Obesity Facts

Research Article

Disparities in Obesity Prevalence in Iranian Adults: Cross-Sectional Study Using Data from the 2016 STEPS Survey

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Abstract
Introduction: This paper outlines the prevalence, disparities, and social determinants of preobesity and obesity in Iranian adults. **Methods:** Data on 28,321 adults who participated in the 2016 National Survey of the Risk Factors of Noncommunicable Diseases (STEPS) survey were analyzed. The body mass index (BMI) was calculated from physically measured height and weight. To assess the association between sociodemographic factors and the prevalence of preobesity and obesity, a χ^2 test and a logistic regression model were used. Socioeconomic inequality was quantified by a concentration index. Disparities in provincial mean BMI and concentration indices were shown on the map of Iran using geographic information system analysis. **Results:** Overall, 60.3% of the participants were affected by preobesity or obesity. The preobesity prevalence was 39% in men and 35.2% in women. The obesity prevalence was 15.6% in men and 30.4% in women. The mean BMI for the country was 26.5. Higher ranges were observed across the northwestern and central territories. Female individuals in the age group 48–57 years who were married and lived in urban settings had an increased risk of being preobese or obese. The concentration index revealed a prorich inequality, with a greater magnitude among women. **Conclusion:** The findings suggest that policies aimed at reducing preobesity and obesity should remain a public health priority in Iran. However, a greater emphasis should be placed on the northwestern and central territories and on higher socioeconomic groups.

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Introduction

Obesity is a chronic disease and an established risk factor for many noncommunicable diseases, including ischemic heart disease, stroke, diabetes, chronic kidney disease, and cancers [1]. It is associated with an increased risk of premature death, with the impact being larger with multiple years of the condition [2]. Over the past few decades, global obesity rates have shown a constant increase, and by 2016 thirty-nine percent of the world's adult population was overweight and 13% was obese [3].

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Iran has experienced a similar trend in recent decades [4]. In 2011, the prevalence of overweight and obesity in Iranian adults was reported to be 34.5 and 21.5%, respectively [5]. However, rates vary substantially across the country, ranging from 27.0 to 38.5% for overweight and from 12.6 to 25.9% for obesity [6]. Regional variations in obesity prevalence have also been found in other parts of the world [7–9]. Much of these variations have been explained by the interactions between environmental and individual factors, including sex, age, and socioeconomic status. Hence, a predictable pattern exists for obesity in subpopulations. In low- and middle-income countries middle-aged adults (mostly women with a high socioeconomic status) are more likely to be overweight or obese, whereas in high-income countries both sexes across all age groups are affected; however, the prevalence tends to be higher in lower socioeconomic strata [10].

Existing studies in Iran have also demonstrated the environmental and individual factors that contribute to obesity; middle age, a lower educational status, and living in urban settings were found to be positively associated with overweight and obesity [5, 11]. However, further information on regional variations in obesity rates is needed since these studies often do not indicate geographic differences, which tend to be as important as national data for public health strategies. Additionally, to reduce health disparities across socioeconomic groups, determination of the obesity-related inequality is helpful for understanding the need to refocus health policies aimed at decreasing the obesity prevalence at the population level. Providing evidence on the social disparities of the disease could also assist decision makers in effectively choosing the related health service expenses that need to be covered under basic insurance plans [12].

Consequently, this study sought to assess the prevalence and sociodemographic factors associated with obesity using data from the most recent nationally representative survey, i.e., the National Survey of the Risk Factors of Noncommunicable Diseases (STEPS), conducted in 2016. Moreover, the geographic distribution and socioeconomic inequality of overweight and obesity in Iran are determined with the intention of informing health policy decisions with the currently most at-risk groups for overweight or obesity.

Methods

Study Population
This descriptive study was performed using data from the seventh-round STEPS survey. This nationwide household survey was implemented in Iran in 2016. To create a nationally representative sample, adults aged 18 years or older were selected based on a multistage clustered probability design, and weighting adjustments were applied. A detailed review of the survey methodology has been published previously [13]. In this survey, trained in-home interviewers collected a wide range of information on sociodemographic characteristics, health behaviors, history of metabolic risk factors, household assets, healthcare utilization, and anthropometric variables using a standardized protocol.

Ultimately 30,541 participants aged 18 years or older were interviewed. However, the analytic sample for the current study consisted of 28,321 adults aged 18 years or older who had complete data on sociodemographic characteristics and physical measurements. The sample population was drawn from both rural and urban settings across 29 out of 31 provinces. The provinces of Qom and North Khorasan opted out of the survey research.

Dependent Variable
Anthropometric measurements were performed by trained healthcare workers during the physical examinations using standardized tools and measurement processes. The body mass index (BMI) was calculated from height and weight data as weight (in kg) divided by height (in m) squared. The continuous BMI variable was categorized based on the World Health Organization (WHO) recommended cut-off values for ease of interpretation [3]. Therefore, individuals were classified into the following 4 groups; underweight (BMI <18.5), normal (BMI 18.5–24.9), preobese (BMI 25.0–29.9), and obese (BMI >30.0).

Independent Variables
Sociodemographic determinants of adult obesity including age, sex, marital status, literacy, employment, health insurance coverage, and residing area were considered as independent variables. Participants were categorized by age into the following groups: 18–27, 28–37, 38–47, 48–57, 58–67, and ≥68 years. Sex was defined as either male or female. Literacy was divided into 3 categories based on the number of years attained (0–5, 6–12, or >12). Additionally, individuals were allocated to 1 of the following employment status classifications: unemployed or retired, student, or employed. Insurance coverage status was categorized as covered or not, and residing area as rural or urban setting.

Wealth Index
A living standard variable is needed to calculate inequality in obesity. Income and consumption expenditure are the direct economic indicators of socioeconomic status. However, no data was collected about household expenditures or income in the 2016 STEPS survey. Therefore, a proxy measure was created by applying the principal component analysis statistical method to the data on household durable assets, housing characteristics, and access to public services. Variables included in the computation of the wealth index were: possession of a house, car, phone line, LCD TV, cooler, vacuum cleaner, dishwasher, washing machine, oven, freezer, side-by-side refrigerator, mobile phone, or personal computer; existence of a separate kitchen area, bathroom, and central heating system; and access to electricity, a water pipeline, a gas pipeline, and internet. The Kaiser-Mayer-Olkin measure of sampling adequacy and the Bartlett test of sphericity were used prior to PCA to determine whether the asset dataset was suitable for data reduction. The Kaiser-Mayer-Olkin value was above 0.5 and the

Bartlett test of sphericity was significant; therefore PCA was appropriate for this dataset [14]. The analysis resulted in the extraction of 6 components with eigenvalues >1, which could explain 53.7% of the variation in the dataset. The first principal component was used to construct the wealth index and it was divided into quintiles for further analysis. The first quintile represented the lowest socioeconomic level. The principal component analysis was conducted using IBM SPSS Statistics for Mac (version 26; IBM Corp., Armonk, NY, USA).

Statistical Analysis

The prevalence of the 4 BMI categories was described for the whole country and for each province separately. To assess the association between the sociodemographic factors and the prevalence of preobesity and obesity, a χ^2 test was applied. For this purpose, individuals were categorized as being either preobese/obese (BMI >24.99) or not preobese/obese (BMI ≤24.99). A multiple logistic regression model was fitted to determine the association of each sociodemographic characteristic with preobesity and obesity, while it was adjusted for the others. The dichotomous variable for BMI was used as the dependent variable in the model and sociodemographic variables were specified as categorical covariates. The estimates were performed using IBM SPSS Statistics for Mac (version 26; IBM Corp.). The threshold for statistical significance was set at α <0.05 for all analyses.

To assess the degree of inequality in the distribution of preobesity and obesity across socioeconomic groups, the concentration index was calculated for the overall population and for each province. However, since the pattern of inequality may also be correlated with sex, the population was further stratified accordingly to estimate the sex-specific inequality. The authors used Stata statistical software (release 15; StataCorp LLC, College Station, TX, USA) for inequality analyses.

To gain more insight into the spatial distribution of the mean BMI, provincial mean BMI were shown on a map of Iran using geographic information system analysis (ArcGIS online). A separate map was created depicting the distribution of concentration indices across provinces.

Concentration Index

The concentration index is the most appropriate measurement for assessing socioeconomic inequalities in health among the few summary indices commonly used for health inequity [15]. The concentration index is measured based on the concentration curve. The curve displays the cumulative percent of the health-related outcome on the y-axis against the cumulative percent of the study population, which is ranked by socioeconomic status on the x-axis (from the lowest to the highest category). The index value ranges between +1 and –1, where 0 reflects complete equality, meaning that the health outcome is equally distributed across socioeconomic levels. The index has a positive value if the health variable is concentrated more among those who are better off. A negative value emerges when the lower socioeconomic levels bear a disproportionate share of the health outcome. The concentration index is determined as twice the area between the obtained concentration curve and the 45° line of equity. The greater the distance, the larger the absolute value of the index and the greater the degree of health inequality [16].

However, the bounds of the concentration index for dichotomized outcome variables are affected by the mean of the health variable. In order to rectify this issue, the concentration index can be normalized by using correction methods [17]. In this study, inequality analyses were undertaken considering the Wagstaff correction method.

Table 1. Sociodemographic characteristics of the study population

Sociodemographic characteristic	Women, n (%)	Men, n (%)	Overall, n (%)
Age (years)			
18–27	2,350 (16.1)	2,151 (15.7)	4,501 (15.9)
28–37	3,575 (24.5)	3,341 (24.4)	6,916 (24.4)
38–47	3,065 (21.0)	2,793 (20.4)	5,858 (20.7)
48–57	2,526 (17.3)	2,391 (17.4)	4,917 (17.4)
58–67	1,872 (12.8)	1,676 (12.2)	3,548 (12.5)
≥68	1,216 (8.3)	1,365 (10.0)	2,581 (9.1)
Marital status			
Single	1,899 (13.0)	2,381 (17.4)	4,280 (15.1)
Married	10,778 (73.8)	11,085 (80.8)	21,863 (77.2)
Divorced/widowed	1,927 (13.2)	251 (1.8)	2,178 (7.7)
Literacy			
Low	6,384 (43.7)	4,125 (30.1)	10,509 (37.1)
Medium	2,915 (20.0)	3,720 (27.1)	6,635 (23.4)
High	5,305 (36.3)	5,872 (42.8)	11,177 (39.5)
Occupational status			
Unemployed/retired	12,531 (85.8)	3,205 (23.4)	15,736 (55.6)
Student	605 (4.1)	619 (4.5)	1,224 (4.3)
Employed	1,468 (10.1)	9,893 (72.1)	11,361 (40.1)
Insurance status			
Not insured	957 (6.6)	1,223 (8.9)	2,180 (7.7)
Insured	13,647 (93.4)	12,494 (91.1)	26,141 (92.3)
Settlement			
Rural	4,300 (29.4)	3,999 (29.2)	8,299 (29.3)
Urban	10,304 (70.6)	9,718 (70.8)	20,022 (70.7)

Result

Data on 28,321 individuals (51.6% women and 48.4% men) were analyzed. Nearly half of the study population was aged between 28 and 48 years. The majority were married and resided in urban settings. More than a third had a high educational status. However, employment rates varied considerably between the sexes and were significantly lower for women than for men (i.e.,10.1 vs. 72.1%, respectively). The distribution of the study participants by sociodemographic characteristics per sex is provided in Table 1.

From the study sample, 10,115 (35.7%) had a normal weight, 1,140 (4%) were classified as underweight, 10,492 (37%) were preobese, and 6,574 (23.2%) were obese. In general, more men than women were within the normal range for BMI (i.e., 41 vs. 30.7%, respectively). Preobesity was also more common in men than in

Table 2. Prevalence of preobesity/obesity in Iran by sociodemographic factors

Sociodemographic characteristic	Not preobese/obese, n (% within category)	Preobese/obese n (% within category)	p valueª
Age (years)			
18–27	2,901 (64.5)	1,600 (35.5)	<0.001
28–37	3,166 (45.8)	3,750 (54.2)	
38–47	1,775 (30.3)	4,083 (69.7)	
48–57	1,324 (26.9)	3,593 (73.1)	
58–67	1,013 (28.6)	2,535 (71.4)	
≥68	1,076 (41.7)	1,505 (58.3)	
Sex			
Female	5,024 (34.4)	9,576 (65.6)	<0.001
Male	6,227 (45.4)	7,490 (54.6)	
Marital status			
Single	2,756 (64.4)	1,524 (35.6)	<0.001
Married	7,788 (35.6)	14,075 (64.4)	
Divorced/ widowed	711 (32.6)	1,467 (67.4)	
Literacy			
Low	3,749 (35.7)	6,760 (64.3)	<0.001
Medium	2,623 (39.5)	4,012 (60.5)	
High	4,883 (43.7)	6,294 (56.3)	
Occupational status			
Unemployed/ retired	5,406 (34.4)	10,330 (65.6)	<0.001
Student	862 (70.4)	362 (29.6)	
Employed	4,987 (43.9)	6,374 (56.1)	
Insurance status			
Not insured	1,009 (46.3)	1,171 (53.7)	<0.001
Insured	10,246 (39.2)	15,895 (60.8)	
Settlement			
Rural	3,943 (47.5)	4,356 (52.5)	<0.001
Urban	7,312 (36.5)	12,710 (63.5)	

ª χ^2 test.

women (i.e., 39 vs. 35.2%), whereas the prevalence of obesity was substantially higher in women than in men (30.4 vs. 15.6%). Underweight rates differed slightly between the sexes (i.e., 3.7% in women vs. 4.4% in men). The provincial variation in preobesity and obesity prevalence was considerable and is provided in online supplementary Table 1 (for all online suppl. material, see www.karger.com/doi/10.1159/000516115). As shown, the provinces of Alborz (40.8%) and Ardabil (40.7%) had the highest preobesity rates, while the highest rates for obesity were observed in Semnan (30.6%) and West Azerbaijan (29.3%).

The mean BMI for the whole country was 26.5 (95% CI 26.4–26.6). The average adult woman had a BMI of 27.4 (95% CI 27.3–27.4) and the average adult man had a

BMI of 25.6 (95% CI 25.5–25.6). Online supplementary Figure 1 shows a map of Iran showing the geographic pattern of mean BMI portioned by province. Higher mean BMI ranges were more common among the northwestern and central territories, yet lower ranges were seen among the southeastern provinces of the country.

Table 2 demonstrates the preobesity/obesity prevalence by sociodemographic characteristics. As indicated, the proportion of preobese/obese individuals increased with age until the age of 68 years, after which the prevalence fell slightly. Preobesity/obesity was less common in single adults, while almost two thirds of the married and divorced or widowed individuals had a BMI >25. A negative educational gradient, i.e., a rate decrease with higher education levels, was observed in the study sample. As per occupational status, the prevalence of preobesity/obesity was significantly higher in homemakers or retirees compared with their employed and student counterparts. In general, high BMI were more prevalent in those who were insured and in those residing in urban settings. All sociodemographic characteristics were significantly related to the prevalence of preobesity/obesity in the bivariate analysis.

Results from the multivariate logistic regression analysis of the preobesity/obesity determinants are presented in Table 3. Participants in the age group 48–57 years who were married and lived in urban settings were more likely to be preobese or obese. Male sex and being employed or a student were negatively associated with high BMI. After accounting for covariates, educational attainment was no longer a statistically significant predictor.

Analysis of the socioeconomic inequality in the prevalence of preobesity/obesity presented a prorich direction. The concentration index for the whole country was 0.15 and it was statistically significant. Sex-stratified concentration index analyses also resulted in positive values and were significant for both sexes. However, women had a larger concentration index than men (i.e., 0.19 vs. 0.11), suggesting a stronger disparity in preobesity/obesity prevalence across socioeconomic levels in women.

The provincial concentration indices are summarized in online supplementary Table 2. The values obtained ranged from 0.00 to 0.29. The most unequal provinces in terms of preobesity/obesity distribution across socioeconomic levels were: Kohgiluyeh and Boyer-Ahmad, Kerman, and Hormozgan. The provinces of Markazi, Ardabil, and Gilan had the most equal distributions. The geographic distribution of concentration indices is shown in online supplementary Figure 2.

Table 3. Logistic regression model of independent variables associated with the prevalence of preobesity/obesity in Iranian adults

Variable	aOR	95% CI for aOR		p value
		lower limit	upper limit	
Age (years)				
18–27	1			
28–37	1.679	1.539	1.833	<0.001
38–47	3.095	2.808	3.412	<0.001
48–57	3.556	3.203	3.948	<0.001
58–67	3.265	2.913	3.660	<0.001
≥68	1.906	1.684	2.157	<0.001
Sex				
Women	1			
Men	0.649	0.605	0.696	<0.001
Marital status				
Single	1			
Married	1.722	1.580	1.876	<0.001
Divorced/widowed	1.579	1.384	1.803	<0.001
Literacy				
Low	1			
Medium	1.092	1.016	1.174	0.017
High	1.056	0.984	1.132	0.130
Occupational status				
Unemployed/retired	1			
Student	0.714	0.614	0.829	<0.001
Employed	0.906	0.843	0.974	0.007
Insurance status				
Not insured	1			
Insured	1.121	1.019	1.232	0.019
Settlement				
Rural	1			
Urban	1.608	1.517	1.705	<0.001
Constant	0.362			<0.001

aOR, adjusted OR.

Discussion

The main findings of this study showed that 60.3% of the participants were affected by preobesity or obesity. The preobesity prevalence was 39% in men and 35.2% in women. The obesity prevalence was 15.6% in men and 30.4% in women. The importance of sociodemographic predictors of preobesity or obesity were also outlined. Individuals in the age group 48–57 years who were married and lived in an urban setting had an increased risk of being preobese or obese. Male sex and being employed or a student were inversely associated with a high BMI. Socioeconomic inequality in preobesity/obesity distribution was quantitatively measured using the concentration index approach. The index revealed a prorich direction which was more severe in magnitude for women compared to men.

Overall, the preobesity/obesity rate in Iran is in line with the rates in Egypt (61.1%) and Saudi Arabia (65.9%) in the Middle East region [18, 19]. It is higher than the prevalence in Europe (53.1%), and it is approaching the rate in the USA (68.5%) [20, 21]. At the national level, a rising trend was observed compared to the prevalence rates reported in similar nationwide surveys performed in 2005 (49.9%) and 2011 (58.1%) [5, 11]. A growing prevalence of obesity had also been reported in previous studies performed in Iran and could be attributed to the urban development and lifestyle transformation marked by a sedentary lifestyle and non-healthy eating habits in recent decades [22, 23]. Findings showed subnational variations in the prevalence of obesity in Iran which were consistent with results from a systematic review conducted earlier in the country [23]. Preobesity/obesity rates in our study ranged from 40.8 to 70.1% in adults across the provinces. Population differences in genetic susceptibility, cultural characteristics, environmental opportunities for physical activity, and access to healthy diet, as well as regional variations in weather conditions affecting outdoor recreation time, may all have contributed to the observed differences.

Age was positively associated with excess body weight until the age of 58—67 years, where the reverse relation began. Similar findings have been reported in other studies [24–26]. Aging is accompanied with increased adipose tissue in the abdomen and deposition of fat in skeletal muscles. In addition, as people age, sedentary behaviors become more common, resulting in a chronic positive energy balance which leads to excessive fat tissue accumulation [27]. However, the negative effect of age on body weight in the elderly observed in this study and those in others might be explained by several physiological changes in neuroendocrine function which could lead to early satiety and a low appetite in older ages [28].

Aligned with other studies, this study showed that abnormal BMI was more prevalent among women compared to men [5, 28–30]. Sociocultural beliefs which limit outdoor activities as well as biological factors such as hormonal signaling influencing energy expenditure during menstruation, pregnancy, and menopausal transition may influence the predisposition of women to excess weight gain [31, 32].

Being single was negatively related to preobesity/obesity prevalence, suggesting that marriage is associated with lifestyle changes that could adversely affect physical activity and eating habits. This supports previous findings in the literature and has important implications for intervention programs targeting families [30, 33].

An inverse association between educational attainment and preobesity/obesity prevalence was determined in the present study, which confirms previous findings in Iran and most countries in the Persian Gulf region [11, 33]. However, inconsistent findings have also been observed in the literature [20, 24]. It is believed that education has a protective effect by providing greater access to health information, increasing the health risk perception, and improving self-control [34].

With regard to occupational status, being employed or a student was found to be a negative predictor of preobesity/obesity presence, which corroborates previous results [5, 20]. High BMI were more prevalent among homemakers and retirees, who are believed to have low physical activity levels.

Results showed that individuals with health insurance were more likely to be preobese or obese. This implies that insured individuals take on more health risks and are less health conscious than those who are noninsured. It is believed that the success of health care and financial coverage plans in promoting the health of individuals is associated with multiple factors including health education [35]. However, further studies are needed to shed light on this finding.

In parallel with previous studies conducted in Iran, the Persian Gulf region, India, and China, residence in urban areas, where a sedentary lifestyle and high-calorie food intake are common, was positively associated with preobesity or obesity [5, 30, 33, 36]. However, it is worth noting that a reverse pattern has also been reported in some regions of the world such as Europe and Russia [20, 24, 37].

This study also highlighted the existing disparities in preobesity/obesity prevalence across socio-economic groups in Iran. A positive association was observed between being preobese or obese and socioeconomic status as measured by wealth. This finding supports previous studies undertaken in Iran and other developing countries like India and Mexico [38–40]. Overall, in low- and middle-income countries, obesity and its related comorbidities are more prevalent in people of a higher socioeconomic status (referred to as prosperity diseases in previous literature) [41]. However, as economies grow, lower socioeconomic groups become more exposed to unhealthy environments and the obesity burden shifts to lower socioeconomic strata [29]. In Iran, despite recording positive economic growth and rapid urbanization in the past decades, a prorich inequality pattern was obtained for preobesity and obesity prevalence in this study [42]. It is assumed that economic development and urban development negatively influenced the lifestyle of people of a higher socioeconomic status by increasing access to ultraprocessed food products, decreasing walkable environments, and promoting sedentary behavior. However, individuals with a lower socioeconomic status were still more likely to have physically demanding occupations and maintain their traditional diet which could reduce the risk of obesity.

Portioning the concentration index across provinces can lead to a better understanding of the regional variations in equity in preobesity/obesity distribution. Provinces with a lower overall social health index ratio showed greater inequality in the preobesity/obesity distribution [43].

The major strength of this study is the fact that a large nationally representative sample of adults from rural and urban communities of Iran, which contained both sexes and all socioeconomic levels, was used for the analyses. This could lead to more reliable inferences about the population and provides important information for future public health interventions. Another strength is that the data on height and weight were collected objectively by trained health workers according to a standardized protocol, which results in more accurate estimates of BMI than those obtained from self-reported measures. However, this study has potential limitations as well; first, since secondary data sources were examined, the assessment of all factors associated with obesity prevalence was not possible, and second, considering the cross-sectional nature of the study, drawing conclusions about causal relationships was not possible.

Conclusion

The findings of this study suggest that policies aimed at reducing preobesity and obesity should remain a public health priority in Iran. Given the provincial variation in the prevalence of obesity, there are key geographic areas such as the northwestern and central territories that require additional consideration. Moreover, there are specific determinants of obesity common to all regions of the country, including sex, age, marital status, and education, which can be targeted in national obesity prevention and health promotion strategies. To alleviate the observed socioeconomic inequality in obesity distribution, community-based efforts including nutrition education and physical activity interventions need to have a stronger emphasis on higher socioeconomic groups which tend to be left uncared for in most public health programs.

Acknowledgement

Statement of Ethics

This study was approved by the Shahid Beheshti University of Medical Sciences Ethics Committee (reference No. IR.SBMU. RETECH.REC.1399.482; approval date: August 18, 2020). All of the participants signed an informed consent form before enrolling into the 2016 STEPS survey. Data was deidentified prior to analysis, and this study was performed according to the Declaration of Helsinki. Participation was voluntary and informed consent was obtained from all of the participants prior to enrolment. The survey protocol was approved by the Ethical Committee of the National Institute for Medical Research Development.

Conflict of Interest Statement

The authors have no conflict of interests to declare.

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Author Contributions

Each author substantially contributed to conduction of this research and drafting of this paper. R.A. was the main researcher and involved in study design, literature search, data analysis, data interpretation, article drafting, and finalization of this paper. A.-A.K. was involved in data cleaning, study design, data interpretation, and article drafting. M.-R.S. was the head of the team and involved in study design, literature search, data analysis, data interpretation, article drafting, and finalization of this paper.

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