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Sex-Specific Educational Gradients in Measured Obesity in Kuwait and Qatar: A Pooled Analysis of Three Who Steps Surveys

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ABSTRACT:

Background: Adult obesity prevalence in the Gulf states is among the highest recorded anywhere, and it is consistently higher in women than in men. How obesity is distributed by socioeconomic position within these populations has received far less attention, and the available evidence comes almost entirely from single-country analyses. We estimated educational gradients in measured obesity, separately for women and men, across the Gulf surveys whose microdata are publicly released.

Methods: We pooled individual records from three WHO STEPS surveys available through the WHO NCD Microdata Repository: Kuwait 2006 (analytic $n = 2,211$), Kuwait 2014 ($n = 3,573$) and Qatar 2012 ($n = 2,383$). Obesity was defined from measured height and weight ($BMI \geq 30 \text{ kg/m}^2$). Education was harmonised to three levels. Inequality was quantified with the slope index of inequality (SII) and relative index of inequality (RII) from survey-weighted regressions with age adjustment, fitted separately by sex. Weighted prevalence estimates were checked against the official survey fact sheets before any model was run.

Results: Obesity prevalence was 41.5% in Kuwait 2006, 40.1% in Kuwait 2014 and 41.1% in Qatar 2012. Among women, obesity was strongly concentrated at low education in every survey: RII 1.68 (95% CI 1.36–2.09) in Kuwait 2006, 1.70 (1.42–2.04) in Kuwait 2014 and 1.59 (1.29–1.96) in Qatar 2012, corresponding to absolute gaps of 23 to 25 percentage points. Among men the gradient was absent in Kuwait in both years but present in Qatar (RII 1.54, 1.12–2.12). The women's gradient in Kuwait did not change between 2006 and 2014 (interaction $p = 0.64$). Gradients grew steeper for severe obesity and were reproduced with waist-based measures.

Conclusions: Obesity in Kuwait and Qatar carries a marked educational patterning in women that has persisted over time, while the male pattern differs between the two countries. Prevention strategies that treat these populations as uniform are likely to miss the groups at highest risk.

1. INTRODUCTION

The Gulf Cooperation Council (GCC) states occupy an unusual position in the global obesity problem. Pooled international analyses place several member countries among those with the highest measured adult BMI in the world, and the countries of the Middle East and North Africa carry some of the largest combined burdens of high BMI recorded in 2022 [1, 2]. Within the region, national surveys report adult obesity above one third of the population, with prevalence in women exceeding that in men by around ten percentage points [3–8]. Rapid income growth over two generations, a food environment reorganised around imported and prepared foods, high car dependence and a climate hostile to outdoor activity for much of the year have all been proposed as contributing conditions, though their relative weight is hard to establish [9]. The diabetes that travels with this

adiposity is well documented in the region, and a recent costing study put the annual economic burden of obesity in Kuwait in the billions of dinars [10, 11].

How obesity is distributed within these societies has received far less attention than how much of it there is. The distinction matters for policy. In most high-income countries obesity now concentrates among groups with less education, a reversal of the pattern observed at earlier stages of economic development, and this reversal tends to appear first, and most strongly, in women [12–18]. Where a population sits on this transition determines whether measures aimed at everyone or measures aimed at disadvantaged groups will reach the people at greatest risk. The Gulf states are an informative case. They moved from middle-income to very high-income status within decades, their welfare and subsidy arrangements differ from those of the European and North American settings in which the gradient literature developed, and large migrant populations complicate the usual meaning of socioeconomic position [19, 20].

The evidence that exists is spread across single-country studies with socioeconomic indicators that are rarely comparable from one study to the next. Analyses of Kuwaiti samples have reported lower odds of obesity with higher educational attainment [6, 7], and similar single-survey findings exist for Qatar, Oman, Saudi Arabia, the United Arab Emirates and the wider region [4, 20–23]. Cross-national work linking gender inequality to the female excess in obesity has included Gulf states only at the aggregate level, without individual socioeconomic data [24]. We are aware of no study that has pooled individual-level Gulf survey data to estimate socioeconomic gradients on a common footing, using formal inequality indices, with women and men examined separately. Relatively few studies anywhere in the region have quantified inequality on both the absolute and the relative scale, although the two can disagree and both are needed for a fair reading [25, 26].

What the single-country record shows is worth setting out. In Kuwait, an analysis of 4,901 adults from the Kuwait Diabetes Epidemiology Program found greater educational attainment associated with lower odds of obesity and of central obesity after adjustment for other factors [6], and the 2014 national sample put obesity at 44% of women against 36% of men [7]. Saudi data suggest education and income can pull in opposite directions, with obesity falling as education rises while bearing a more complicated relation to household income [21]. Iranian cohort data locate wealth-related inequality in overweight and obesity mainly among women [22], and multilevel work across cities in Latin America, a region at a comparable stage of the nutrition transition, found educational inequality in obesity larger for women than for men in nearly every setting examined [18]. For Qatar the record is thinner: a primary-care series from Doha [23] and Qatar Biobank samples reporting central obesity in close to half of adults [8] describe the burden without addressing its social distribution. Set beside one another, these studies point in a consistent direction. Their differing indicators, adjustment sets and outcome definitions nevertheless leave the size of the gradient, its absolute as against relative form, and its stability across countries and over time unresolved, which is the gap this study addresses. The WHO STEPS programme makes such an analysis possible. STEPS surveys use a standardised instrument, probability samples of resident adults and measured anthropometry, and the microdata for several Gulf surveys are released through the WHO NCD Microdata Repository [27–29]. Pooling these files permits inequality estimation with enough power to treat women and men separately, and the repeat survey in Kuwait allows a within-country check on whether the gradient moved over an eight-year interval.

This study had three aims: to estimate sex-specific prevalence of measured obesity in the Gulf countries with available STEPS microdata; to quantify educational gradients in obesity using the slope and relative indices of inequality, separately by sex; and to examine whether these gradients changed in Kuwait between 2006 and 2014. A further aim was to test whether the findings hold under alternative adiposity measures and thresholds.

2. METHODS

2.1 Design and data sources

This is a pooled cross-sectional analysis of individual-level microdata from WHO STEPS surveys in GCC member states, restricted to surveys whose datasets are released for research use in the WHO NCD Microdata Repository. Three surveys met this condition at the time of analysis: Kuwait 2006, Kuwait 2014 and Qatar 2012 [27–29]. No repository entry existed for Oman, Bahrain, Saudi Arabia or the United Arab Emirates. Each survey followed the standard STEPS design, with an interviewer-administered questionnaire and physical measurement of height, weight and waist circumference by trained staff. Kuwait 2006 sampled adults aged 20–64; Kuwait 2014 drew a simple random sample of adults aged 18–69 (4,391 participants, response rate 89%) [30]; Qatar 2012 used a multi-stage cluster design covering Qatari and non-Qatari households and enrolled 2,496 adults

aged 18–64 with an 88% response rate [31]. Survey-specific sampling details are reproduced in Supplementary Table S1 from the official country documentation.

2.2 Participants

We included adults with valid measured height and weight within each survey's age range. Pregnant women, records with the STEPS missing-value codes or biologically implausible measurements (height outside 100–230 cm, weight outside 25–250 kg, BMI outside 12–60 kg/m²) and records missing sex, age, education or a positive survey weight were excluded. The analytic samples were 2,211 of 2,280 records for Kuwait 2006, 3,573 of 3,918 for Kuwait 2014 and 2,383 of 2,496 for Qatar 2012, a pooled total of 8,167.

2.3 Outcomes

The primary outcome was obesity, BMI ≥ 30 kg/m² from measured values [32]. Secondary outcomes were severe obesity (BMI ≥ 35), overweight or obesity (BMI ≥ 25) and abdominal obesity from measured waist circumference (≥ 102 cm in men, ≥ 88 cm in women).

2.4 Socioeconomic indicator

Education served as the socioeconomic indicator. It is recorded in every STEPS survey, is fixed early in adult life and is therefore less exposed to reverse causation than income, and it can be harmonised across instruments. Kuwait 2006 and Qatar 2012 used the generic STEPS seven-level coding, while Kuwait 2014 used a national eight-level scheme; both were mapped to three levels (below secondary; completed secondary or high school; any post-secondary qualification). The mapping is documented category by category in Supplementary Table S2. Household income was recorded inconsistently across the three instruments and was not used.

2.5 Statistical analysis

All estimates apply the physical-measurement survey weights (wstep2) supplied with each dataset, and variance estimation accounts for the sampling structure: primary sampling units enter as clusters in a with-replacement approximation, which reduces to individual-level sandwich variance for the simple random samples in Kuwait and to 96 cluster groups in Qatar. As a validation step, weighted prevalence estimates were compared with the official WHO fact sheets before any model was fitted; the pooled estimates reproduced the published figures to within 0.3 percentage points in both surveys with published fact sheets [30, 31].

Inequality was quantified on two scales. Following standard practice [25, 26], each participant was assigned the weighted midpoint of their survey- and sex-specific cumulative education rank (a ridit score), oriented so that 0 represents the top of the education distribution and 1 the bottom. The relative index of inequality (RII) is the exponentiated ridit coefficient from a survey-weighted Poisson regression with sandwich variance estimation [33], adjusted for age in five-year bands, and can be read as the ratio of predicted obesity prevalence at the bottom of the education distribution to that at the top. The slope index of inequality (SII), the corresponding absolute difference in percentage points, comes from the analogous linear model. Models were fitted separately by sex within each survey. Differences between women and men were tested with a sex-by-ridit interaction, and change over time in Kuwait with a year-by-ridit interaction. Analyses used Python 3.12 with the statsmodels library; the full harmonisation and analysis code is available from the authors and will be deposited alongside the article.

2.6 Sensitivity analyses

Four checks were run: outcomes redefined at BMI ≥ 35 and BMI ≥ 25 ; abdominal obesity in place of BMI; restriction to the common age band 20–64 shared by all three surveys; and inspection of the education-specific prevalences underlying each index. Citizenship is not recorded in the public-use extracts, so analyses stratified by nationality were not possible; the implications are taken up in the discussion.

2.7 Ethics and data use

The study is a secondary analysis of anonymised public-use data and was [granted an exemption determination by the Institutional Review Board of Prince Sattam bin Abdulaziz University; reference to be inserted]. The terms of use of the WHO NCD Microdata Repository were followed, including acknowledgement of each data source, sharing of the manuscript with WHO prior to publication and an offer of co-authorship to the coordinators of each contributing survey.

3. RESULTS

3.1 Sample characteristics and prevalence

Table 1 describes the three analytic samples. Weighted obesity prevalence was 41.5% in Kuwait 2006 (36.2% of men, 47.1% of women), 40.1% in Kuwait 2014 (36.3% and 43.9%) and 41.1% in Qatar 2012 (39.0% and 43.3%). Mean BMI sat between 29.2 and 29.6 kg/m² in all three surveys. The education distribution shifted upward markedly in Kuwait between 2006 and 2014, with the share holding a post-secondary qualification rising from 26% to 63% on the harmonised coding.

Table 1. Characteristics of the analytic samples (weighted percentages unless stated).

	Kuwait 2006	Kuwait 2014	Qatar 2012
Analytic n (unweighted)	2,211	3,573	2,383
Age range sampled	20–64	18–69	18–64
Women, %	48	51	49
Mean age, years	35.0	36.3	35.0
Education: below secondary, %	9	17	18
Education: secondary, %	65	20	51
Education: post-secondary, %	26	63	30
Mean BMI, kg/m ²	29.6	29.4	29.2
Obesity (BMI ≥ 30), %	41.5	40.1	41.1

3.2 Obesity by education level

Table 2 and Figure 1 show weighted obesity prevalence by education level, sex and survey. Among women the pattern is steep and consistent. Obesity affected 74.6% of women with less than secondary education in Kuwait 2006 against 32.3% of those with post-secondary education; the corresponding figures were 67.8% against 37.0% in Kuwait 2014 and 65.6% against 38.1% in Qatar 2012. Among men the differences were small in both Kuwaiti surveys (43.0% versus 33.8% in 2006; 38.8% versus 35.3% in 2014) and larger in Qatar (45.5% versus 34.2%).

Table 2. Weighted obesity prevalence (%) by education level, sex and survey; unweighted cell n in parentheses.

Survey	Sex	Below secondary	Secondary	Post-secondary
Kuwait 2006	Men	43.0 (63)	36.6 (608)	33.8 (244)
	Women	74.6 (226)	47.1 (742)	32.3 (328)
Kuwait 2014	Men	38.8 (234)	37.1 (327)	35.3 (814)
	Women	67.8 (379)	45.6 (345)	37.0 (1,474)
Qatar 2012	Men	45.5 (168)	39.8 (502)	34.2 (363)
	Women	65.6 (323)	36.2 (559)	38.1 (468)

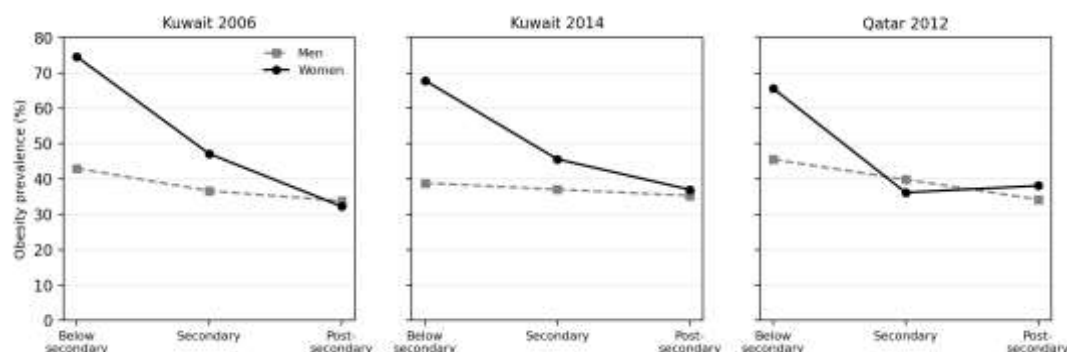


Figure 1. Weighted obesity prevalence by harmonised education level, by sex, in each survey.

3.3 Inequality indices

Table 3 and Figure 2 give the age-adjusted indices. Among women, the RII was 1.68 (95% CI 1.36–2.09) in Kuwait 2006, 1.70 (1.42–2.04) in Kuwait 2014 and 1.59 (1.29–1.96) in Qatar 2012, with $p < 0.001$ throughout. On the absolute scale the SII ranged from +22.6 to +24.8 percentage points, so the model-predicted prevalence at the bottom of the education distribution exceeds that at the top by close to a quarter of the female population. Among men, no gradient was detectable in Kuwait in either year (RII 1.08, 0.78–1.49 in 2006; 0.98, 0.77–1.25 in 2014), whereas Qatar showed one (RII 1.54, 1.12–2.12; SII +17.4 points, 4.8–30.1). The sex difference in the relative gradient was significant in Kuwait (ratio of RIIs 1.67, $p = 0.007$ in 2006; 1.78, $p < 0.001$ in 2014) and compatible with chance in Qatar (1.12, $p = 0.55$).

Table 3. Age-adjusted relative (RII) and slope (SII) indices of inequality in obesity, by sex and survey. RII > 1 and SII > 0 indicate higher prevalence at lower education.

Survey	Sex	RII (95% CI)	p	SII, pp (95% CI)	p
Kuwait 2006	Men	1.08 (0.78–1.49)	0.63	+2.9 (–9.1, +15.0)	0.63
	Women	1.68 (1.36–2.09)	<0.001	+24.8 (+14.7, +34.8)	<0.001
Kuwait 2014	Men	0.98 (0.77–1.25)	0.87	–0.8 (–9.8, +8.3)	0.87
	Women	1.70 (1.42–2.04)	<0.001	+23.2 (+15.6, +30.9)	<0.001
Qatar 2012	Men	1.54 (1.12–2.12)	0.007	+17.4 (+4.8, +30.1)	0.007
	Women	1.59 (1.29–1.96)	<0.001	+22.6 (+12.3, +33.0)	<0.001

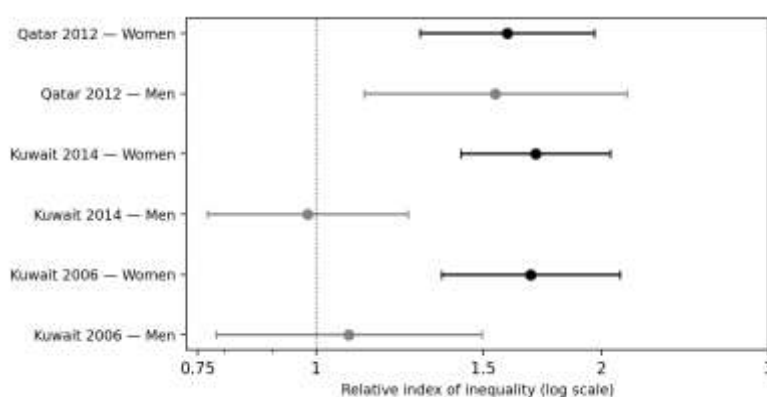


Figure 2. Relative index of inequality (95% CI) in obesity by sex and survey, log scale. Values above 1 indicate higher prevalence at lower education.

3.4 Change over time in Kuwait

Between 2006 and 2014, the educational gradient in Kuwait did not move on the relative scale in either sex: the ratio of RIIs across years was 0.94 ($p = 0.76$) for men and 1.06 ($p = 0.64$) for women. The female gradient was therefore already fully formed in 2006 and persisted essentially unchanged through 2014, over a period in which the education distribution itself shifted upward and overall prevalence stayed near 40%.

3.5 Sensitivity analyses

The women's gradient steepened with the severity of the outcome. For severe obesity the RII reached 1.82 (1.28–2.61) in Kuwait 2006, 2.77 (1.93–3.98) in Kuwait 2014 and 1.89 (1.36–2.63) in Qatar 2012, while for the broad overweight-or-obesity outcome it flattened toward the null (1.21, 1.18 and 1.09 respectively), as expected when a threshold captures most of the population. Waist-based abdominal obesity reproduced the BMI findings: significant gradients among women in all three surveys (RII 1.65, 1.44 and 1.26) and none among Kuwaiti men (0.96 and 0.98), with the Qatari male estimate positive but imprecise (1.27, 0.96–1.66). Restriction to ages 20–64 left every conclusion in place (women's RII 1.68, 1.78 and 1.61). Full sensitivity results appear in Table 4.

Table 4. Sensitivity analyses: age-adjusted RII (95% CI).

Outcome / restriction	Kuwait 2006	Kuwait 2014	Qatar 2012
Severe obesity (BMI ≥ 35), women	1.82 (1.28–2.61)	2.77 (1.93–3.98)	1.89 (1.36–2.63)
Overweight or obesity (BMI ≥ 25), women	1.21 (1.07–1.38)	1.18 (1.08–1.28)	1.09 (0.97–1.22)
Abdominal obesity, women	1.65 (1.35–2.01)	1.44 (1.23–1.69)	1.26 (1.04–1.52)
Abdominal obesity, men	0.96 (0.68–1.36)	0.98 (0.72–1.34)	1.27 (0.96–1.66)
Ages 20–64, obesity, women	1.68 (1.36–2.09)	1.78 (1.48–2.13)	1.61 (1.31–1.99)
Ages 20–64, obesity, men	1.08 (0.78–1.49)	1.00 (0.78–1.28)	1.54 (1.10–2.15)

4. DISCUSSION

Three findings stand out. First, obesity among women in Kuwait and Qatar carries a steep educational patterning, on the order of a 60 to 70 percent relative excess and more than 20 percentage points in absolute terms at the extremes of the education distribution. Second, this patterning was stable in Kuwait across an eight-year interval during which the population's educational profile improved considerably. Third, the male picture is not uniform: Kuwaiti men showed no gradient in either survey year, while Qatari men showed a clear one.

The female gradient is consistent with the broader pattern seen in high-income countries, where the concentration of obesity among the less educated appears earliest and most strongly in women [12–14, 16, 17]. Single-country analyses in the Gulf had pointed the same way [6, 7, 20, 21], and cross-national comparisons of overweight inequality among women in transitioning economies describe exactly this trajectory [13, 15, 18]. What the pooled indices add is comparability and magnitude. An absolute gap above 20 percentage points, replicated in three surveys from two countries and steepening at higher BMI thresholds, is difficult to attribute to the particulars of any one instrument or sampling frame. The dose-response with severity deserves emphasis, since it places the inequality where the clinical risk is greatest.

The flat gradient among Kuwaiti men, against a clear one among Qatari men, admits more than one reading. Population composition is the most likely candidate. The Qatar 2012 survey covered Qatari and non-Qatari households in a country where the resident population is dominated by male labour migrants, and low educational attainment among men in Qatar largely identifies this group, whose diet, physical demands of work and duration of residence differ from those of nationals [19, 20]. The Kuwaiti samples, drawn differently, may contain a different balance. Citizenship is not carried in the public-use extracts, so this reading could not be tested directly, and it is presented as interpretation rather than result. An alternative reading, that

male obesity in the Gulf is genuinely less socially patterned than female obesity, has some support in the Kuwaiti data taken alone [6, 7], and the two accounts are not exclusive.

Why the female gradient should be so pronounced is beyond what cross-sectional data can settle, but the candidate mechanisms are familiar: differences by education in dietary composition and awareness, in access to and social acceptability of physical activity for women, in labour-force participation and the occupational activity that comes with it, and in reproductive histories [9, 20, 24]. The persistence of the gradient in Kuwait between 2006 and 2014 argues against the idea that rising education alone will dissolve it, since the gradient survived a substantial upward shift in the education distribution. Inequality attached itself to the new distribution rather than fading with the old one.

For policy, the implication is directional rather than prescriptive. Both countries operate population-wide measures against obesity and its consequences. The present results suggest these are unlikely to be sufficient for the group carrying the largest burden, women with little formal education, whose obesity prevalence approached or exceeded two thirds in every survey examined here. Interventions that reach this group on its own terms, through primary care, community settings and channels that do not presume high literacy, would follow more directly from the data than further untargeted campaigns. Monitoring should also change: reporting national prevalence without its social distribution conceals the feature of the epidemic these analyses find most stable.

4.1 Strengths and limitations

The strengths are measured rather than self-reported anthropometry, probability samples with published response rates of 88 to 89 percent where documented, formal inequality indices on both scales, a within-country repeat that permits a trend estimate, and a reproducibility check against the official fact sheets that the pooled estimates passed to within 0.3 percentage points. Several limitations remain. Only three surveys from two countries are represented, because no other GCC member has deposited adult STEPS microdata in the repository; the findings describe Kuwait and Qatar, not the Gulf as a whole. The surveys span 2006 to 2014 and are not contemporaneous with each other or with the present. Education was harmonised to three coarse levels, which discards information and may attenuate gradients. Income was unavailable, citizenship was absent from the extracts, and the cross-sectional design precludes causal statements. A national STEPS round was completed in Qatar in 2023–24 [34]; its microdata had not been deposited at the time of analysis, and re-estimation of these indices when the file becomes available is a natural next step. Finally, the ridit-based indices assume an ordered education variable; the underlying category-specific prevalences in Table 2 let the reader check that no ordering artefact drives the results.

4.2 CONCLUSIONS

Educational inequality in measured obesity among women in Kuwait and Qatar is large, consistent across surveys, steepest for severe obesity and, in Kuwait, unchanged over eight years. Among men it is present in Qatar and absent in Kuwait. Obesity strategy in these countries has good reason to treat the social distribution of the condition as an object of policy alongside its overall level, and surveillance reporting would gain from making that distribution routinely visible.

DECLARATIONS

Ethics: Secondary analysis of anonymised public-use data; [PSAU IRB exemption determination, reference number to be inserted]. Data availability: All microdata are available from the WHO NCD Microdata Repository (<https://extranet.who.int/ncdsmicrodata>), catalogue entries KWT_2006_STEPS_v01, KWT_2014_STEPS_v01 and QAT_2012_STEPS_v01. Analysis code is available from the corresponding author.

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CONFLICT OF INTERESTS:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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SUPPLEMENTARY MATERIAL (SUBMITTED SEPARATELY)

Table S1: survey designs, sampling and response rates as documented in the country reports. Table S2: category-by-category education harmonisation for each survey instrument. Code file: harmonisation and analysis script.