
<b>Dependent Variables:</b>	
1. Age Groups	<p>a) 15-24 years</p> <p>b) 25-34 years</p> <p>c) 35-49 years</p>
2. Place of residence	<p>a) Urban</p> <p>b) Rural</p>
3. Region of residence	<p>a) Kachin</p> <p>b) Kayah</p> <p>c) Kayin</p> <p>d) Chin</p> <p>e) Sagaing</p> <p>f) Taninthayi</p> <p>g) Bago</p> <p>h) Magway</p> <p>i) Mandalay</p> <p>j) Mon</p> <p>k) Rakhine</p> <p>l) Yangon</p> <p>m) Shan</p> <p>n) Ayeyarwaddy</p> <p>o) Naypyitaw</p>

4. Education	<ul style="list-style-type: none"> <li>a) No education</li> <li>b) Primary education</li> <li>c) Secondary education</li> <li>d) Higher education</li> </ul>
5. Wealth quintile	<ul style="list-style-type: none"> <li>a) Poorest</li> <li>b) Poorer</li> <li>c) Middle</li> <li>d) Richer</li> <li>e) Richest</li> </ul>
6. Current working status	<ul style="list-style-type: none"> <li>a) Yes</li> <li>b) No</li> </ul>
7. Parity	<ul style="list-style-type: none"> <li>a) 0</li> <li>b) 1</li> <li>c) 2</li> <li>d) 3</li> <li>e) 3+</li> </ul>

157

## 158 data analysis

159 Weighted descriptive statistics (frequency and percentage) were used to present the socio-  
 160 demographic characteristics of the respondents. Chi-square ( $\chi^2$ ) test was performed to see  
 161 whether the groups according to the BMI status differ for the explanatory variables. To find the  
 162 association between the explanatory and outcome variables multinomial logistic regression  
 163 analysis was conducted. The variables showed  $p$ -value  $<0.05$  in multivariable analysis were

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3 164 considered as statistically significant. Both unadjusted and adjusted Relative Risk Ratio (RRR)  
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5 165 were reported. All the analysis was done using Stata 13.0.  
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11 167 **ethical consideration**  
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14 168 MDHS received ethical approval from Ethics Review Committee on Medical Research  
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16 169 including Human Subjects in the Department of Medical Research, Ministry of Health and  
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18 170 Sports as well as from the ICF Institutional Review Board. Written informed consent was taken  
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20 171 from the participants. In case of minor participants, assent form was signed by the respondents  
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22 172 and written informed consent was given by the adult guardian.  
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30 174 **patient involvement**  
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33 175 Patients were not involved in the study.  
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## 176 FINDINGS

### 177 socio-demographic characteristics of the respondents

178 The socio-demographic characteristics of the respondents are presented in Table 2.  
179 Majority of the study participants were aged between 35 years and 49 years (42.3%) and were  
180 resident of the rural area (70.8%). The highest proportion of participants was from the Yangon  
181 region (15.1%), followed by Ayeyarwaddy (12.5%) and Mandalay region (12.2%) whereas  
182 lowest participation was from Kayah region (0.5%). Around half of the respondents (41.3%)  
183 were educated up to the primary level and about one-third (36.1%) received secondary level  
184 education, however, 10.2% received higher education and 12.4% received no education. More  
185 than two-third (68.1%) of the women were employed at the time of interview. Nearly two-fifths  
186 of the women (41.7%) were nulliparous, while cumulatively similar proportion of respondents  
187 (46.6%) had experience of being pregnant- for one time (15.3%), two times (15.8%) and more  
188 than three times (15.5%). Regarding household wealth index highest proportion of the  
189 respondents belonged to richest wealth quintile (22.2%) followed by richer (21.1%) and middle  
190 (20.9%) quintile. Among our study participants, the majority (60.1%) reported that they watched  
191 television at least once a week; however, 23.1% did not watch television at all and 16.8%  
192 watched television less than once a week. Noticeably, more than quarter (26.5%) of our study  
193 participants were overweight, and 12.2% of them were obese.

194



195 **Table 2: Socio Demographic Characteristics of the Study Participants, MDHS 2015-16 (N=**  
 196 **12,020)**

Variable	Frequency (Percentage)
<b>Age Group (years)</b>	
15-24	3433 (28.6)
25-34	3503 (29.1)
35-49	5084 (42.3)
<b>Place of Residence</b>	
Urban	3505 (29.2)
Rural	8515 (70.8)
<b>Region of Residence</b>	
Kachin	333 (2.8)
Kayah	60 (0.5)
Kayin	274 (2.3)
Chin	90 (0.8)
Sagaing	1351 (11.3)
Taninthayi	265 (2.2)
Bago	1197 (9.9)
Magway	1030 (8.6)
Mandalay	1462 (12.2)
Mon	432 (3.6)
Rakhine	695 (5.8)
Yangon	1822 (15.1)
Shan	1216 (10.1)
Ayeyarwaddy	1508 (12.5)
Naypyitaw	285 (2.3)
<b>Highest Educational Status</b>	
No Formal Education	1484 (12.4)
Primary	4966 (41.3)
Secondary	4345 (36.1)
Higher	1255 (10.2)
<b>Currently Employed</b>	
Yes	8183 (68.1)
No	3837 (32.9)
<b>Wealth index</b>	
Poorest	2052 (17.1)
Poorer	2251 (18.7)
Middle	2509 (20.9)
Richer	2533 (21.1)
Richest	2675 (22.2)
<b>Parity</b>	
0	5009 (41.7)
1	1844 (15.3)

2	1903 (15.8)
3	1405 (11.7)
3+	1859 (15.5)
<b>Frequency of Viewing Television</b>	
Not at all	2777 (23.1)
Less than once a week	2015 (16.8)
At least once a week	7227 (60.1)
<b>Body Mass Index (BMI)</b>	
BMI <23 (normal weight and underweight)	7373 (61.3)
23 ≤ BMI <27.5 (overweight)	3186 (26.)
BMI ≥27.5 (obese)	1460 (12.2%)

197

198 MDHS, Myanmar Demographic and Health Survey

199 The frequency of watching television at least once a week was higher among the urban  
200 women (80.8% versus 51.7%) than the rural women. Around 30% of the rural women didn't  
201 view television at all, where the proportion was less for the urban women (7.2%) (Figure 2).

202

### 203 **prevalence of overweight and obesity across the explanatory variables**

204 Table 3 shows the prevalence of three categories of BMI across the explanatory variables  
205 with the chi-square ( $\chi^2$ ) value. Except for current employment status, significant differences  
206 were found among the BMI of women across the explanatory variables. The prevalence of  
207 overweight and obesity increased with age ( $p$ -value<0.0001) and was the most common in  
208 Yangon and Kachin region ( $p$ -value<0.0001). This prevalence was also higher in the urban areas  
209 compared to the rural areas (overweight: 31.1% versus 24.6%; obesity: 17.9% versus 9.8%;  $p$ -  
210 value<0.0001). Plausibly, Women with higher educational status, having two children, belonging  
211 to the richest wealth group had a higher prevalence of overweight and obesity ( $p$ -value<0.0001).  
212 The prevalence of overweight and obesity was also higher among the individuals who used to  
213 watch television at least once a week ( $p$ -value<0.0001).

214 Table 3: Prevalence of overweight and obesity across the explanatory variables, MDHS 2015-16

Variable	BMI Status (%)			$\chi^2$	p-value
	BMI <23	23 $\geq$ BMI <27.5	BMI $\geq$ 27.5		
<b>Age Group (years)</b>					
15-24	82.4	14.3	3.3	173.8569	<0.0001
25-34	60.4	27.6	12.0		
35-49	47.7	34.0	18.3		
<b>Place of Residence</b>					
Urban	51.0	31.1	17.9	258.4282	<0.0001
Rural	65.6	24.6	9.8		
<b>Region of Residence</b>					
Kachin	54.6	30.0	15.4	240.1499	<0.0001
Kayah	63.3	27.1	9.6		
Kayin	59.1	27.1	13.8		
Chin	71.7	23.9	4.4		
Sagaing	58.7	27.7	13.6		
Taninthayi	57.0	28.6	14.4		
Bago	64.5	25.9	9.6		
Magway	67.7	24.0	8.3		
Mandalay	64.2	25.4	10.5		
Mon	59.7	25.0	15.3		
Rakhine	75.3	19.2	5.5		
Yangon	49.7	33.8	16.5		
Shan	60.2	25.7	14.1		
Ayeyarwaddy	64.8	23.3	11.8		
Naypyitaw	63.3	26.0	10.7		
<b>Highest Educational Status</b>					
No formal education	65.4	25.3	9.3	40.4818	0.0003
Primary	59.8	27.6	12.6		
Secondary	63.1	25.3	11.6		
Higher	56.6	28.1	15.3		

<b>Current Employment Status</b>					
Yes	61.2	26.6	12.2	0.2181	0.9348
No	61.6	26.4	12.0		
<b>Wealth Index</b>					
Poorest	75.2	18.6	6.2	427.7143	<0.0001
Poorer	66.8	25.0	8.2		
Middle	61.5	28.0	10.5		
Richer	57.2	28.2	14.6		
Richest	49.9	30.9	19.2		
<b>Parity</b>					
0	75.2	18.4	6.4	759.5925	<0.0001
1	55.5	30.8	13.7		
2	49.4	32.7	17.9		
3	45.6	36.1	18.3		
3+	54.0	30.4	15.6		
<b>Frequency of viewing Television</b>					
Not at all	67.2	24.5	8.3	89.6916	<0.001
Less than once a week	63.3	25.9	10.8		
At least once a week	58.5	27.5	14.0		

215  
216 BMI, body mass index; MDHS, Myanmar Demographic and Health Survey.

### 217 **association between the frequency of viewing television and overweight and obesity**

218 Multinomial logistic regression was fitted to find out the association between frequency  
219 of viewing television and overweight and obesity. The results are presented in Table 4. In the  
220 final model after adjusting for age, place and region of residence, wealth index, highest  
221 educational status, current employment status and parity, it was found that, women who watched  
222 television at least once a week were 1.3 times higher odds of being obese than the women who  
223 never watched television (ARRR: 1.334, 95% CI: 1.089- 1.635;  $p$ -value=0.006). However, the  
224 frequency of watching television and overweight revealed no statistically significant association.

225  
226 When stratified by urban and rural residence, neither overweight nor obesity showed  
227 any significant association with frequency of viewing television in the urban areas. However, in  
228 the rural areas, women who viewed television least once a week had 1.4 times likely to be obese  
229 than those who didn't watch television at all (ARRR: 1.399, 95% CI: 1.113- 1.759;  $p$ -  
230 value=0.004).

231 **Table 4: Association between the frequency of viewing Television and overweight and obesity among reproductive age women**  
 232 **of Myanmar, MDHS 2015-16**

Frequency of viewing Television	Overweight (23≥ BMI <27.5)				Obesity (BMI ≥27.5)			
	CRRR	p-value	ARRR	p-value	CRRR	p-value	ARRR	p-value
<b>Total:</b>								
Not at all	Ref		Ref		Ref		Ref	
Less than once a week	1.122 (0.940 - 1.340)	0.201	0.990 (0.822- 1.193)	0.919	1.371 (1.075- 1.748)	<b>0.011</b>	1.063 (0.831- 1.358)	0.627
At least once a week	1.287 (1.127- 1.469)	<b>&lt;0.000 1</b>	1.076 (0.928- 1.248)	0.331	1.931 (1.595- 2.337)	<b>&lt;0.000 1</b>	1.334 (1.089- 1.635)	<b>0.006</b>
<b>In Urban Area:</b>								
Not at all	Ref		Ref		Ref		Ref	
Less than once a week	1.285 (0.830- 1.990)	0.258	0.948 (0.562- 1.600)	0.841	1.081 (0.635- 1.840)	0.773	0.948 (0.562- 1.600)	0.841
At least once a week	1.316 (0.886- 1.954)	0.171	1.117 (0.738- 1.691)	0.597	1.242 (0.839- 1.841)	0.276	1.117 (0.738- 1.691)	0.597
<b>In Rural Area:</b>								
Not at all	Ref		Ref		Ref		Ref	
Less than once a week	1.036(0.850- 1.262)	0.727	0.947(0.771-1.161)	0.598	1.273 (0.966-1.678)	0.086	1.055 (0.801- 1.380)	0.702
At least once a week	1.101(0.955- 1.268)	0.184	1.040 (0.891- 1.215)	0.616	1.607 (1.289- 2.004)	<b>&lt;0.000 1</b>	1.399 (1.113- 1.759)	<b>0.004</b>

234 MDHS, Myanmar Demographic and Health Survey; CRRR, Crude Relative Risk Ratio; ARRR, Adjusted Relative Risk Ratio.

235 Adjusted for age, place of residence, region of residence, highest educational status, current employment status, wealth index, and parity.

236 Model goodness-of-fit: To assess the internal validity of the regression model, the F-adjusted  
237 mean residual goodness-of-fit test was used. The *p*-value of the F statistics of the adjusted model  
238 was <0.001, indicating an acceptable model fitness

239

240

## 241 DISCUSSION

242 To the best of our knowledge, this is the first study to utilize a nationally representative  
243 sample to examine the association between frequency of television viewing with the prevalence  
244 of overweight and obesity among women of reproductive age group in Myanmar. The prevalence  
245 of overweight and obesity was higher among the women living in the urban areas than the in  
246 rural areas. This finding is consistent with the study done in other South and South East Asian  
247 countries as well as in the other continents.<sup>3 21 43-48</sup> Urban women had a higher frequency of  
248 television watching.. Similar findings were reported in studies conducted in Bangladesh.<sup>21</sup> This  
249 may be due to higher coverage of electricity and a availability of many satellite channels in the  
250 urban area in comparison to the rural areas.<sup>21</sup>

251

252 It was found in our study that among rural women, the prevalence of obesity was  
253 significantly associated with watching television for at least once a week. This finding is also  
254 consistent with the finding from Bangladesh.<sup>21</sup>

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256 Despite the frequency of watching television had no association with overweight and  
257 obesity among the urban women, they were more likely to be overweight/obese than the rural



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3 258 women. This may be explained by the sedentary lifestyle and intake of high-calorie food by the  
4  
5 259 urban residents, those determinants had overridden the effect of increased frequency of watching  
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7 260 television. On the other hand, due to the presence of less developed transportation facilities,  
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9  
10 261 involvement in more laborious work and less consumption of obesogenic diets in the rural area,  
11  
12 262 the prevalence of overweight/obesity is less there.<sup>21</sup> Those who view television more frequently  
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14 263 in the rural area; they are more prone to lead sedentary lifestyle and are at risk of developing  
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17 264 obesity.<sup>21 49 50</sup>  
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### 21 22 266 **comparison with previous studies**

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24  
25 267 The finding of our study is coherent with a recent study in Bangladesh which showed a  
26  
27 268 positive association between frequency of television viewing and overweight/obesity in women  
28  
29 269 of reproductive age group.<sup>21</sup> In the context of developed countries (for example, USA and  
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31 270 Australia) a positive association between the increased frequency of television viewing and  
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33 271 overweight/obesity has been found.<sup>34 36-38</sup> In a recently published multi-country study, this  
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36 272 association has also been observed in case of children and adolescents.<sup>51</sup>  
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### 41 42 43 274 **policy and program implications**

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47 276 High prevalence of overweight/obesity is associated with increased NCD burden in  
48  
49 277 Myanmar, as shown in the recent evidence.<sup>11 52</sup> With the economic development of the country,  
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51 278 people of Myanmar are getting more used to with sedentary lifestyle and obesogenic food,  
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54 279 which, in turn, is raising the burden of overweight/obesity. Considering the epidemiologic,  
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3 280 demographic, and nutritional transition, the policy makers of Myanmar should focus on the  
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5 281 prevention and control of both overweight/obesity and NCDs. Newly released ‘Myanmar  
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7 282 National Health Plan 2017-2021’ incorporates the prevention and control programs of NCDs.<sup>53</sup>  
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10 283 Along with this, Social Behavioral Change Communication (SBCC) campaign should be  
11  
12 284 developed in order to promote physical activity and create awareness among the population,  
13  
14 285 specially among the children and the adolescents in order to prevent overweight/obesity at the  
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16 286 beginning of the life. Further research should be performed among men and adolescents to  
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18 287 determine whether this positive association exists among those target population or not.  
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## 25 289 **STRENGTHS AND LIMITATIONS**

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28 290 This is the first study which utilized a nationally representative sample to examine the  
29  
30 291 association between frequency of watching television with overweight/obesity among the  
31  
32 292 reproductive age group women in Myanmar. However, the survey could not establish the  
33  
34 293 temporal relationship between the exposure and outcome variables because of its cross-sectional  
35  
36 294 design. The frequency of television viewing was measured in weeks, not in days/hours; the latter  
37  
38 295 could have given more precise information. In the multivariable analysis, food habit and duration  
39  
40 296 of physical activity were not included because this information was not collected in MDHS.  
41  
42 297 Finally, there may be the presence of reporting bias while measuring the frequency of television  
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44 298 watching.  
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## 50 51 300 **CONCLUSIONS**

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2  
3 301 The rising burden of obesity and overweight is now a global concern., Obesity  
4  
5 302 ultimately leads an individual to develop NCDs and premature death. Our study results  
6  
7 303 demonstrate that watching television is associated with obesity among women in Myanmar.  
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10 304 Therefore, necessary steps should be taken to make people aware of harmful consequences of  
11  
12 305 physical inactivity as well as to encourage them to in physical activity. Additional research is  
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14 306 also warranted to explore the situation in the general population of Myanmar.  
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## 24 309 **LIST OF ABBREVIATION**

- 25  
26  
27 310 ASEAN- Association of Southeast Asian Nations  
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29 311 BMI- Body Mass Index  
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31 312 GDP- *Gross Domestic Product*  
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33 313 GNI- Gross National Income  
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35 314 NCDs- Non-Communicable Diseases  
36  
37 315 MDHS- Myanmar Demographic and Health Survey  
38  
39 316 SBCC- Social Behavioral Change Communication  
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41 317 SEARO- South-East Asia Regional Office  
42  
43 318 USAID- United States Agency for International Development  
44  
45 319 USD- United States Dollar  
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47 320 WHO- World Health Organization  
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49 321 3MDG- Three Millennium Development Goal Fund  
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### 323 **Contributors**

324 RDG, IHS, MH, IS and MS conceptualized the study. RDG, IHS, MH, IS, MRH and MS  
325 designed the study and acquired the data. RDG, IHS, MH and IS conducted the data analysis.  
326 RDG, IHS, MH, IS, MRH and MS interpreted the data. RDG, IHS, MH, IS and MRH prepared  
327 the first draft. RDG, IHS, MH, IS, MRH and MS participated in critical revision of the  
328 manuscript and contributed to its intellectual improvement. All authors went through the final  
329 draft and approved it for submission. RDG, IHS, MH and IS equally contributed in this work as  
330 first author.

331

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334

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337

### 338 **Competing Interests**

339 None declared.

340

### 341 **Patient consent**

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3 342 None Declared  
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9 344 **Disclaimer**

10  
11 345 The authors are alone responsible for the integrity and accuracy of data analysis and the writing  
12 the manuscript.  
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19 348 **Ethics approval**

20  
21  
22 349 The datasets were obtained from DHS Programme with proper procedure. The study exempt  
23 from collecting ethical approval because the survey protocols were reviewed and approved by  
24 350  
25 Ethics Review Committee on Medical Research including Human Subjects in the Department of  
26 351  
27 Medical Research, Ministry of Health and Sports as well as from the ICF Institutional Review  
28 352  
29 Board.  
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37 355 **Data sharing statement**

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39  
40 356 The dataset of MDHS 2015-16 is available at the Demographic and Health Surveys Program.  
41 Extra data is available which is available on request at [http://dhsprogram-com/what-we-](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm)  
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43 [do/survey/survey-display-349.cfm](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm).  
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3 **510 Figures:**  
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6 **511 Figure 1:** Flowchart showing the process of selecting the participants in the survey  
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8 **512 Figure 2:** Distribution of the respondents by place of residence with frequency of watching television  
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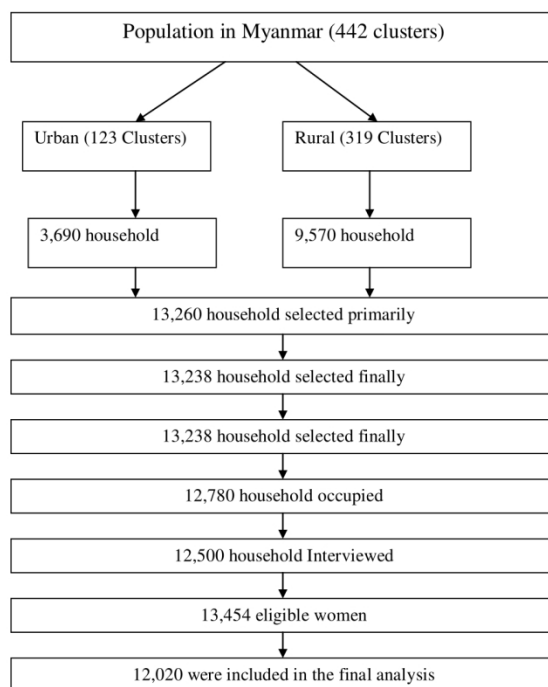
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13 **514 Supplementary Materials:**  
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15 **515 Supplementary File 1:** STROBE Checklist  
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18 **516 Supplementary File 2:** Supplementary Table 1: Adjusted odds ratios for factors associated with  
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20 overweight and obesity compared to normal weight among women of Myanmar, MDHS 2015-  
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26 **519 Supplementary File 3:** Supplementary Table 2: Adjusted odds ratios for factors associated with  
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28 overweight and obesity compared to normal weight for urban area among women of Myanmar,  
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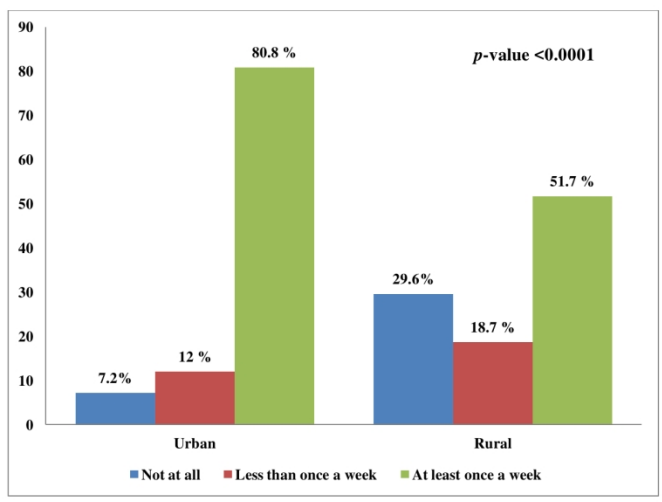
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34 **522 Supplementary File 4:** Supplementary Table 3: Adjusted odds ratios for factors associated with  
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36 overweight and obesity compared to normal weight for rural area among women of Myanmar,  
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Flowchart showing the process of selecting the participants in the survey

143x186mm (300 x 300 DPI)

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Distribution of the respondents by place of residence with frequency of watching television  
143x186mm (300 x 300 DPI)

**Supplementary Table 1: Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight among women of Myanmar, MDHS 2015-16.**

Variable	Overweight (23≥ BMI <27.5)				Obesity (BMI ≥27.5)			
	Adjusted RRR	95% CI		p-value	Adjusted RRR	95% CI		p-value
		Lower Limit	Upper Limit			Lower Limit	Upper Limit	
15-24	Ref				Ref			
25-34	2.014178	1.716823	2.363035	<0.0001	3.453528	2.530329	4.713558	<0.0001
35-49	3.047071	2.576591	3.60346	<0.0001	6.250267	4.556371	8.573892	<0.0001
<b>Place of Residence</b>								
Urban	Ref				Ref			
Rural	0.7866087	0.662566	0.9338741	0.006	0.6516484	0.5244415	0.8097104	<0.0001
<b>Region of Residence</b>								
Kachin	Ref				Ref			
Kayah	0.7747752	0.5352607	1.121466	0.176	0.5308337	0.3379477	0.8338106	0.006
Kayin	0.865386	0.6301812	1.188377	0.371	0.8680791	0.6063682	1.242745	0.439
Chin	0.6542445	0.4568423	0.9369444	0.021	0.2413828	0.1530058	0.3808067	<0.0001
Sagaing	0.871381	0.6190346	1.226595	0.429	0.8686633	0.6093857	1.238257	0.435
Taninthayi	1.024705	0.7408348	1.417348	0.882	1.030117	0.6931852	1.530819	0.883
Bago	0.7593014	0.5547193	1.039334	0.085	0.5695773	0.3946052	0.8221339	0.003
Magway	0.6498518	0.4593069	0.919445	0.015	0.4745499	0.3306871	0.6809992	<0.0001
Mandalay	0.6863519	0.495081	0.951517	0.024	0.5367759	0.3719	0.7747	0.001



		7	6			034	399	
Mon	0.7907257	0.542886 6	1.151709	0.220	0.9121818	0.5952 813	1.3977 86	0.672
Rakhine	0.6639056	0.460749 3	0.956638 6	<b>0.028</b>	0.4831741	0.3258 298	0.7165 004	<b>&lt;0.0001</b>
Yangon	1.122907	0.796641	1.582797	0.507	0.8897992	0.6200 706	1.2768 59	0.525
Shan	0.84052	0.589794 8	1.19783	0.336	0.9392429	0.6368 666	1.3851 84	0.751
Ayeyarwaddy	0.7594529	0.545486 7	1.057347	0.103	0.8496266	0.5608 967	1.2869 85	0.441
Naypyitaw	0.744938	0.529284 9	1.048457	0.091	0.5791332	0.3768 765	0.8899 341	<b>0.013</b>
<b>Highest Educational Status</b>								
No Formal Education	Ref				Ref			
Primary	1.153131	0.956893	1.389614	0.134	1.465104	1.1371 68	1.8876 11	<b>0.003</b>
Secondary	1.193937	0.945784 6	1.507198	0.136	1.466041	1.0759 91	1.9974 85	<b>0.015</b>
Higher	1.038379	0.778352 9	1.385272	0.797	1.211783	0.8417 414	1.7445	0.301
<b>Marital Status</b>								
Single	Ref				Ref			
Married	1.574419	1.251288	1.980995	<b>&lt;0.0001</b>	1.878905	1.2909 44	2.7346 55	<b>0.001</b>
Separated/ Divorced/ Widowed	1.052985	0.797765 7	1.389854	0.715	0.9991828	0.6415 03	1.5562 92	0.997
<b>Currently employment</b>								
No	Ref				Ref			
Yes	1.046469	0.922830 3	1.186673	0.478	1.113853	0.9502 117	1.3056 76	0.183
<b>Wealth index</b>								

Poorest	Ref				Ref			
Poorer	1.463942	1.227376	1.746103	<0.0001	1.446222	1.0736 28	1.9481 21	0.015
Middle	1.859199	1.530768	2.258096	<0.0001	2.117198	1.5618 36	2.8700 35	<0.0001
Richer	1.947941	1.576063	2.407564	<0.0001	2.913029	2.1333 31	3.9776 93	<0.0001
Rich	2.276987	1.771738	2.926319	<0.0001	4.003093	2.8194 04	5.6837 36	<0.0001
<b>Parity</b>								
0	Ref				Ref			
1	1.448628	1.135308	1.848419	0.003	1.529933	1.0304 49	2.2715 29	0.035
2	1.414514	1.100211	1.818606	0.007	1.677003	1.1357 06	2.4762 89	0.009
3	1.601212	1.231188	2.082445	<0.0001	1.808826	1.2260 71	2.6685 67	0.003
3+	1.243818	.9581223	1.614704	0.101	1.601881	1.0739 8	2.3892 66	0.021
<b>Frequency of watching TV</b>								
Not at all	Ref				Ref			
Less than once a week	0.9904753	0.822553 6	1.192678	0.919	1.062536	0.8313 49	1.3580 14	0.627
At least once a week	1.076105	0.927818 4	1.248092	0.331	1.333905	1.0880 42	1.6353 26	0.006

**Supplementary Table 2: Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight for urban area among women of Myanmar, MDHS 2015-16.**

Variable	Overweight (23≥ BMI <27.5)				Obesity (BMI ≥27.5)			
	Adjusted RRR	95% CI		p-value	Adjusted RRR	95% CI		p-value
		Lower Limit	Upper Limit			Lower Limit	Upper Limit	
15-24	Ref				Ref			
25-34	1.99629	1.511645	2.636315	<0.0001	4.662324	2.941363	7.390199	<0.0001
35-49	3.631152	2.661972	4.953195	<0.0001	11.90942	7.439211	19.06577	<0.0001
<b>Region of Residence</b>								
Kachin	Ref				Ref			
Kayah	0.6197694	0.3415865	1.1245	0.114	0.535549	0.2663595	1.076788	0.079
Kayin	0.9026549	0.6332612	1.286651	0.568	0.9352865	0.5386067	1.624118	0.811
Chin	1.010079	0.6093459	1.674352	0.969	0.4215907	0.2488876	.7141325	<b>0.002</b>
Sagaing	0.8465951	0.5540117	1.293697	0.438	1.131411	0.6621374	1.933271	0.649
Taninthayi	0.6013035	0.3472516	1.041222	0.069	0.5079112	0.2597578	0.9931321	<b>0.048</b>
Bago	0.7487075	0.457641	1.224897	0.246	0.4372885	0.2406765	0.7945156	<b>0.007</b>
Magway	0.3872192	0.1664396	.9008591	<b>0.028</b>	0.5108682	0.2888877	0.903418	<b>0.021</b>
Mandalay	0.8098875	0.5581317	1.175202	0.264	0.8457557	0.4863151	1.470863	0.550
Mon	0.5160773	0.2762577	.9640843	<b>0.038</b>	0.6199155	0.2671926	1.43827	0.263
Rakhine	0.5414014	0.377641	.7761741	<b>0.001</b>	0.6079698	0.3650	1.01241	0.056

		3				95	4	
Yangon	0.9914488	0.651252 6	1.509354	0.968	1.015649	0.5795 707	1.7798 41	0.956
Shan	0.8882496	0.557285 2	1.415769	0.615	1.158867	0.5529 16	2.4288 9	0.694
Ayeyarwaddy	0.6028135	0.360625 4	1.00765	0.053	1.081547	0.5686 131	2.0571 89	0.809
Naypyitaw	0.8093038	0.518803 3	1.262468	0.348	0.5976147	0.2742 415	1.3022 95	0.193
<b>Highest Educational Status</b>								
No Formal Education	Ref				Ref			
Primary	0.9969074	0.574876 5	1.728761	0.991	1.25865	0.7212 307	2.1965 23	0.415
Secondary	0.923249	0.550566 4	1.548203	0.760	1.322484	0.7063 417	2.4760 86	0.379
Higher	0.8297145	0.473439 3	1.454096	0.511	0.9428715	0.4966 776	1.7899 07	0.856
<b>Marital Status</b>								
Single	Ref				Ref			
Married	1.706656	1.134786	2.566718	<b>0.011</b>	1.307464	0.7423 622	2.3027 32	0.350
Separated/ Divorced/ Widowed	1.403443	0.859922	2.2905	0.173	0.784481	0.4185 441	1.4703 6	0.445
<b>Currently employment</b>								
No	Ref				Ref			
Yes	1.1686	0.883859	1.545072	0.271	1.423277	1.0829 64	1.8705 29	<b>0.012</b>
<b>Wealth index</b>								
Poorest	Ref				Ref			
Poorer	1.637195	0.845656 8	3.169616	0.142	1.029602	0.2450 144	4.3266 06	0.968
Middle	1.575722	0.759095	3.270869	0.220	2.615763	0.9747	7.0191	0.056

		2				966	22	
Richer	2.159063	1.090346	4.275298	<b>0.028</b>	3.797769	1.368644	10.5382	<b>0.011</b>
Rich	2.366448	1.198188	4.673787	<b>0.014</b>	4.987571	1.715419	14.50133	<b>0.004</b>
<b>Parity</b>								
0	Ref				Ref			
1	1.324264	0.8217526	2.134067	0.246	1.606277	0.8523954	3.026912	0.141
2	1.156168	0.7296707	1.831955	0.533	1.465602	0.8190305	2.622598	0.196
3	1.479512	0.9000301	2.432093	0.121	1.931239	1.092153	3.41498	<b>0.024</b>
3+	1.097445	0.674996	1.784286	0.705	1.970916	1.069589	3.631777	<b>0.030</b>
<b>Frequency of watching TV</b>								
Not at all	Ref				Ref			
Less than once a week	0.9481362	0.5617306	1.600344	0.841	0.9481362	0.5617306	1.600344	0.841
At least once a week	1.1173	0.7381243	1.69126	0.597	1.1173	0.7381243	1.69126	0.597

**Supplementary Table 3: Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight for rural area among women of Myanmar, MDHS 2015-16.**

Variable	Overweight (23≥ BMI <27.5)				Obesity (BMI ≥27.5)			
	Adjusted RRR	95% CI		p-value	Adjusted RRR	95% CI		p-value
		Lower Limit	Upper Limit			Lower Limit	Upper Limit	
15-24	Ref				Ref			
25-34	1.993053	1.645366	2.414212	<0.0001	2.662185	1.766248	4.012592	<0.0001
35-49	2.837788	2.322254	3.467769	<0.0001	4.037205	2.637831	6.17895	<0.0001
<b>Region of Residence</b>								
Kachin	Ref				Ref			
Kayah	0.8581715	0.5276925	1.39562	0.536	0.512983	0.2832599	0.9290107	<b>0.028</b>
Kayin	0.8802213	0.5669098	1.366689	0.569	0.8355287	0.5274436	1.323569	0.443
Chin	0.5510667	0.3355356	.905044	<b>0.019</b>	0.1779341	0.0820571	0.3858356	<0.0001
Sagaing	0.9185937	0.583784	1.445422	0.713	0.8014693	0.5151804	1.246851	0.325
Taninthayi	1.242773	0.8108307	1.904818	0.317	1.292552	0.819649	2.038299	0.268
Bago	0.7871062	0.5175211	1.197123	0.262	0.6241537	0.3969461	0.9814123	<b>0.041</b>
Magway	0.7377705	0.4743426	1.147494	0.176	0.4485698	0.2820159	0.7134876	<b>0.001</b>
Mandalay	0.6591658	0.4166751	1.042778	0.075	0.4312958	0.2610264	0.7126332	<b>0.001</b>
Mon	0.9603201	0.5975	1.543456	0.867	1.121258	0.7191246	1.748264	0.612
Rakhine	0.7224051	0.447117	1.167186	0.183	0.4226528	0.2468	0.72356	<b>0.002</b>

		2				825	45	
Yangon	1.331271	0.809228 8	2.190087	0.259	0.8599715	0.5528 334	1.33774 7	0.502
Shan	0.8526008	0.526012 8	1.381959	0.516	0.8601828	0.5482 5	1.34959 3	0.511
Ayeyarwaddy	0.8402438	0.542896 9	1.300449	0.434	0.7797158	0.4609 332	1.31896 9	0.352
Naypyitaw	0.7125468	0.441512 7	1.149962	0.165	0.5826169	0.3610 18	.940237	<b>0.027</b>
<b>Highest Educational Status</b>								
No Formal Education	Ref				Ref			
Primary	1.155671	0.943010 1	1.416289	0.163	1.475255	1.1063 83	1.96710 9	<b>0.008</b>
Secondary	1.25736	0.954780 5	1.655829	0.103	1.410123	0.9838 434	2.0211	0.061
Higher	1.028378	0.693413 3	1.525153	0.889	1.541224	0.9218 403	2.57677	0.099
<b>Marital Status</b>								
Single	Ref				Ref			
Married	1.446478	1.08462 3	1.929057	<b>0.012</b>	2.684179	1.6122 73	4.46873 2	<b>&lt;0.0001</b>
Separated/ Divorced/ Widowed	0.8678572	0.607186 7	1.240436	0.436	1.35682	0.7291 331	2.52486 3	0.334
<b>Currently employment</b>								
No	Ref				Ref			
Yes	1.011636	0.889311 1	1.150787	0.860	0.9643305	0.7881 907	1.17983 3	0.723
<b>Wealth index</b>								
Poorest	Ref				Ref			
Poorer	1.467707	1.218223	1.768285	<b>&lt;0.0001</b>	1.534762	1.1383 91	2.06914 4	<b>0.005</b>
Middle	1.943905	1.577616	2.395239	<b>&lt;0.0001</b>	2.15362	1.5570	2.97882	<b>&lt;0.0001</b>

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Richer	1.933188	1.529228	2.443857	<0.0001	2.907661	2.09556	4.03448	<0.0001
Rich	2.326294	1.669484	3.241508	<0.0001	4.025519	2.657761	6.097162	<0.0001
<b>Parity</b>								
0	Ref				Ref			
1	1.529117	1.149527	2.034053	0.004	1.450185	0.8730671	2.408791	0.151
2	1.553539	1.143311	2.110961	0.005	1.755926	1.041618	2.960084	0.035
3	1.731549	1.254656	2.389708	0.001	1.762302	1.03753	2.993367	0.036
3+	1.367349	0.9952458	1.878574	0.054	1.480344	0.8671131	2.527257	0.150
<b>Frequency of watching TV</b>								
Not at all	Ref				Ref			
Less than once a week	0.9466965	0.7716262	1.161488	0.598	1.054994	0.8013967	1.388841	0.702
At least once a week	1.040453	0.8908021	1.215246	0.616	1.399062	1.11264	1.759217	0.004



**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

**Title of the study: Frequency of Television viewing and prevalence of overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide survey**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	7-8
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8-9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10-12
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12-13
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	12-13
		(b) Describe any methods used to examine subgroups and interactions	12-13

		(c) Explain how missing data were addressed	12-13
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	Not applicable
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14
		(b) Indicate number of participants with missing data for each variable of interest	14
Outcome data	15*	Report numbers of outcome events or summary measures	17
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	20
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	22
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	22-24
Generalisability	21	Discuss the generalisability (external validity) of the study results	22-24
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	26

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

For peer review only

# BMJ Open

## Frequency of Television viewing and association with overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide cross-sectional survey

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6 2 **obesity among women of the reproductive age group in Myanmar: Results**  
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8 3 **from a nationwide cross-sectional survey**  
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## 25 ABSTRACT

26 **Objectives:** This study aimed to discern the association between the frequency of television  
27 viewing and overweight/obesity among reproductive age women of Myanmar.

28 **Design:** This was a cross-sectional study.

29 **Setting:** This study used Myanmar Demographic and Health Survey (2015-16) data.

30 **Participants:** Total of 12,021 women both aged 15-49 years and also not pregnant or did not  
31 deliver a child within the two months prior to the survey were included.

32 **Primary and secondary outcome measures:** The primary outcome was overweight (23.0 to  
33 <27.5 kg/m<sup>2</sup>) and obesity ( $\geq$ 27.5 kg/m<sup>2</sup>), which was measured using the Asian BMI cut off.  
34 Ordered logistic regression analysis was conducted to find the association between the  
35 explanatory and outcome variables.

36 **Results:** The prevalence of overweight was 26.5% and obesity was 12.2% among the study  
37 participants. The odds of being overweight/obese were 20% higher (adjusted odds ratio (AOR):  
38 1.16, 95% CI: 1.02-1.32; *p*-value = 0.023) among those who watched television at least once a  
39 week compared to those who did not watch television at all.. Rural women who watched  
40 television at least once a week were 1.2 times more likely to be obese (AOR: 1.16, 95% CI: 1.01-  
41 1.34; *p*-value = 0.040) compared to those who did not watch television at all.

42 **Conclusions:** Frequent television watching was associated with obesity among rural women of  
43 reproductive age in Myanmar.

44 **Key words:** Obesity, Overweight, Non-communicable Disease, Myanmar

## 45 STRENGTHS AND LIMITATIONS OF THE STUDY

- 46 • This study utilized a nationally representative sample to investigate the association between  
47 the frequency of television viewing and overweight/obesity among women of reproductive  
48 age from Myanmar.
- 49 • This study utilized standard and valid tools for data collection. The probability of the  
50 existence of measurement error is lower in this study in comparison to other cross-sectional  
51 studies conducted in Myanmar.
- 52 • Temporal relationship could not be established due to cross-sectional nature of the survey.
- 53 • The frequency of television viewing was measured in weeks, not in days/hours; the latter  
54 could have given more precise information.
- 55 • In the multivariable analysis, food habit and duration of physical activity were not included  
56 because that information was not collected in the survey.



## 57 INTRODUCTION

58 Both developed and developing countries are facing the increasing burden of overweight  
59 and obesity, which are posing as major public health problems.<sup>1-3</sup> The prevalence of overweight  
60 and obesity increased by 27.5% among the global adult population and 47.1% among the global  
61 child population between 1980 and 2013.<sup>4</sup> During the same time period, globally, the prevalence  
62 of overweight and obesity rose from 29.8% to 38.0% among adult females, in particular.<sup>4</sup>  
63 Although this burden is lowest in South and Southeast Asia, countries of this region are still  
64 experiencing the rising burden of overweight and obesity.<sup>5</sup> Myanmar is a low and middle-income  
65 country (LMIC) situated in the Southeast Asia region. In 2015-16, the first Myanmar  
66 Demographic and Health Survey (MDHS) was conducted using a nationally representative  
67 sample across the country.<sup>6</sup> The survey found a high prevalence of overweight and obesity  
68 among women of reproductive age.<sup>7</sup>

69 Overweight and obesity is an important risk factor for the development of several non-  
70 communicable diseases (NCDs) like diabetes mellitus<sup>8</sup>, hypertension<sup>9</sup>, cardiovascular diseases  
71<sup>10</sup>, cancer<sup>11</sup> and chronic kidney diseases.<sup>12</sup> In addition, overweight and obese women experience  
72 complications during pregnancy (gestational diabetes mellitus, pre-eclampsia and eclampsia)  
73 more frequently than women of normal body weight.<sup>13 14</sup>

74 It has been found that energy expenditure is very low among people who spend their  
75 leisure time watching television, rather than being involved in physical activities like playing  
76 games, gardening, etc. This ultimately increases their risk of gaining excessive body weight.<sup>15 16</sup>  
77 Television watching is also associated with an increase in energy intake, which may sometimes

78 be attributable to their frequent exposure to television advertisements of foods and beverages and  
79 the subsequent consumption of said foods and beverages.<sup>17-21</sup>

80 Across the world, many studies have shown a positive association between the increased  
81 frequency of television viewing and overweight/obesity. In the USA and Australia, it has been  
82 found that people who view television more frequently are at higher risk of being  
83 overweight/obese.<sup>20 22-24</sup> A study from Bangladesh has found that watching television frequently  
84 (at least once a week) was associated with obesity among women of reproductive age.<sup>25</sup>  
85 However, this association has not been explored in other South and Southeast Asian countries  
86 including Myanmar. Therefore, this study was conducted to determine the association between  
87 television viewing and the prevalence of overweight and obesity among women of reproductive  
88 age in Myanmar using the MDHS 2015-16 data.

## 90 **METHODS**

### 91 **study settings**

92 According to the 2014 census, the total population of Myanmar was 51.5 million with a  
93 population density of 76 persons per square kilometer (km<sup>2</sup>). The country is home to 135 ethnic  
94 groups.<sup>26 27</sup> The *Gross Domestic Product (GDP)* growth rate of Myanmar was 6.4% and per  
95 capita, Gross National Income (GNI) was 1,455 USD in 2016-17. More than a quarter (26.1%)  
96 of the population was living under the poverty line in 2014. Myanmar also has the lowest life  
97 expectancy at birth (66.6 years) among the Association of Southeast Asian Nations (ASEAN).<sup>26</sup>

98 <sup>28</sup>

## 99 study design

100 This study analyzed the data of MDHS 2015-16, the first Demographic and Health  
101 Survey of Myanmar.<sup>6</sup> The detailed method has been published previously.<sup>6</sup> MDHS 2015-16 was  
102 a cross-sectional survey which used a nationally representative sample and was conducted  
103 through a joint collaboration between the Ministry of Health and Sports of Myanmar and ICF  
104 International. The United States Agency for International Development (USAID) and Three  
105 Millennium Development Goal Fund (3MDG) provided financial support for the survey. Two-  
106 stage cluster sampling techniques were used for sample selection. The sample was stratified for  
107 each of the seven states and eight regions of Myanmar. At the first stage, 442 clusters (urban:  
108 123 and rural: 319) were selected randomly from a sample frame of 4,000 clusters. At the second  
109 stage, 30 households were selected from each of the clusters. In total, 13,260 households were  
110 selected for the final sample. The target group of this study was women of reproductive age (15-  
111 49 years). The permanent residents and the visitors who stayed in the selected households the  
112 night before the date of data collection were included in the questionnaire survey. Around 96%  
113 of eligible women agreed to participate in the survey. Among them, 98% agreed for  
114 anthropometric measurement. However, pregnant women and women who had given birth  
115 within the preceding two months of the survey were excluded. The final weighted sample size of  
116 this study was 12,021 ([Figure 1](#)).

## 117 survey tools and data collection

118 A standard woman's questionnaire used by the DHS program was adopted and modified  
119 according to the local context and pre-tested to collect the socio-demographic information (e.g.  
120 age, sex, household wealth index and place of residence) through face-to-face interviews.

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3 121 Trained field staff carried out the interviews and anthropometric measurements. Measuring  
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5 122 boards specially made by Shorr Productions were used for height measurement and lightweight  
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8 123 SECA scales with digital screens were used for measuring the weight of the respondents.  
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11 124 The main outcome variables of this study were overweight and obesity. To define these  
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13 125 variables, an Asia specific body mass index (BMI) cut-off value was used.<sup>29</sup> Women having a  
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15 126 BMI <23.0 kg/m<sup>2</sup> were considered to be normal weight or underweight, women having a BMI  
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17 127 between 23.0 kg/m<sup>2</sup> and <27.5 kg/m<sup>2</sup> were considered to be overweight and women having a  
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19 128 BMI ≥27.5 kg/m<sup>2</sup> were considered to be obese.  
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24 129 The main explanatory variable of interest for this study was the frequency of viewing  
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26 130 television. Data were collected as the following categories: (1) not viewing television at all, (2)  
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28 131 viewing television less than once a week, and (3) viewing television at least once a week.<sup>10</sup> The  
29  
30 132 other independent variables considered based on the literature review were age group, place of  
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32 133 residence, region of residence, education, wealth quintile, current working status, parity and  
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34 134 number of household members in the family. The categories of the variables are mentioned in  
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36 135 Table 1.  
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41 136 **Table 1: List of variables considered for the study**  
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Name of the Variables	Categories
<b>Outcome Variables:</b>	
Body Mass Index (BMI)	a) 0= Normal weight or underweight (BMI <23 kg/m <sup>2</sup> ) b) 1= Overweight (BMI 23.0 kg/m <sup>2</sup> to <27.5 kg/m <sup>2</sup> ) c) 2= Obesity (BMI ≥27.5 kg/m <sup>2</sup> )

<b>Explanatory Variable:</b>	
<b>Frequency of Viewing Television</b>	<p>a) 0= Not at all</p> <p>b) 1= Less than once a week</p> <p>c) 2= At least once a week</p>
<b>Covariates:</b>	
1. Age Groups	<p>a) 0= 15-24 years</p> <p>b) 1= 25-34 years</p> <p>c) 2= 35-49 years</p>
2. Place of Residence	<p>a) 0= Urban</p> <p>b) 1= Rural</p>
3. Region of Residence	<p>a) 0= Kachin</p> <p>b) 1= Kayah</p> <p>c) 2= Kayin</p> <p>d) 3= Chin</p> <p>e) 4= Sagaing</p> <p>f) 5= Taninthayi</p> <p>g) 6= Bago</p> <p>h) 7= Magway</p> <p>i) 8= Mandalay</p> <p>j) 9= Mon</p> <p>k) 10= Rakhine</p> <p>l) 11= Yangon</p>

	<p>m) 12= Shan</p> <p>n) 13= Ayeyarwaddy</p> <p>o) 14= Naypyitaw</p>
4. Education	<p>a) 0= No education</p> <p>b) 1= Primary education</p> <p>c) 2= Secondary education</p> <p>d) 3= Higher education</p>
5. Wealth quintile	<p>a) 0= Poorest</p> <p>b) 1= Poorer</p> <p>c) 2= Middle</p> <p>d) 3= Richer</p> <p>e) 4= Richest</p>
6. Current working status	<p>a) 0= Yes</p> <p>b) 1= No</p>
7. Parity	<p>a) 0= 0 (nullipara)</p> <p>b) 1= 1 (primipara)</p> <p>c) 2= 2</p> <p>d) 3= 3</p> <p>e) 4= &gt;3</p>
8. Number of Household Members	<p>a) 0= ≤5</p> <p>b) 1= &gt;5</p>

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## 138 **data analysis**

139 Weighted descriptive statistics (frequency and percentage) were used to present the  
140 socio-demographic characteristics of the respondents. A chi-square ( $\chi^2$ ) test was performed to  
141 determine whether the groups differed in terms of the explanatory variables according to the  
142 BMI status. To find the association between the explanatory and outcome variables, ordered  
143 logistic regression analysis was conducted. Initially, bivariate analyses were done. Variables  
144 which showed a *p-value* <0.20 in bivariate analyses were included in the multivariable model.  
145 This value of 0.2 was considered significant to prevent residual confounding in multivariable  
146 analysis.<sup>30</sup> The variables which showed *p-value* <0.05 in multivariable analysis were considered  
147 to be statistically significant. Both the unadjusted Crude Odd Ratio (COR) and Adjusted Odds  
148 Ratio (AOR) were reported. Variance inflation factors (VIF) were assessed to check  
149 multicollinearity among the variables; however, no significant multicollinearity was observed. A  
150 test for interaction effect between the frequency of TV viewing and the place of residence was  
151 performed; however, no significant interaction effect was observed. The cluster effect was  
152 adjusted during analysis. All the analyses was done using Stata 13.0. The authors followed the  
153 guidelines outlined in the Strengthening the Reporting of Observational Studies in Epidemiology  
154 (*STROBE*) statement in writing the manuscript (Supplementary File 1).

## 155 **ethical consideration**

156 MDHS received ethical approval from the Ethics Review Committee on Medical  
157 Research including Human Subjects in the Department of Medical Research, Ministry of Health  
158 and Sports as well as from the ICF Institutional Review Board. Written informed consent was

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3 159 taken from the participants. In case of minor participants, assent form was signed by the  
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5 160 respondents and written informed consent was given by the adult guardian.  
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## 9 161 **patient Involvement**

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12 162 Patients were not involved in the study.  
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## 164 **FINDINGS**

### 165 **socio-demographic characteristics of the respondents**

166 The data of 12,021 weighted samples were analyzed. More than a quarter (26.5%) of the  
167 study participants were overweight, and 12.2% of them were obese (Figure 2). The socio-  
168 demographic characteristics of the respondents along with the prevalence of the three categories  
169 of BMI across the independent variables with the associated chi-square ( $\chi^2$ ) value are presented  
170 in Table 2. The majority of the study participants was aged between 35 and 49 years (42.3%) and  
171 was residing in the rural area (70.8%). The highest proportion of participants was from the  
172 Yangon Region (15.1%), followed by the Ayeyarwaddy Region (12.5%) and the Mandalay  
173 Region (12.2%), whereas the lowest participation was from the Kayah Region (0.5%). Around  
174 half of the respondents (41.3%) were educated up to the primary level and about one-third  
175 (36.1%) received secondary level education; furthermore, 10.2% received higher education and  
176 12.4% received no education. More than two-thirds (68.1%) of the women were employed at the  
177 time of interview. Nearly two-fifths of the women (41.7%) were nulliparous, while cumulatively  
178 a similar proportion of respondents (46.6%) had the experience of being pregnant- once (15.3%),  
179 twice (15.8%), thrice (11.7%) and more than three times (15.5%). The highest proportion of the



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3 180 respondents belonged to the richest wealth quintile (22.2%) followed by richer (21.1%) and  
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5 181 middle (20.9%) quintile. Among the study participants, the majority (60.1%) reported that they  
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7 182 watched television at least once a week; however, 23.1% did not watch television at all and  
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10 183 16.8% watched television less than once a week. Except for current employment status,  
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12 184 significant differences were found among the BMI of women across the explanatory variables.  
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14 185 The prevalence of overweight and obesity increased with age ( $p$ -value  $<0.0001$ ) and was the  
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16 186 most common in the Yangon and Kachin Region ( $p$ -value  $<0.0001$ ). This prevalence was also  
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18 187 higher in the urban areas compared to the rural areas (overweight: 31.1% versus 24.6%; obesity:  
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20 188 17.9% versus 9.8%;  $p$ -value  $<0.0001$ ). Plausibly, Women with higher educational status, having  
21  
22 189 two children and belonging to the richest wealth group had a higher prevalence of overweight  
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24 190 and obesity ( $p$ -value  $<0.0001$ ). The prevalence of overweight and obesity was also higher among  
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26 191 the individuals who used to watch television at least once a week ( $p$ -value  $<0.0001$ ) (Table 2).  
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192 **Table 2: Socio Demographic characteristics of the study participants and prevalence of overweight and obesity across the**  
 193 **independent variables, MDHS 2015-16 (N= 12,021)**

Variable	Frequency (%)	BMI Status (%)			$\chi^2$	p-value
		BMI <23	23 $\geq$ BMI <27.5	BMI $\geq$ 27.5		
<b>Age Group (years)</b>						
15-24	3433 (28.6)	82.4	14.3	3.3	173.9	<0.0001
25-34	3504 (29.1)	60.4	27.6	12.0		
35-49	5084 (42.3)	47.7	34.0	18.3		
<b>Place of Residence</b>						
Urban	3505 (29.2)	51.0	31.1	17.9	258.4	<0.0001
Rural	8516 (70.8)	65.6	24.6	9.8		
<b>Region of Residence</b>						
Kachin	334 (2.8)	54.6	30.0	15.4	240.1	<0.0001
Kayah	60 (0.5)	63.3	27.1	9.6		
Kayin	274 (2.3)	59.1	27.1	13.8		
Chin	90 (0.8)	71.7	23.9	4.4		
Sagaing	1351 (11.3)	58.7	27.7	13.6		
Taninthayi	265 (2.2)	57.0	28.6	14.4		
Bago	1197 (9.9)	64.5	25.9	9.6		
Magway	1030 (8.6)	67.7	24.0	8.3		
Mandalay	1462 (12.2)	64.2	25.4	10.5		

Mon	432 (3.6)	59.7	25.0	15.3		
Rakhine	695 (5.8)	75.3	19.2	5.5		
Yangon	1822 (15.1)	49.7	33.8	16.5		
Shan	1216 (10.1)	60.2	25.7	14.1		
Ayeyarwaddy	1508 (12.5)	64.8	23.3	11.8		
Naypyitaw	285 (2.3)	63.3	26.0	10.7		
<b>Highest Educational Status</b>						
No Formal Education	1485 (12.4)	65.4	25.3	9.3	40.5	<b>0.0003</b>
Primary	4966 (41.3)	59.8	27.6	12.6		
Secondary	4345 (36.1)	63.1	25.3	11.6		
Higher	1225 (10.2)	56.6	28.1	15.3		
<b>Currently Employed</b>						
Yes	8184 (68.1)	61.2	26.6	12.2	0.2	0.9348
No	3837 (32.9)	61.6	26.4	12.0		
<b>Wealth index</b>						
Poorest	2052 (17.1)	75.2	18.6	6.2	427.7	<b>&lt;0.0001</b>
Poorer	2252 (18.7)	66.8	25.0	8.2		
Middle	2509 (20.9)	61.5	28.0	10.5		
Richer	2533 (21.1)	57.2	28.2	14.6		
Richest	2675 (22.2)	49.9	30.9	19.2		
<b>Marital Status</b>						
Single	4191 (34.9)	76.8	17.4	5.8	120.1	<b>&lt;0.0001</b>
Currently Married	7021 (58.4)	52.1	31.9	16.0		
Separated/Divorced/Widowed	809 (6.7)	61.1	27.4	11.5		
<b>Parity</b>						
0	5010 (41.7)	75.2	18.4	6.4	759.6	<b>&lt;0.0001</b>
1	1844 (15.3)	55.5	30.8	13.7		

2	1903 (15.8)	49.4	32.7	17.9		
3	1405 (11.7)	45.6	36.1	18.3		
>3	1859 (15.5)	54.0	30.4	15.6		
<b>Number of Household Member</b>						
≤5	7402 (61.6)	59.8	27.2	13.0	7.4	<0.001
>5	4620 (38.4)	63.9	25.5	10.6		
<b>Frequency of Viewing Television</b>						
Not at all	2779 (23.1)	67.2	24.5	8.3	89.7	<0.001
Less than once a week	2015 (16.8)	63.3	25.9	10.8		
At least once a week	7227 (60.1)	58.5	27.5	14.0		

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3 195 The frequency of watching television at least once a week was higher among the urban  
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5 196 women than the rural women (80.8% versus 51.7%). Around 30% of the rural women did not  
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8 197 view television at all, whereas the proportion was lower for the urban women (7.2%) (Figure 3).  
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### 10 11 198 **association between the frequency of viewing television and overweight and obesity** 12

13 199 Ordered logistic regression was used to discern the association between the frequency of  
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15 200 viewing television and overweight and obesity. During the analyses, the normal weight category  
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17 201 (BMI < 23 kg/m<sup>2</sup>) was held as the reference group. The results are presented in Table 3. In the  
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19 202 final model after adjusting for age, place and region of residence, wealth index, highest  
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21 203 educational status, current employment status, parity and number of household members, it was  
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23 204 found that, women who watched television at least once a week were 1.2 times more likely to be  
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25 205 overweight/obese than the women who never watched television (AOR: 1.16 , 95% CI: 1.02-  
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27 206 1.32; *p*-value=0.023).  
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32 207 When stratified by urban and rural residence, overweight/obesity showed significant  
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34 208 association with the frequency of viewing television in the urban areas. However, in the rural  
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36 209 areas, women who watched television at least once a week were 1.2 times more likely to be  
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38 210 overweight/obese than those who did not watch television at all (AOR: 1.16, 95% CI: 1.01-1.34;  
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40 211 *p*-value=0.040) (Table 3).  
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45 212 The final logistic regression models are shown in supplementary table 1-3  
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47 213 (supplementary file 2).  
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214 **Table 3: Association between the frequency of viewing Television and overweight and obesity among reproductive age women**  
 215 **of Myanmar, MDHS\* 2015-16**

Frequency of viewing Television				
	COR**(95% CI***)	p-value	AOR****(95% CI***)	p-value
<b>Total:</b>				
Not at all	Ref		Ref	
Less than once a week	1.20 (1.03-1.40)	<b>0.020</b>	1.01 (0.87-1.19)	0.870
At least once a week	1.49 (1.32-1.69)	<b>&lt;0.001</b>	1.16 (1.02- 1.32)	<b>0.023</b>
<b>In Urban Area:</b>				
Not at all	Ref		Ref	
Less than once a week	1.15 (0.80-1.67)	0.441	1.05 (0.73-1.51)	0.779
At least once a week	1.25 (0.93-1.69)	0.144	1.14( 0.85-1.52)	0.389
<b>In Rural Area:</b>				
Not at all	Ref		Ref	
Less than once a week	1.11 (0.93-1.32)	0.242	0.98 (0.82-1.17)	0.829
At least once a week	1.26 (1.10-1.44)	<b>0.001</b>	1.16 (1.01-1.34)	<b>0.040</b>

216

217 \* MDHS: Myanmar Demographic and Health Survey

218 \*\* COR: Crude Odds Ratio

219 \*\*\* CI: Confidence Interval

1  
2  
3 220 \*\*\*\* *AOR: Adjusted Odds Ratio*

4  
5 221 *Results are based on ordered logistics regression and adjusted for age, place of residence, region of residence, highest educational*  
6 *status, current employment status, wealth index, parity and number of household members. BMI <23 group was held as the reference*  
7 *group.*  
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18 226 **model goodness-of-fit:** To assess the internal validity of the regression model, the F-adjusted mean residual goodness-of-fit test was  
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21 227 used. The *p*-value of the F statistics of the adjusted model was <0.001, indicating an acceptable model fitness.  
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## 228 DISCUSSION

229 To the best of our knowledge, this is the first study to utilize a nationally representative  
230 sample to examine the association between frequency of television viewing with the prevalence  
231 of overweight and obesity among women of reproductive age in Myanmar. More than one fourth  
232 of the women surveyed were overweight and one in eight women was obese. This study also  
233 found that watching television at least once a week was significantly associated with  
234 overweight/obesity in women of reproductive age in rural Myanmar.

235 The prevalence of overweight and obesity among women of reproductive age was found  
236 to be 26.5% and 12.2% respectively. The total burden of overweight/obesity (38.7%) was almost  
237 similar to the burden of overweight/obesity among the same target group in other South and  
238 Southeast Asian countries, including Nepal (32.8%)<sup>31</sup>, Bangladesh (36%)<sup>3</sup> and Pakistan (39%).<sup>32</sup>  
239 Each of these studies utilized a nationally representative sample and the Asian BMI cutoff.

240 The prevalence of overweight and obesity was higher among the women living in the  
241 urban areas compared to those living in the rural areas. This finding is consistent with studies  
242 done in other South and Southeast Asian countries, including Bangladesh, as well as in the other  
243 continents.<sup>3 25 33-35</sup> Urban women had a higher frequency of television watching. This may be due  
244 to the higher coverage of electricity and the availability of many satellite channels in urban areas  
245 in comparison to rural areas.<sup>25</sup>

246 It was found that among rural women, the prevalence of overweight/obesity was  
247 significantly associated with watching television at least once a week. This finding is also  
248 consistent with the finding from Bangladesh.<sup>25</sup>



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3 249 Despite the frequency of television watching among urban women, there was no  
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5 250 association between this behavior and the prevalence of overweight/obesity. However, they were  
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8 251 more likely to be overweight/obese than rural women. A propensity towards a more sedentary  
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10 252 lifestyle and the intake of high-calorie foods by the urban residents may be potential  
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12 253 determinants that have overridden the effect from an increased frequency of watching television.  
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14 254 On the other hand, reliance on less developed transportation facilities, involvement in more  
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17 255 laborious work and comparatively lower consumption of obesogenic diets among the rural  
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19 256 women are factors that may contribute to a lower prevalence of overweight/obesity.<sup>25</sup> Those who  
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21 257 view television more frequently in the rural area are more prone to lead a sedentary lifestyle and  
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24 258 as such are at greater risk of developing obesity.<sup>25</sup>

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27 259 The findings from our study are coherent with a recent study in Bangladesh, which  
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30 260 showed a positive association between the frequency of television viewing and  
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32 261 overweight/obesity in women of reproductive age.<sup>25</sup> Similar positive associations were also  
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34 262 found in developed countries (e.g. USA and Australia).<sup>20 22-24</sup> In a recently published multi-  
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36 263 country study, this association has also been observed in the case of children and adolescents.<sup>36</sup>

### 264 **Policy and Program Implications**

265 The high prevalence of overweight/obesity is associated with an increased burden from  
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267 NCDs in Myanmar, as shown in recent evidence.<sup>7 37</sup> An unintended consequence of the  
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269 continuing economic development of the country is the increasing preference for a sedentary  
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271 lifestyle and obesogenic food, which, in turn, is raising the burden of overweight/obesity.  
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273 Considering the epidemiologic, demographic, and nutritional transition, the policymakers of  
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275 Myanmar should focus on the prevention and control of both overweight/obesity and NCDs. The

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3 271 newly released ‘Myanmar National Health Plan 2017-2021’ incorporates NCD prevention and  
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5 272 control programs.<sup>38</sup> Furthermore, a Social Behavioral Change Communication (SBCC) campaign  
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8 273 should be developed in order to promote physical activity and raise awareness among the  
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10 274 population, especially among children and adolescents, in order to prevent overweight/obesity as  
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12 275 early as possible. Further research should be conducted among men and adolescents to determine  
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14 276 whether this positive association exists among those target population as well.  
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## 21 278 **STRENGTHS AND LIMITATIONS**

24 279 This is the first study, which utilized a nationally representative sample to examine the  
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26 280 association between the frequency of watching television and overweight/obesity among women  
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28 281 of reproductive age in Myanmar. Moreover, as MDHS utilized standard and valid tools for data  
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30 282 collection, the probability of the existence of any measurement error is lower in this study in  
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32 283 comparison to other cross-sectional studies conducted in Myanmar. However, the survey could  
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34 284 not establish the temporal relationship between the exposure and the outcome variables because  
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36 285 of its cross-sectional design. The frequency of television viewing was measured in weeks, as  
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38 286 opposed to days/hours; the latter could have given more precise information. In the multivariable  
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40 287 analysis, food habit and duration of physical activity were not included because this information  
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42 288 was not collected in MDHS. There may be the presence of reporting bias while measuring the  
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44 289 frequency of television watching. The information related to the frequency of time spent on other  
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46 290 types of telecommunication devices such as mobile phones or computers was not collected, so  
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48 291 the association with those variables with overweight/obesity could not be measured.  
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## 293 CONCLUSIONS

294 The rising burden of overweight and obesity is now a global concern. Obesity ultimately  
295 leads towards the development of NCDs and premature death. The results from this study  
296 demonstrate that watching television is associated with obesity among reproductive age women  
297 in Myanmar. Therefore, necessary steps should be taken to improve awareness regarding the  
298 harmful consequences of watching TV for longer hours and physical inactivity as well as to  
299 encouragement of increased physical activity. Additional research is also warranted to explore  
300 the situation among the general population of Myanmar.

301

## 302 LIST OF ABBREVIATION

- 303 ASEAN- Association of Southeast Asian Nations  
304 BMI- Body Mass Index  
305 GDP- *Gross Domestic Product*  
306 GNI- Gross National Income  
307 NCDs- Non-Communicable Diseases  
308 MDHS- Myanmar Demographic and Health Survey  
309 SBCC- Social Behavioral Change Communication  
310 SEARO- South-East Asia Regional Office  
311 USAID- United States Agency for International Development  
312 USD- United States Dollar  
313 WHO- World Health Organization  
314 3MDG- Three Millennium Development Goal Fund

## 315 **Contributors**

316 RDG, IHS, MH, IS and MS conceptualized the study. RDG, IHS, MH, IS, MRH and MS  
317 designed the study and acquired the data. RDG, IHS, MH and IS conducted the data analysis.  
318 RDG, IHS, MH, IS, MRH and MS interpreted the data. RDG, IHS, MH, IS and MRH prepared  
319 the first draft. RDG, IHS, MH, IS, MRH and MS participated in critical revision of the  
320 manuscript and contributed to its intellectual improvement. All authors went through the final  
321 draft and approved it for submission. RDG, IHS, MH and IS equally contributed in this work as  
322 first author.

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## 328 **Competing Interests**

329 None declared.

## 330 **Patient Consent**

331 None Declared

## 332 **Disclaimer**

333 The authors are alone responsible for the integrity and accuracy of data analysis and the writing  
334 the manuscript.

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3 **335 Ethics Approval**  
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6 336 The datasets were obtained from DHS Programme with proper procedure. The study  
7  
8 337 exempt from collecting ethical approval because the survey protocols were reviewed and  
9  
10 338 approved by Ethics Review Committee on Medical Research including Human Subjects in the  
11  
12 339 Department of Medical Research, Ministry of Health and Sports as well as from the ICF  
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14 340 Institutional Review Board.  
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18 **341 Data Sharing Statement**  
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21  
22 342 The dataset of MDHS 2015-16 is available at the Demographic and Health Surveys  
23  
24 343 Program. Extra data is available which is available on request at [http://dhsprogram-com/what-](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm)  
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26 344 [we-do/survey/survey-display-349.cfm](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm)  
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3 454 **Figures:**

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6 455 **Figure 1:** Flowchart showing the process of selecting the participants in the survey

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8 456 **Figure 2:** Distribution of the respondents by BMI status

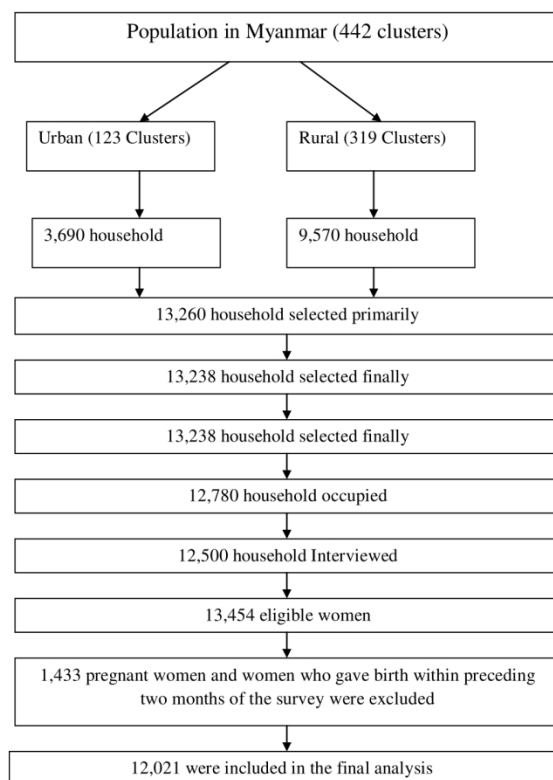
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10 457 **Figure 3:** Distribution of the respondents by place of residence with frequency of watching  
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17 460 **Supplementary Materials:**

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20 461 **Supplementary File 1:** STROBE Checklist

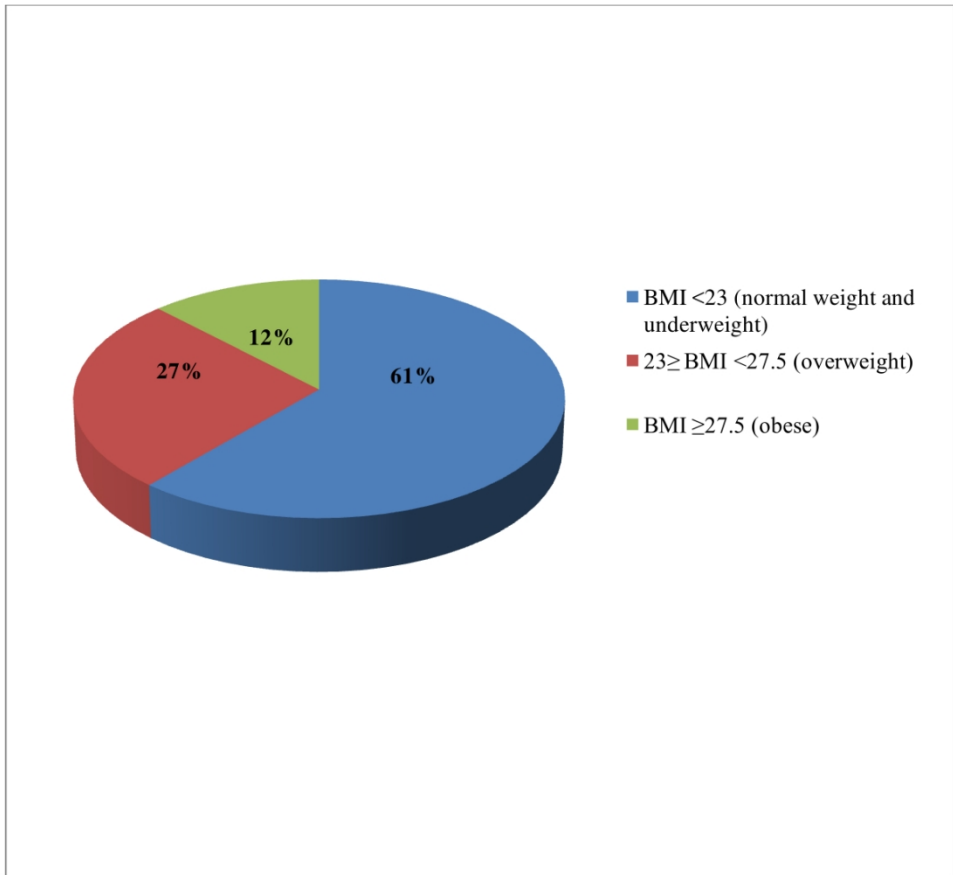
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23 462 **Supplementary File 2:** Supplementary Tables  
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Flowchart showing the process of selecting the participants in the survey

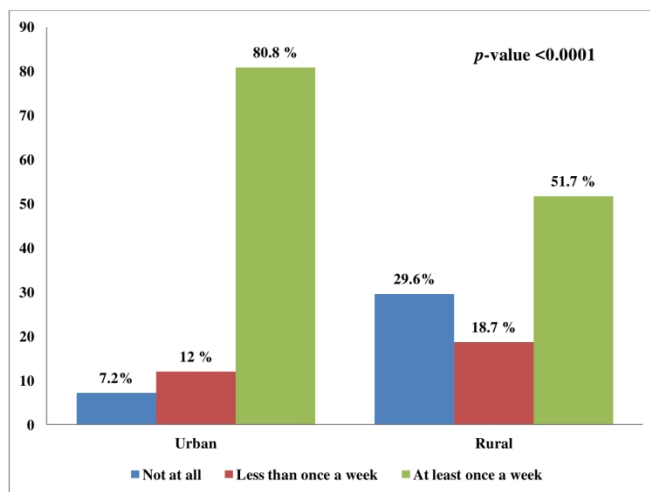
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Distribution of the respondents by BMI status

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Distribution of the respondents by place of residence with frequency of watching television

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies**

**Title of the study: Frequency of Television viewing and association with overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide cross-sectional survey**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	11

		(c) Explain how missing data were addressed	11
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	Not applicable
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	12-19
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	17-19
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	20
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	20-22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.



**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

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# Supplementary Tables

**Supplementary Table 1: Crude and Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	<i>p</i> -value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	<i>p</i> -value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.11	2.73-3.54	<0.001	2.34	2.01-2.73	<0.001
35-49	5.21	4.66 - 5.83	<0.001	3.65	3.14-4.26	<0.001
<b>Place of Residence</b>						
Urban	Ref			Ref		
Rural	0.54	0.47-0.61	<0.001	0.74	0.64-0.87	<0.001
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.68	0.49-0.94	0.019	0.68	0.50-0.92	0.012
Kayin	0.84	0.64-1.10	0.202	0.88	0.69-1.12	0.301
Chin	0.45	0.33-0.61	<0.001	0.50	0.38-0.66	<0.001

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Sagaing	0.85	0.65-1.11	0.234	0.88	0.67-1.15	0.343
Taninthayi	0.91	0.70-1.17	0.459	1.03	0.78-1.66	0.832
Bago	0.65	0.51-0.82	<b>&lt;0.001</b>	0.68	0.54-0.87	<b>0.002</b>
Magway	0.56	0.43-0.74	<b>&lt;0.001</b>	0.60	0.46-0.77	<b>&lt;0.001</b>
Mandalay	0.67	0.52-0.87	0.002	0.64	0.50-0.82	<b>&lt;0.001</b>
Mon	0.84	0.64-1.11	0.217	0.87	0.63-1.20	0.381
Rakhine	0.39	0.29-0.52	<b>&lt;0.001</b>	0.61	0.45-0.82	<b>0.001</b>
Yangon	1.18	0.90-1.55	0.224	0.98	0.75-1.27	0.854
Shan	0.81	0.60-1.09	0.165	0.91	0.68-1.20	0.486
Ayeyarwaddy	0.66	0.50-0.88	0.005	0.81	0.61-1.08	0.152
Naypyitaw	0.69	0.53-0.90	0.006	0.68	0.52-0.90	<b>0.008</b>
<b>Highest Educational Status</b>						
No Formal Education	Ref			Ref		
Primary	1.29	1.13-1.48	<b>&lt;0.001</b>	1.24	1.06-1.45	<b>0.006</b>
Secondary	1.13	0.97-1.32	0.115	1.26	1.04-1.53	<b>0.018</b>
Higher	1.50	1.22-1.83	<b>&lt;0.001</b>	1.10	0.86-1.40	0.452
<b>Currently employment</b>						
No	Ref					

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Yes	1.02	0.91-1.13	0.762			
<b>Wealth index</b>						
Poorest	Ref			Ref		
Poorer	1.49	1.29-1.72	<0.001	1.46	1.24-1.72	<0.001
Middle	1.87	1.61-2.18	<0.001	1.92	1.62-2.28	<0.001
Richer	2.31	1.97-2.72	<0.001	2.26	1.88-2.72	<0.001
Rich	3.16	2.68-3.72	<0.001	2.82	2.28-3.48	<0.001
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.03	2.73-3.37	<0.001	1.60	1.30-1.98	<0.001
Separated/ Divorced/ Widowed	2.10	1.75-2.51	<0.001	1.03	0.80-1.32	0.820
<b>Parity</b>						
0	Ref			Ref		
1	2.42	2.13-2.75	<0.001	1.44	1.15-1.81	0.002
2	3.13	2.73-3.59	<0.001	1.50	1.19-1.98	0.001
3	3.53	3.07-4.06	<0.001	1.61	1.29-2.02	<0.001

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3+	2.62	2.30-2.99	<0.001	1.42	1.13-1.69	0.003
<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.83	0.76-0.92	<0.001	0.92	0.83-1.03	0.150
<b>Frequency of watching TV</b>						
Not at all	Ref			Ref		
Less than once a week	1.20	1.03-1.40	0.020	1.01	0.87-1.19	0.870
At least once a week	1.49	1.32-1.69	<0.001	1.16	1.02-1.32	0.023

MDHS: Myanmar Demographic and Health Survey

CI: Confidence Interval

<sup>1</sup> Variable with p-value less than <0.2 from unadjusted model were included into multivariable analysis

**Supplementary Table 2: Crude odds ratios for factors associated with overweight and obesity compared to normal weight for urban area among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	<i>p</i> -value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	<i>p</i> -value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.43	2.72-4.33	<b>&lt;0.001</b>	2.67	2.07-3.44	<b>&lt;0.001</b>
35-49	7.63	6.32-9.21	<b>&lt;0.001</b>	5.52	4.30-7.08	<b>&lt;0.001</b>
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.70	0.42-1.19	0.188	0.63	0.38-1.05	0.075
Kayin	0.95	0.75-1.19	0.646	0.94	0.69-1.28	0.675
Chin	0.76	0.56-1.02	0.070	0.71	0.51-0.99	<b>0.041</b>
Sagaing	0.96	0.72-1.28	0.790	0.99	0.70-1.40	0.943
Taninthayi	0.62	0.47-0.82	<b>0.001</b>	0.61	0.38-0.98	<b>0.042</b>
Bago	0.71	0.53-0.93	<b>0.015</b>	0.62	0.43-0.89	<b>0.010</b>
Magway	0.59	0.36-0.97	<b>0.038</b>	0.50	0.29-0.86	<b>0.013</b>
Mandalay	0.98	0.79-1.22	0.848	0.85	0.62-1.18	0.334

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Mon	0.77	0.49-1.20	0.243	0.62	0.32-1.20	0.154
Rakhine	0.61	0.41-0.89	<b>0.012</b>	0.60	0.43-0.83	<b>0.002</b>
Yangon	1.00	0.76-1.34	0.975	1.01	0.71-1.46	0.944
Shan	1.03	0.69-1.55	0.885	1.05	0.65-1.70	0.839
Ayeyarwaddy	0.74	0.52-1.06	0.099	0.89	0.55-1.44	0.632
Naypyitaw	0.80	0.51-1.25	0.322	0.75	0.49-1.15	0.181

**Highest Educational Status**

No Formal Education	Ref			Ref		
Primary	1.14	0.84-1.56	0.389	1.10	0.76-1.58	0.605
Secondary	0.78	0.57-1.06	0.107	1.13	0.76-1.68	0.530
Higher	0.84	0.59-1.20	0.346	0.92	0.61-1.40	0.704

**Currently employment**

No	Ref			Ref		
Yes	1.22	1.00-1.49	<b>0.046</b>	1.29	1.06-1.56	<b>0.010</b>

**Wealth index**

Poorest	Ref			Ref		
Poorer	1.35	0.76-2.37	0.302	1.44	0.69-2.99	0.330

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Middle	1.53	0.94-2.50	0.089	1.99	1.09-3.64	<b>0.025</b>
Richer	2.14	1.28-3.57	<b>0.004</b>	2.65	1.43-4.91	<b>0.002</b>
Rich	2.43	1.47-4.02	<b>0.001</b>	3.08	1.63-5.82	<b>0.001</b>
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.21	2.73-3.78	<b>&lt;0.001</b>	1.46	1.01-2.11	<b>0.042</b>
Separated/ Divorced/ Widowed	2.67	2.01-3.55	<b>&lt;0.001</b>	1.05	0.70-1.56	0.828
<b>Parity</b>						
0	Ref			Ref		
1	2.61	2.05-3.33	<b>&lt;0.001</b>	1.36	0.89-2.08	0.152
2	3.21	2.60-3.96	<b>&lt;0.001</b>	1.27	0.87-1.85	0.221
3	3.95	3.01-5.20	<b>&lt;0.001</b>	1.50	1.03-2.18	<b>0.034</b>
3+	3.91	2.96-5.17	<b>&lt;0.001</b>	1.44	0.97-2.14	0.072
<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.94	0.79-1.11	0.449	1.13	0.92-1.38	0.250



Frequency of watching TV*						
Not at all	Ref			Ref		
Less than once a week	1.15	0.80-1.67	0.441	1.05	0.73-1.51	0.779
At least once a week	1.25	0.93-1.69	0.144	1.14	0.85-1.52	0.389

MDHS: Myanmar Demographic and Health Survey

CI: Confidence Interval

<sup>1</sup> Variable with p-value less than <0.2 from unadjusted model were included into multivariable analysis

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**Supplementary Table 3: Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight for rural area among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	p-value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	p-value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.10	2.65-3.62	<0.001	2.09	1.75-2.51	<0.001
35-49	4.61	4.01-5.30	<0.001	2.89	2.39-3.49	<0.001
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.70	0.46-1.06	0.091	0.71	0.48-1.06	0.091
Kayin	0.85	0.58-1.24	0.401	0.89	0.63-1.25	0.497
Chin	0.36	0.23-0.57	<0.001	0.43	0.28-0.64	<0.001
Sagaing	0.90	0.63-1.30	0.586	0.88	0.61-1.25	0.466
Taninthayi	1.10	0.77-1.56	0.606	1.25	0.88-1.78	0.206
Bago	0.68	0.49-0.94	<b>0.018</b>	0.72	0.52-0.99	<b>0.044</b>
Magway	0.62	0.44-0.87	<b>0.006</b>	0.62	0.44-0.86	<b>0.005</b>
Mandalay	0.58	0.40-0.83	<b>0.004</b>	0.57	0.40-0.81	<b>0.002</b>
Mon	0.90	0.63-1.29	0.570	1.03	0.72-1.49	0.860
Rakhine	0.39	0.26-0.58	<0.001	0.63	0.43-0.93	<b>0.022</b>
Yangon	1.07	0.77-1.49	0.681	1.07	0.75-1.52	0.713
Shan	0.78	0.51-1.17	0.222	0.86	0.59-1.24	0.418
Ayeyarwaddy	0.71	0.49-1.03	0.074	0.82	0.56-1.18	0.282
Naypyitaw	0.64	0.44-0.93	<b>0.020</b>	0.67	0.46-0.97	<b>0.035</b>

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<b>Highest Educational Status</b>						
No Formal Education	Ref			Ref		
Primary	1.27	1.09-1.47	<0.001	1.24	1.04-1.47	0.018
Secondary	0.98	0.82-1.17	0.84	1.26	1.00-1.57	0.047
Higher	1.13	0.84-1.52	0.40	1.18	0.84-1.57	0.328
<b>Currently employment</b>						
No	Ref					
Yes	1.01	0.89-1.14	0.890			
<b>Wealth index</b>						
Poorest	Ref			Ref		
Poorer	1.49	1.28-1.73	<0.001	1.50	1.27-1.77	<0.001
Middle	1.87	1.59-2.20	<0.001	2.00	1.67-2.40	<0.001
Richer	2.05	1.72-2.45	<0.001	2.30	1.88-2.81	<0.001
Rich	2.59	2.01-3.35	<0.001	2.97	2.27-3.88	<0.001
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.35	2.93-3.83	<0.001	1.69	1.29-2.21	<0.001
Separated/ Divorced/ Widowed	1.92	1.53-2.42	<0.001	0.97	0.70-1.36	0.877
<b>Parity</b>						
0	Ref			Ref		
1	2.44	2.07-2.87	<0.001	1.47	1.12-1.93	0.005
2	3.37	2.83-4.03	<0.001	1.63	1.22-2.18	0.001
3	3.86	3.26-4.57	<0.001	1.71	1.29-2.28	<0.001
3+	2.92	2.48-3.43	<0.001	1.51	1.12-2.02	0.006

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<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.74	0.66-0.83	<b>&lt;0.001</b>	0.83	0.73-0.95	<b>0.005</b>
<b>Frequency of watching TV</b>						
Not at all	Ref			Ref		
Less than once a week	1.11	0.93-1.32	0.242	0.98	0.82-1.17	0.829
At least once a week	1.26	1.10-1.44	<b>0.001</b>	1.16	1.01-1.34	<b>0.040</b>

*MDHS: Myanmar Demographic and Health Survey*

*CI: Confidence Interval*

<sup>1</sup> Variable with p-value less than <0.2 from unadjusted model were included into multivariable analysis

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# BMJ Open

## Frequency of Television viewing and association with overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide cross-sectional survey

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-024680.R2
Article Type:	Research
Date Submitted by the Author:	04-Feb-2019
Complete List of Authors:	Das Gupta, Rajat; BRAC University James P Grant School of Public Health, Sajal, Ibrahim Hossain; BRAC University James P Grant School of Public Health Hasan, Mehedi; BRAC University, James P Grant School of Public Health Sutradhar, Ipsita; BRAC University, James P Grant School of Public Health Rifat Haider, Mohammad; University of South Carolina Arnold School of Public Health Sarker, Malabika; BRAC University James P Grant School of Public Health, Public Health; University of Heidelberg, Institute of Public Health
<b>Primary Subject Heading</b>:	Epidemiology
Secondary Subject Heading:	Nutrition and metabolism, Obstetrics and gynaecology, Public health, Reproductive medicine, Sociology
Keywords:	Obesity, Overweight, Noncommunicable Disease, Myanmar

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1 **Title: Frequency of Television viewing and association with overweight and**  
2 **obesity among women of the reproductive age group in Myanmar: Results**  
3 **from a nationwide cross-sectional survey**

4  
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## 25 ABSTRACT

26 **Objectives:** This study aimed to discern the association between the frequency of television  
27 viewing and overweight and obesity among reproductive age women of Myanmar.

28 **Design:** This was a cross-sectional study.

29 **Setting:** This study used Myanmar Demographic and Health Survey (2015-16) data.

30 **Participants:** Total of 12,021 women both aged 15-49 years and also not pregnant or did not  
31 deliver a child within the two months prior to the survey were included.

32 **Primary and secondary outcome measures:** The primary outcome was overweight (23.0 to  
33 <27.5 kg/m<sup>2</sup>) and obesity ( $\geq 27.5$  kg/m<sup>2</sup>), which was measured using the Asian BMI cut off.  
34 Ordered logistic regression analysis was conducted to find the association between the  
35 explanatory and outcome variables. The potential confounders controlled in the multivariable  
36 analyses were age, place of residence, region of residence, highest educational status, current  
37 employment status, wealth index, parity and number of household members.

38 **Results:** The prevalence of overweight was 26.5% and obesity was 12.2% among the study  
39 participants. The odds of being overweight and obese were 20% higher (adjusted odds ratio  
40 (AOR): 1.16, 95% CI: 1.02-1.32;  $p$ -value = 0.023) among those who watched television at least  
41 once a week compared to those who did not watch television at all. Rural women who watched  
42 television at least once a week were 1.2 times more likely to be obese (AOR: 1.16, 95% CI: 1.01-  
43 1.34;  $p$ -value = 0.040) compared to those who did not watch television at all.



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3 44 **Conclusions:** Frequent television watching was associated with obesity among rural women of  
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6 45 reproductive age in Myanmar.  
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9 46 **Key words:** Obesity, Overweight, Non-communicable Disease, Myanmar  
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## 47 STRENGTHS AND LIMITATIONS OF THE STUDY

- 48 • This study utilized a nationally representative sample to investigate the association between  
49 the frequency of television viewing and overweight/obesity among women of reproductive  
50 age from Myanmar.
- 51 • Due to utilization of standard and valid tools for data collection, the probability of the  
52 existence of measurement error is lower in this study in comparison to other cross-sectional  
53 studies conducted in Myanmar.
- 54 • Temporal relationship could not be established due to cross-sectional nature of the survey.
- 55 • The frequency of television viewing was measured in weeks, not in days/hours; the latter  
56 could have given more precise information.
- 57 • In the multivariable analysis, food habit and duration of physical activity were not included  
58 because that information was not collected in the survey.

## 59 INTRODUCTION

60 Both developed and developing countries are facing the increasing burden of overweight  
61 and obesity, which are posing as major public health problems.<sup>1-3</sup> The prevalence of overweight  
62 and obesity increased by 27.5% among the global adult population and 47.1% among the global  
63 child population between 1980 and 2013.<sup>4</sup> During the same time period, globally, the prevalence  
64 of overweight and obesity rose from 29.8% to 38.0% among adult females, in particular.<sup>4</sup>  
65 Although this burden is lowest in South and Southeast Asia, countries of this region are still  
66 experiencing the rising burden of overweight and obesity.<sup>5</sup> Myanmar is a low and middle-income  
67 country (LMIC) situated in the Southeast Asia region. In 2015-16, the first Myanmar  
68 Demographic and Health Survey (MDHS) was conducted using a nationally representative  
69 sample across the country.<sup>6</sup> The survey found a high prevalence of overweight and obesity  
70 among women of reproductive age.<sup>7</sup>

71 Overweight and obesity is an important risk factor for the development of several non-  
72 communicable diseases (NCDs) like diabetes mellitus<sup>8</sup>, hypertension<sup>9</sup>, cardiovascular diseases  
73<sup>10</sup>, cancer<sup>11</sup> and chronic kidney diseases.<sup>12</sup> In addition, overweight and obese women experience  
74 complications during pregnancy (gestational diabetes mellitus, pre-eclampsia and eclampsia)  
75 more frequently than women of normal body weight.<sup>13 14</sup>

76 It has been found that energy expenditure is very low among people who spend their  
77 leisure time watching television, rather than being involved in physical activities like playing  
78 games, gardening, etc. This ultimately increases their risk of gaining excessive body weight.<sup>15 16</sup>  
79 Television watching is also associated with an increase in energy intake, which may sometimes

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3 80 be attributable to their frequent exposure to television advertisements of foods and beverages and  
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5 81 the subsequent consumption of said foods and beverages.<sup>17-21</sup>  
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9 82 Across the world, many studies have shown a positive association between the increased  
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11 83 frequency of television viewing and overweight/obesity. In the USA and Australia, it has been  
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13 84 found that people who view television more frequently are at higher risk of being  
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15 85 overweight/obese.<sup>20 22-24</sup> A study from Bangladesh has found that watching television frequently  
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17 86 (at least once a week) was associated with obesity among women of reproductive age.<sup>25</sup>  
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19 87 However, this association has not been explored in other South and Southeast Asian countries  
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21 88 including Myanmar. Therefore, this study was conducted to determine the association between  
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23 89 television viewing and the prevalence of overweight and obesity among women of reproductive  
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25 90 age in Myanmar using the MDHS 2015-16 data.  
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## 32 33 92 **METHODS**

### 34 35 93 **study settings**

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39 94 According to the 2014 census, the total population of Myanmar was 51.5 million with a  
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41 95 population density of 76 persons per square kilometer (km<sup>2</sup>). The country is home to 135 ethnic  
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43 96 groups.<sup>26 27</sup> The *Gross Domestic Product (GDP)* growth rate of Myanmar was 6.4% and per  
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45 97 capita, Gross National Income (GNI) was 1,455 USD in 2016-17. More than a quarter (26.1%)  
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47 98 of the population was living under the poverty line in 2014. Myanmar also has the lowest life  
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49 99 expectancy at birth (66.6 years) among the Association of Southeast Asian Nations (ASEAN).<sup>26</sup>  
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## 101 **study design**

102 This study analyzed the data of MDHS 2015-16, the first Demographic and Health  
103 Survey of Myanmar.<sup>6</sup> The detailed method has been published previously.<sup>6</sup> MDHS 2015-16 was  
104 a cross-sectional survey which used a nationally representative sample and was conducted  
105 through a joint collaboration between the Ministry of Health and Sports of Myanmar and ICF  
106 International. The United States Agency for International Development (USAID) and Three  
107 Millennium Development Goal Fund (3MDG) provided financial support for the survey. Two-  
108 stage cluster sampling techniques were used for sample selection. The sample was stratified for  
109 each of the seven states and eight regions of Myanmar. At the first stage, 442 clusters (urban:  
110 123 and rural: 319) were selected randomly from a sample frame of 4,000 clusters. At the second  
111 stage, 30 households were selected from each of the clusters. In total, 13,260 households were  
112 selected for the final sample. The target group of this study was women of reproductive age (15-  
113 49 years). The permanent residents and the visitors who stayed in the selected households the  
114 night before the date of data collection were included in the questionnaire survey. Around 96%  
115 of eligible women agreed to participate in the survey. Among them, 98% agreed for  
116 anthropometric measurement. However, pregnant women and women who had given birth  
117 within the preceding two months of the survey were excluded. The final weighted sample size of  
118 this study was 12,021 (Figure 1).

## 119 **survey tools and data collection**

120 A standard woman's questionnaire used by the DHS program was adopted and modified  
121 according to the local context and pre-tested to collect the socio-demographic information (e.g.  
122 age, sex, household wealth index and place of residence) through face-to-face interviews.

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3 123 Trained field staff carried out the interviews and anthropometric measurements. Measuring  
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5 124 boards specially made by Shorr Productions were used for height measurement and lightweight  
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8 125 SECA scales with digital screens were used for measuring the weight of the respondents.  
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11 126 The main outcome variables of this study were overweight and obesity. To define these  
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13 127 variables, an Asia specific body mass index (BMI) cut-off value was used.<sup>29</sup> Women having a  
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15 128 BMI <23.0 kg/m<sup>2</sup> were considered to be normal weight or underweight, women having a BMI  
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17 129 between 23.0 kg/m<sup>2</sup> and <27.5 kg/m<sup>2</sup> were considered to be overweight and women having a  
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19 130 BMI ≥27.5 kg/m<sup>2</sup> were considered to be obese.  
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24 131 The main explanatory variable of interest for this study was the frequency of viewing  
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26 132 television. Data were collected as the following categories: (1) not viewing television at all, (2)  
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28 133 viewing television less than once a week, and (3) viewing television at least once a week.<sup>10</sup> The  
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30 134 other independent variables considered based on the literature review were age group, place of  
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32 135 residence, region of residence, education, wealth quintile, current working status, parity and  
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34 136 number of household members in the family. The categories of the variables are mentioned in  
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36 137 Table 1.  
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41 138 **Table 1: List of variables considered for the study**  
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Name of the Variables	Categories
<b>Outcome Variables:</b>	
Body Mass Index (BMI)	a) 0= Normal weight or underweight (BMI <23 kg/m <sup>2</sup> ) b) 1= Overweight (BMI 23.0 kg/m <sup>2</sup> to <27.5 kg/m <sup>2</sup> ) c) 2= Obesity (BMI ≥27.5 kg/m <sup>2</sup> )

<b>Explanatory Variable:</b>	
<b>Frequency of Viewing Television</b>	a) 0= Not at all b) 1= Less than once a week c) 2= At least once a week
<b>Covariates:</b>	
1. Age Groups	a) 0= 15-24 years b) 1= 25-34 years c) 2= 35-49 years
2. Place of Residence	a) 0= Urban b) 1= Rural
3. Region of Residence	a) 0= Kachin b) 1= Kayah c) 2= Kayin d) 3= Chin e) 4= Sagaing f) 5= Taninthayi g) 6= Bago h) 7= Magway i) 8= Mandalay j) 9= Mon k) 10= Rakhine l) 11= Yangon

	<p>m) 12= Shan</p> <p>n) 13= Ayeyarwaddy</p> <p>o) 14= Naypyitaw</p>
4. Education	<p>a) 0= No education</p> <p>b) 1= Primary education</p> <p>c) 2= Secondary education</p> <p>d) 3= Higher education</p>
5. Wealth quintile	<p>a) 0= Poorest</p> <p>b) 1= Poorer</p> <p>c) 2= Middle</p> <p>d) 3= Richer</p> <p>e) 4= Richest</p>
6. Current working status	<p>a) 0= Yes</p> <p>b) 1= No</p>
7. Parity	<p>a) 0= 0 (nullipara)</p> <p>b) 1= 1 (primipara)</p> <p>c) 2= 2</p> <p>d) 3= 3</p> <p>e) 4= &gt;3</p>
8. Number of Household Members	<p>a) 0= ≤5</p> <p>b) 1= &gt;5</p>

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## 140 **data analysis**

141 Weighted descriptive statistics (frequency and percentage) were used to present the  
142 socio-demographic characteristics of the respondents. A chi-square ( $\chi^2$ ) test was performed to  
143 determine whether the groups differed in terms of the explanatory variables according to the  
144 BMI status. To find the association between the explanatory and outcome variables, ordered  
145 logistic regression analysis was conducted considering the proportional odds assumption was  
146 fulfilled. Initially, bivariate analyses were done. Variables which showed a *p-value* <0.20 in  
147 bivariate analyses were included in the multivariable model. This value of 0.2 was considered  
148 significant to prevent residual confounding in multivariable analysis.<sup>30</sup> The variables which  
149 showed *p-value* <0.05 in multivariable analysis were considered to be statistically significant.  
150 Both the unadjusted Crude Odd Ratio (COR) and Adjusted Odds Ratio (AOR) were reported.  
151 Variance inflation factors (VIF) were assessed to check multicollinearity among the variables. A  
152 VIF value greater than 5 was considered as an indication of multicollinearity; however, no  
153 significant multicollinearity was observed.<sup>31</sup> A test for interaction effect between the frequency  
154 of TV viewing and the place of residence was performed; however, no significant interaction  
155 effect was observed. The cluster effect was adjusted during analysis. All the analyses was done  
156 using Stata 13.0. The authors followed the guidelines outlined in the Strengthening the Reporting  
157 of Observational Studies in Epidemiology (*STROBE*) statement in writing the manuscript  
158 (Supplementary File 1).

## 159 **ethical consideration**

160 MDHS received ethical approval from the Ethics Review Committee on Medical  
161 Research including Human Subjects in the Department of Medical Research, Ministry of Health

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3 162 and Sports as well as from the ICF Institutional Review Board. Written informed consent was  
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5 163 taken from the participants. In case of minor participants, assent form was signed by the  
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8 164 respondents and written informed consent was given by the adult guardian.  
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## 10 11 165 **patient Involvement**

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14 166 Patients were not involved in the study.  
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## 19 20 21 168 **FINDINGS**

### 22 23 24 169 **socio-demographic characteristics of the respondents**

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27 170 The data of 12,021 weighted samples were analyzed. More than a quarter (26.5%) of the  
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29 171 study participants were overweight, and 12.2% of them were obese (Figure 2). The socio-  
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31 172 demographic characteristics of the respondents along with the prevalence of the three categories  
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33 173 of BMI across the independent variables with the associated chi-square ( $\chi^2$ ) value are presented  
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35 174 in Table 2. The majority of the study participants was aged between 35 and 49 years (42.3%) and  
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37 175 was residing in the rural area (70.8%). The highest proportion of participants was from the  
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39 176 Yangon Region (15.1%), followed by the Ayeyarwaddy Region (12.5%) and the Mandalay  
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41 177 Region (12.2%), whereas the lowest participation was from the Kayah Region (0.5%). Around  
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43 178 half of the respondents (41.3%) were educated up to the primary level and about one-third  
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45 179 (36.1%) received secondary level education; furthermore, 10.2% received higher education and  
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47 180 12.4% received no education. More than two-thirds (68.1%) of the women were employed at the  
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49 181 time of interview. Nearly two-fifths of the women (41.7%) were nulliparous, while cumulatively  
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51 182 a similar proportion of respondents (46.6%) had the experience of being pregnant- once (15.3%),  
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3 183 twice (15.8%), thrice (11.7%) and more than three times (15.5%). The highest proportion of the  
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5 184 respondents belonged to the richest wealth quintile (22.2%) followed by richer (21.1%) and  
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7 185 middle (20.9%) quintile. Among the study participants, the majority (60.1%) reported that they  
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9 186 watched television at least once a week; however, 23.1% did not watch television at all and  
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11 187 16.8% watched television less than once a week. Except for current employment status,  
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13 188 significant differences were found among the BMI of women across the explanatory variables.  
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15 189 The prevalence of overweight and obesity increased with age ( $p$ -value  $<0.0001$ ) and was the  
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17 190 most common in the Yangon and Kachin Region ( $p$ -value  $<0.0001$ ). This prevalence was also  
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19 191 higher in the urban areas compared to the rural areas (overweight: 31.1% versus 24.6%; obesity:  
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21 192 17.9% versus 9.8%;  $p$ -value  $<0.0001$ ). Plausibly, Women with higher educational status, having  
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23 193 two children and belonging to the richest wealth group had a higher prevalence of overweight  
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25 194 and obesity ( $p$ -value  $<0.0001$ ). The prevalence of overweight and obesity was also higher among  
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27 195 the individuals who used to watch television at least once a week ( $p$ -value  $<0.0001$ ) (Table 2).  
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196 **Table 2: Socio Demographic characteristics of the study participants and prevalence of overweight and obesity across the**  
 197 **independent variables, MDHS 2015-16 (N= 12,021)**

Variable	Frequency (%)	BMI Status (%)			$\chi^2$	p-value
		BMI <23	23 $\geq$ BMI <27.5	BMI $\geq$ 27.5		
<b>Age Group (years)</b>						
15-24	3433 (28.6)	82.4	14.3	3.3	173.9	<0.0001
25-34	3504 (29.1)	60.4	27.6	12.0		
35-49	5084 (42.3)	47.7	34.0	18.3		
<b>Place of Residence</b>						
Urban	3505 (29.2)	51.0	31.1	17.9	258.4	<0.0001
Rural	8516 (70.8)	65.6	24.6	9.8		
<b>Region of Residence</b>						
Kachin	334 (2.8)	54.6	30.0	15.4	240.1	<0.0001
Kayah	60 (0.5)	63.3	27.1	9.6		
Kayin	274 (2.3)	59.1	27.1	13.8		
Chin	90 (0.8)	71.7	23.9	4.4		
Sagaing	1351 (11.3)	58.7	27.7	13.6		
Taninthayi	265 (2.2)	57.0	28.6	14.4		
Bago	1197 (9.9)	64.5	25.9	9.6		
Magway	1030 (8.6)	67.7	24.0	8.3		
Mandalay	1462 (12.2)	64.2	25.4	10.5		

Mon	432 (3.6)	59.7	25.0	15.3		
Rakhine	695 (5.8)	75.3	19.2	5.5		
Yangon	1822 (15.1)	49.7	33.8	16.5		
Shan	1216 (10.1)	60.2	25.7	14.1		
Ayeyarwaddy	1508 (12.5)	64.8	23.3	11.8		
Naypyitaw	285 (2.3)	63.3	26.0	10.7		
<b>Highest Educational Status</b>						
No Formal Education	1485 (12.4)	65.4	25.3	9.3	40.5	<b>0.0003</b>
Primary	4966 (41.3)	59.8	27.6	12.6		
Secondary	4345 (36.1)	63.1	25.3	11.6		
Higher	1225 (10.2)	56.6	28.1	15.3		
<b>Currently Employed</b>						
Yes	8184 (68.1)	61.2	26.6	12.2	0.2	0.9348
No	3837 (32.9)	61.6	26.4	12.0		
<b>Wealth index</b>						
Poorest	2052 (17.1)	75.2	18.6	6.2	427.7	<b>&lt;0.0001</b>
Poorer	2252 (18.7)	66.8	25.0	8.2		
Middle	2509 (20.9)	61.5	28.0	10.5		
Richer	2533 (21.1)	57.2	28.2	14.6		
Richest	2675 (22.2)	49.9	30.9	19.2		
<b>Marital Status</b>						
Single	4191 (34.9)	76.8	17.4	5.8	120.1	<b>&lt;0.0001</b>
Currently Married	7021 (58.4)	52.1	31.9	16.0		
Separated/Divorced/Widowed	809 (6.7)	61.1	27.4	11.5		
<b>Parity</b>						
0	5010 (41.7)	75.2	18.4	6.4	759.6	<b>&lt;0.0001</b>
1	1844 (15.3)	55.5	30.8	13.7		

2	1903 (15.8)	49.4	32.7	17.9		
3	1405 (11.7)	45.6	36.1	18.3		
>3	1859 (15.5)	54.0	30.4	15.6		
<b>Number of Household Member</b>						
≤5	7402 (61.6)	59.8	27.2	13.0	7.4	<0.001
>5	4620 (38.4)	63.9	25.5	10.6		
<b>Frequency of Viewing Television</b>						
Not at all	2779 (23.1)	67.2	24.5	8.3	89.7	<0.001
Less than once a week	2015 (16.8)	63.3	25.9	10.8		
At least once a week	7227 (60.1)	58.5	27.5	14.0		

Peer review only

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199 The frequency of watching television at least once a week was higher among the urban  
200 women than the rural women (80.8% versus 51.7%). Around 30% of the rural women did not  
201 view television at all, whereas the proportion was lower for the urban women (7.2%) (Figure 3).

### 202 **association between the frequency of viewing television and overweight and obesity**

203 Ordered logistic regression was used to discern the association between the frequency of  
204 viewing television and overweight and obesity. During the analyses, the normal weight category  
205 (BMI < 23 kg/m<sup>2</sup>) was held as the reference group. The results are presented in Table 3. In the  
206 final model after adjusting for age, place and region of residence, wealth index, highest  
207 educational status, current employment status, parity and number of household members, it was  
208 found that, women who watched television at least once a week were 1.2 times more likely to be  
209 overweight and obese than the women who never watched television (AOR: 1.16, 95% CI: 1.02-  
210 1.32; *p*-value=0.023).

211 When stratified by urban and rural residence, overweight and obesity showed significant  
212 association with the frequency of viewing television in the urban areas. However, in the rural  
213 areas, women who watched television at least once a week were 1.2 times more likely to be  
214 overweight and obese than those who did not watch television at all (AOR: 1.16, 95% CI: 1.01-  
215 1.34; *p*-value=0.040) (Table 3).

216 The final logistic regression models are shown in supplementary table 1-3  
217 (supplementary file 2).

218 **Table 3: Association between the frequency of viewing Television and overweight and obesity among reproductive age women**  
 219 **of Myanmar, MDHS\* 2015-16**

Frequency of viewing Television				
	COR**(95% CI***)	p-value	AOR****(95% CI***)	p-value
<b>Total:</b>				
Not at all	Ref		Ref	
Less than once a week	1.20 (1.03-1.40)	<b>0.020</b>	1.01 (0.87-1.19)	0.870
At least once a week	1.49 (1.32-1.69)	<b>&lt;0.001</b>	1.16 (1.02- 1.32)	<b>0.023</b>
<b>In Urban Area:</b>				
Not at all	Ref		Ref	
Less than once a week	1.15 (0.80-1.67)	0.441	1.05 (0.73-1.51)	0.779
At least once a week	1.25 (0.93-1.69)	0.144	1.14( 0.85-1.52)	0.389
<b>In Rural Area:</b>				
Not at all	Ref		Ref	
Less than once a week	1.11 (0.93-1.32)	0.242	0.98 (0.82-1.17)	0.829
At least once a week	1.26 (1.10-1.44)	<b>0.001</b>	1.16 (1.01-1.34)	<b>0.040</b>

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221 \* MDHS: Myanmar Demographic and Health Survey

222 \*\* COR: Crude Odds Ratio

223 \*\*\* CI: Confidence Interval



1  
2  
3 224 \*\*\*\* *AOR: Adjusted Odds Ratio*

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5 225 *Results are based on ordered logistics regression and adjusted for age, place of residence, region of residence, highest educational*  
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7 226 *status, current employment status, wealth index, parity and number of household members. BMI <23 group was held as the reference*  
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10 227 *group.*

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18 230 **model goodness-of-fit:** To assess the internal validity of the regression model, the F-adjusted mean residual goodness-of-fit test was  
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21 231 used. The *p*-value of the F statistics of the adjusted model was <0.001, indicating an acceptable model fitness.

## 232 DISCUSSION

233 To the best of our knowledge, this is the first study to utilize a nationally representative  
234 sample to examine the association between frequency of television viewing with the prevalence  
235 of overweight and obesity among women of reproductive age in Myanmar. More than one fourth  
236 of the women surveyed were overweight and one in eight women was obese. This study also  
237 found that watching television at least once a week was significantly associated with  
238 overweight/obesity in women of reproductive age in rural Myanmar.

239 The prevalence of overweight and obesity among women of reproductive age was found  
240 to be 26.5% and 12.2% respectively. The total burden of overweight/obesity (38.7%) was almost  
241 similar to the burden of overweight and obesity among the same target group in other South and  
242 Southeast Asian countries, including Nepal (32.8%)<sup>32</sup>, Bangladesh (36%)<sup>3</sup> and Pakistan (39%).<sup>33</sup>  
243 Each of these studies utilized a nationally representative sample and the Asian BMI cutoff.

244 The prevalence of overweight and obesity was higher among the women living in the  
245 urban areas compared to those living in the rural areas. This finding is consistent with studies  
246 done in other South and Southeast Asian countries, including Bangladesh, as well as in the other  
247 continents.<sup>3 25 34-36</sup> Urban women had a higher frequency of television watching. This may be due  
248 to the higher coverage of electricity and the availability of many satellite channels in urban areas  
249 in comparison to rural areas.<sup>25</sup>

250 It was found that among rural women, the prevalence of overweight and obesity was  
251 significantly associated with watching television at least once a week. This finding is also  
252 consistent with the finding from Bangladesh.<sup>25</sup>

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3 253 Despite the frequency of television watching among urban women, there was no  
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5 254 association between this behavior and the prevalence of overweight and obesity. However, they  
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8 255 were more likely to be overweight/obese than rural women. A propensity towards a more  
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10 256 sedentary lifestyle and the intake of high-calorie foods by the urban residents may be potential  
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12 257 determinants that have overridden the effect from an increased frequency of watching television.  
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14 258 On the other hand, reliance on less developed transportation facilities, involvement in more  
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16 259 laborious work and comparatively lower consumption of obesogenic diets among the rural  
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18 260 women are factors that may contribute to a lower prevalence of overweight and obesity.<sup>25</sup> Those  
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20 261 who view television more frequently in the rural area are more prone to lead a sedentary lifestyle  
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22 262 and as such are at greater risk of developing obesity.<sup>25</sup>  
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27 263 The findings from our study are coherent with a recent study in Bangladesh, which  
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29 264 showed a positive association between the frequency of television viewing and overweight and  
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31 265 obesity in women of reproductive age.<sup>25</sup> Similar positive associations were also found in  
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33 266 developed countries (e.g. USA and Australia).<sup>20 22-24</sup> In a recently published multi-country study,  
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35 267 this association has also been observed in the case of children and adolescents.<sup>37</sup>  
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## 40 268 **Policy and Program Implications**

41  
42 269 The high prevalence of overweight/obesity is associated with an increased burden from  
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44 270 NCDs in Myanmar, as shown in recent evidence.<sup>7 38</sup> An unintended consequence of the  
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46 271 continuing economic development of the country is the increasing preference for a sedentary  
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48 272 lifestyle and obesogenic food, which, in turn, is raising the burden of overweight/obesity.  
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50 273 Considering the epidemiologic, demographic, and nutritional transition, the policymakers of  
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52 274 Myanmar should focus on the prevention and control of both overweight and obesity and NCDs.  
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3 275 The newly released ‘Myanmar National Health Plan 2017-2021’ incorporates NCD prevention  
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5 276 and control programs.<sup>39</sup> Furthermore, a Social Behavioral Change Communication (SBCC)  
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7 277 campaign should be developed in order to promote physical activity and raise awareness among  
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9 278 the population, especially among children and adolescents, in order to prevent  
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11 279 overweight/obesity as early as possible. Further research should be conducted among men and  
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13 280 adolescents to determine whether this positive association exists among those target population  
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15 281 as well.  
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## 23 283 **STRENGTHS AND LIMITATIONS**

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26 284 This is the first study, which utilized a nationally representative sample to examine the  
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28 285 association between the frequency of watching television and overweight/obesity among women  
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30 286 of reproductive age in Myanmar. Moreover, as MDHS utilized standard and valid tools for data  
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32 287 collection, the probability of the existence of any measurement error is lower in this study in  
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34 288 comparison to other cross-sectional studies conducted in Myanmar. However, the survey could  
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36 289 not establish the temporal relationship between the exposure and the outcome variables because  
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38 290 of its cross-sectional design. As a result, the causal association that frequent TV watching may  
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40 291 cause obesity could not be established. The frequency of television viewing was measured in  
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42 292 weeks, as opposed to days/hours; the latter could have given more precise information. In the  
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44 293 multivariable analysis, food habit and duration of physical activity were not included because  
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46 294 this information was not collected in MDHS. There may be the presence of reporting bias while  
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48 295 measuring the frequency of television watching. The information related to the frequency of time  
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296 spent on other types of telecommunication devices such as mobile phones or computers was not  
297 collected, so the association with those variables with overweight/obesity could not be measured.

298

## 299 **CONCLUSIONS**

300 The rising burden of overweight and obesity is now a global concern. Obesity ultimately  
301 leads towards the development of NCDs and premature death. The results from this study  
302 demonstrate that watching television is associated with obesity among reproductive age women  
303 in Myanmar. Therefore, necessary steps should be taken to improve awareness regarding the  
304 harmful consequences of watching TV for longer hours and physical inactivity as well as to  
305 encouragement of increased physical activity. Additional research is also warranted to explore  
306 the situation among the general population of Myanmar.

307

## 308 **LIST OF ABBREVIATION**

309 ASEAN- Association of Southeast Asian Nations

310 BMI- Body Mass Index

311 GDP- *Gross Domestic Product*

312 GNI- Gross National Income

313 NCDs- Non-Communicable Diseases

314 MDHS- Myanmar Demographic and Health Survey

315 SBCC- Social Behavioral Change Communication

316 SEARO- South-East Asia Regional Office

317 USAID- United States Agency for International Development

318 USD- United States Dollar

319 WHO- World Health Organization

320 3MDG- Three Millennium Development Goal Fund

### 321 **Contributors**

322 RDG, IHS, MH, IS and MS conceptualized the study. RDG, IHS, MH, IS, MRH and MS  
323 designed the study and acquired the data. RDG, IHS, MH and IS conducted the data analysis.  
324 RDG, IHS, MH, IS, MRH and MS interpreted the data. RDG, IHS, MH, IS and MRH prepared  
325 the first draft. RDG, IHS, MH, IS, MRH and MS participated in critical revision of the  
326 manuscript and contributed to its intellectual improvement. All authors went through the final  
327 draft and approved it for submission. RDG, IHS, MH and IS equally contributed in this work as  
328 first author.

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### 334 **Competing Interests**

335 None declared.

### 336 **Patient Consent**

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3 337 None Declared  
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6 338 **Disclaimer**  
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9 339 The authors are alone responsible for the integrity and accuracy of data analysis and the writing  
10 the manuscript.  
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12  
13 341 **Ethics Approval**  
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15  
16 342 The datasets were obtained from DHS Programme with proper procedure. The study  
17  
18 343 exempt from collecting ethical approval because the survey protocols were reviewed and  
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20 344 approved by Ethics Review Committee on Medical Research including Human Subjects in the  
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22 345 Department of Medical Research, Ministry of Health and Sports as well as from the ICF  
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24 346 Institutional Review Board.  
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29 347 **Data Sharing Statement**  
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31  
32 348 The dataset of MDHS 2015-16 is available at the Demographic and Health Surveys  
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34 349 Program. Extra data is available which is available on request at [http://dhsprogram-com/what-](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm)  
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36 350 [we-do/survey/survey-display-349.cfm](http://dhsprogram-com/what-we-do/survey/survey-display-349.cfm)  
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3 462 **Figures:**

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6 463 **Figure 1:** Flowchart showing the process of selecting the participants in the survey

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8 464 **Figure 2:** Distribution of the respondents by BMI status

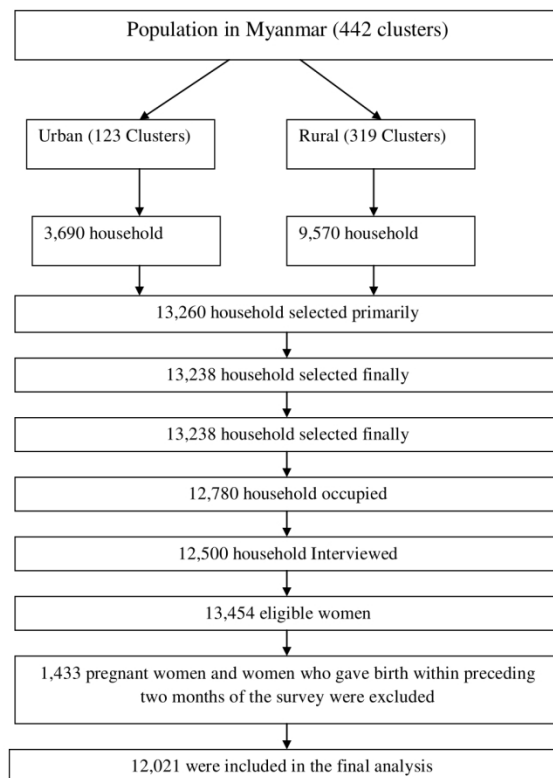
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10 465 **Figure 3:** Distribution of the respondents by place of residence with frequency of watching  
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17 468 **Supplementary Materials:**

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20 469 **Supplementary File 1:** STROBE Checklist

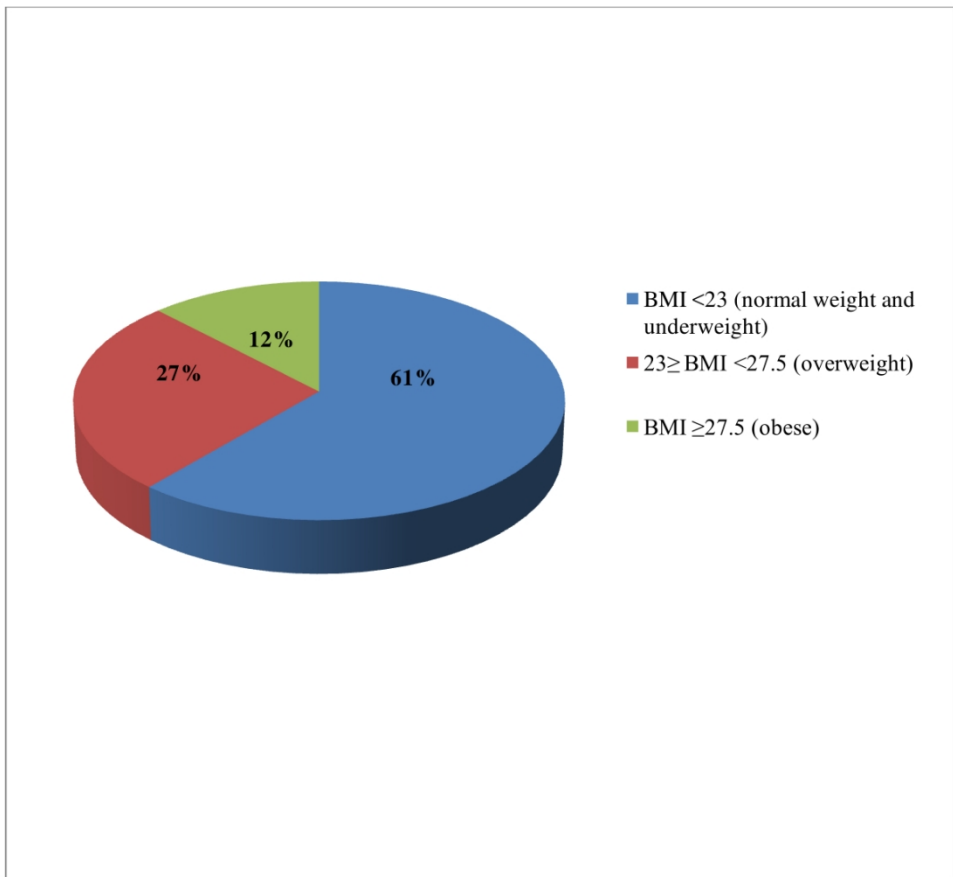
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23 470 **Supplementary File 2:** Supplementary Tables



Flowchart showing the process of selecting the participants in the survey

143x186mm (300 x 300 DPI)

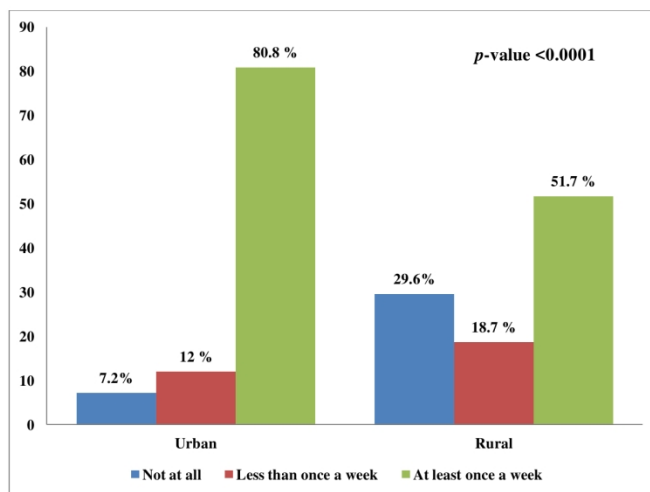
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Distribution of the respondents by BMI status

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Distribution of the respondents by place of residence with frequency of watching television

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies**

**Title of the study: Frequency of Television viewing and association with overweight and obesity among women of the reproductive age group in Myanmar: Results from a nationwide cross-sectional survey**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	11

		(c) Explain how missing data were addressed	11
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	Not applicable
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	12-19
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	17-19
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	20
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	20-22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

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# Supplementary Tables

**Supplementary Table 1: Crude and Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	<i>p</i> -value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	<i>p</i> -value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.11	2.73-3.54	<0.001	2.34	2.01-2.73	<0.001
35-49	5.21	4.66 - 5.83	<0.001	3.65	3.14-4.26	<0.001
<b>Place of Residence</b>						
Urban	Ref			Ref		
Rural	0.54	0.47-0.61	<0.001	0.74	0.64-0.87	<0.001
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.68	0.49-0.94	0.019	0.68	0.50-0.92	0.012
Kayin	0.84	0.64-1.10	0.202	0.88	0.69-1.12	0.301
Chin	0.45	0.33-0.61	<0.001	0.50	0.38-0.66	<0.001

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Sagaing	0.85	0.65-1.11	0.234	0.88	0.67-1.15	0.343
Taninthayi	0.91	0.70-1.17	0.459	1.03	0.78-1.66	0.832
Bago	0.65	0.51-0.82	<b>&lt;0.001</b>	0.68	0.54-0.97	<b>0.002</b>
Magway	0.56	0.43-0.74	<b>&lt;0.001</b>	0.60	0.46-0.77	<b>&lt;0.001</b>
Mandalay	0.67	0.52-0.87	0.002	0.64	0.50-0.82	<b>&lt;0.001</b>
Mon	0.84	0.64-1.11	0.217	0.87	0.63-1.20	0.381
Rakhine	0.39	0.29-0.52	<b>&lt;0.001</b>	0.61	0.45-0.82	<b>0.001</b>
Yangon	1.18	0.90-1.55	0.224	0.98	0.75-1.27	0.854
Shan	0.81	0.60-1.09	0.165	0.91	0.68-1.20	0.486
Ayeyarwaddy	0.66	0.50-0.88	0.005	0.81	0.61-1.08	0.152
Naypyitaw	0.69	0.53-0.90	0.006	0.68	0.52-0.90	<b>0.008</b>
<b>Highest Educational Status</b>						
No Formal Education	Ref			Ref		
Primary	1.29	1.13-1.48	<b>&lt;0.001</b>	1.24	1.06-1.45	<b>0.006</b>
Secondary	1.13	0.97-1.32	0.115	1.26	1.04-1.53	<b>0.018</b>
Higher	1.50	1.22-1.83	<b>&lt;0.001</b>	1.10	0.86-1.40	0.452
<b>Currently employment</b>						
No	Ref					

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Yes	1.02	0.91-1.13	0.762			
<b>Wealth index</b>						
Poorest	Ref			Ref		
Poorer	1.49	1.29-1.72	<0.001	1.46	1.24-1.72	<0.001
Middle	1.87	1.61-2.18	<0.001	1.92	1.62-2.28	<0.001
Richer	2.31	1.97-2.72	<0.001	2.26	1.88-2.72	<0.001
Rich	3.16	2.68-3.72	<0.001	2.82	2.28-3.48	<0.001
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.03	2.73-3.37	<0.001	1.60	1.30-1.98	<0.001
Separated/ Divorced/ Widowed	2.10	1.75-2.51	<0.001	1.03	0.80-1.32	0.820
<b>Parity</b>						
0	Ref			Ref		
1	2.42	2.13-2.75	<0.001	1.44	1.15-1.81	0.002
2	3.13	2.73-3.59	<0.001	1.50	1.19-1.98	0.001
3	3.53	3.07-4.06	<0.001	1.61	1.29-2.02	<0.001

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3+	2.62	2.30-2.99	<0.001	1.42	1.13-1.69	0.003
<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.83	0.76-0.92	<0.001	0.92	0.83-1.03	0.150
<b>Frequency of watching TV</b>						
Not at all	Ref			Ref		
Less than once a week	1.20	1.03-1.40	0.020	1.01	0.87-1.19	0.870
At least once a week	1.49	1.32-1.69	<0.001	1.16	1.02-1.32	0.023

MDHS: Myanmar Demographic and Health Survey

CI: Confidence Interval

<sup>1</sup> Variable with p-value less than <0.2 from unadjusted model were included into multivariable analysis



**Supplementary Table 2: Crude odds ratios for factors associated with overweight and obesity compared to normal weight for urban area among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	<i>p</i> -value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	<i>p</i> -value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.43	2.72-4.33	<b>&lt;0.001</b>	2.67	2.07-3.44	<b>&lt;0.001</b>
35-49	7.63	6.32-9.21	<b>&lt;0.001</b>	5.52	4.30-7.08	<b>&lt;0.001</b>
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.70	0.42-1.19	0.188	0.63	0.38-1.05	0.075
Kayin	0.95	0.75-1.19	0.646	0.94	0.69-1.28	0.675
Chin	0.76	0.56-1.02	0.070	0.71	0.51-0.99	<b>0.041</b>
Sagaing	0.96	0.72-1.28	0.790	0.99	0.70-1.40	0.943
Taninthayi	0.62	0.47-0.82	<b>0.001</b>	0.61	0.38-0.98	<b>0.042</b>
Bago	0.71	0.53-0.93	<b>0.015</b>	0.62	0.43-0.89	<b>0.010</b>
Magway	0.59	0.36-0.97	<b>0.038</b>	0.50	0.29-0.86	<b>0.013</b>
Mandalay	0.98	0.79-1.22	0.848	0.85	0.62-1.18	0.334

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Mon	0.77	0.49-1.20	0.243	0.62	0.32-1.20	0.154
Rakhine	0.61	0.41-0.89	<b>0.012</b>	0.60	0.43-0.83	<b>0.002</b>
Yangon	1.00	0.76-1.34	0.975	1.01	0.71-1.46	0.944
Shan	1.03	0.69-1.55	0.885	1.05	0.65-1.70	0.839
Ayeyarwaddy	0.74	0.52-1.06	0.099	0.89	0.55-1.44	0.632
Naypyitaw	0.80	0.51-1.25	0.322	0.75	0.49-1.15	0.181
<b>Highest Educational Status</b>						
No Formal Education	Ref			Ref		
Primary	1.14	0.84-1.56	0.389	1.10	0.76-1.58	0.605
Secondary	0.78	0.57-1.06	0.107	1.13	0.76-1.68	0.530
Higher	0.84	0.59-1.20	0.346	0.92	0.61-1.40	0.704
<b>Currently employment</b>						
No	Ref			Ref		
Yes	1.22	1.00-1.49	<b>0.046</b>	1.29	1.06-1.56	<b>0.010</b>
<b>Wealth index</b>						
Poorest	Ref			Ref		
Poorer	1.35	0.76-2.37	0.302	1.44	0.69-2.99	0.330

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Middle	1.53	0.94-2.50	0.089	1.99	1.09-3.64	<b>0.025</b>
Richer	2.14	1.28-3.57	<b>0.004</b>	2.65	1.43-4.91	<b>0.002</b>
Rich	2.43	1.47-4.02	<b>0.001</b>	3.08	1.63-5.82	<b>0.001</b>
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.21	2.73-3.78	<b>&lt;0.001</b>	1.46	1.01-2.11	<b>0.042</b>
Separated/ Divorced/ Widowed	2.67	2.01-3.55	<b>&lt;0.001</b>	1.05	0.70-1.56	0.828
<b>Parity</b>						
0	Ref			Ref		
1	2.61	2.05-3.33	<b>&lt;0.001</b>	1.36	0.89-2.08	0.152
2	3.21	2.60-3.96	<b>&lt;0.001</b>	1.27	0.87-1.85	0.221
3	3.95	3.01-5.20	<b>&lt;0.001</b>	1.50	1.03-2.18	<b>0.034</b>
3+	3.91	2.96-5.17	<b>&lt;0.001</b>	1.44	0.97-2.14	0.072
<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.94	0.79-1.11	0.449	1.13	0.92-1.38	0.250

Frequency of watching TV*						
Not at all	Ref			Ref		
Less than once a week	1.15	0.80-1.67	0.441	1.05	0.73-1.51	0.779
At least once a week	1.25	0.93-1.69	0.144	1.14	0.85-1.52	0.389

MDHS: Myanmar Demographic and Health Survey

CI: Confidence Interval

<sup>1</sup> Variable with p-value less than <0.2 from unadjusted model were included into multivariable analysis

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**Supplementary Table 3: Adjusted odds ratios for factors associated with overweight and obesity compared to normal weight for rural area among women of Myanmar, MDHS 2015-16.**

Variable	Crude Odds Ratio (COR)	95% CI	p-value <sup>1</sup>	Adjusted Odds Ratio (AOR)	95% CI	p-value <sup>1</sup>
<b>Age Group (in years)</b>						
15-24	Ref			Ref		
25-34	3.10	2.65-3.62	<0.001	2.09	1.75-2.51	<0.001
35-49	4.61	4.01-5.30	<0.001	2.89	2.39-3.49	<0.001
<b>Region of Residence</b>						
Kachin	Ref			Ref		
Kayah	0.70	0.46-1.06	0.091	0.71	0.48-1.06	0.091
Kayin	0.85	0.58-1.24	0.401	0.89	0.63-1.25	0.497
Chin	0.36	0.23-0.57	<0.001	0.43	0.28-0.64	<0.001
Sagaing	0.90	0.63-1.30	0.586	0.88	0.61-1.25	0.466
Taninthayi	1.10	0.77-1.56	0.606	1.25	0.88-1.78	0.206
Bago	0.68	0.49-0.94	<b>0.018</b>	0.72	0.52-0.99	<b>0.044</b>
Magway	0.62	0.44-0.87	<b>0.006</b>	0.62	0.44-0.86	<b>0.005</b>
Mandalay	0.58	0.40-0.83	<b>0.004</b>	0.57	0.40-0.81	<b>0.002</b>
Mon	0.90	0.63-1.29	0.570	1.03	0.72-1.49	0.860
Rakhine	0.39	0.26-0.58	<0.001	0.63	0.43-0.93	<b>0.022</b>
Yangon	1.07	0.77-1.49	0.681	1.07	0.75-1.52	0.713
Shan	0.78	0.51-1.17	0.222	0.86	0.59-1.24	0.418
Ayeyarwaddy	0.71	0.49-1.03	0.074	0.82	0.56-1.18	0.282
Naypyitaw	0.64	0.44-0.93	<b>0.020</b>	0.67	0.46-0.97	<b>0.035</b>

<b>Highest Educational Status</b>						
No Formal Education	Ref			Ref		
Primary	1.27	1.09-1.47	<0.001	1.24	1.04-1.47	0.018
Secondary	0.98	0.82-1.17	0.84	1.26	1.00-1.57	0.047
Higher	1.13	0.84-1.52	0.40	1.18	0.84-1.57	0.328
<b>Currently employment</b>						
No	Ref					
Yes	1.01	0.89-1.14	0.890			
<b>Wealth index</b>						
Poorest	Ref			Ref		
Poorer	1.49	1.28-1.73	<0.001	1.50	1.27-1.77	<0.001
Middle	1.87	1.59-2.20	<0.001	2.00	1.67-2.40	<0.001
Richer	2.05	1.72-2.45	<0.001	2.30	1.88-2.81	<0.001
Rich	2.59	2.01-3.35	<0.001	2.97	2.27-3.88	<0.001
<b>Marital Status</b>						
Single	Ref			Ref		
Married	3.35	2.93-3.83	<0.001	1.69	1.29-2.21	<0.001
Separated/ Divorced/ Widowed	1.92	1.53-2.42	<0.001	0.97	0.70-1.36	0.877
<b>Parity</b>						
0	Ref			Ref		
1	2.44	2.07-2.87	<0.001	1.47	1.12-1.93	0.005
2	3.37	2.83-4.03	<0.001	1.63	1.22-2.18	0.001
3	3.86	3.26-4.57	<0.001	1.71	1.29-2.28	<0.001
3+	2.92	2.48-3.43	<0.001	1.51	1.12-2.02	0.006

<b>Number of Household Member</b>						
≤5	Ref			Ref		
>5	0.74	0.66-0.83	<b>&lt;0.001</b>	0.83	0.73-0.95	<b>0.005</b>
<b>Frequency of watching TV</b>						
Not at all	Ref			Ref		
Less than once a week	1.11	0.93-1.32	0.242	0.98	0.82-1.17	0.829
At least once a week	1.26	1.10-1.44	<b>0.001</b>	1.16	1.01-1.34	<b>0.040</b>

*MDHS: Myanmar Demographic and Health Survey*

*CI: Confidence Interval*

<sup>1</sup> Variable with *p*-value less than <0.2 from unadjusted model were included into multivariable analysis