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Partner Drunkenness, Household Wealth and Intimate Partner Violence in Malawi: Examining Socioeconomic Inequality and Effect Modification

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Abstract

Background: Partner alcohol use is associated with intimate partner violence (IPV), but less is known about how partner drunkenness relates to socioeconomic inequalities in IPV. We examined the socioeconomic distribution of partner drunkenness and IPV, whether household wealth modified their association, and the contribution of partner drunkenness to wealth-related inequality in IPV in Malawi.

Methods: We conducted a cross-sectional analysis of the nationally representative 2024 Malawi Demographic and Health Survey among 15,130 women eligible for the domestic violence module. Partner drunkenness was classified as none, sometimes, or often, and the primary outcome was past-year physical and/or sexual IPV. Survey-weighted concentration indices assessed socioeconomic inequality. Survey-weighted regression models examined associations and wealth modification. Standardised association-based population attributable fractions (PAFs) and regression-based concentration-index decomposition assessed the modelled burden associated with partner drunkenness and its contribution to wealth-related IPV inequality.

Results: In 2024, 27.5% of women reported a sometimes- or often-drunk partner, and 21.5% reported past-year physical and/or sexual IPV. Both partner drunkenness (concentration index −0.0513, 95% CI −0.0771 to −0.0254) and IPV (−0.0822, 95% CI −0.109 to −0.0551) were concentrated among poorer women. Standardised IPV risk increased from 17.1% among women reporting no partner drunkenness to 27.5% among

those reporting sometimes drunkenness and 42.8% among those reporting often drunkenness. There was no statistically significant evidence that household wealth modified the association on either the multiplicative or additive scale. Partner drunkenness accounted for an estimated 20.7% (95% CI 17.6–23.8) of the modelled IPV burden under the no-drunkenness scenario and contributed 19.6% (95% CI 8.4–30.8) to wealth-related IPV inequality.

Conclusions: Partner drunkenness was associated with higher IPV risk, and both were disproportionately concentrated among poorer women in Malawi. Its contribution to wealth-related inequality was consistent with more concentrated exposure among poorer women, without evidence of systematic wealth-related amplification of the association. These findings highlight the relevance of considering partner drunkenness alongside broader socioeconomic and relationship factors in IPV prevention.

Keywords: alcohol; intimate partner violence; partner drunkenness; socioeconomic inequality; women; Malawi; Demographic and Health Survey; health equity

Background

Intimate partner violence (IPV) is a major global public health and human rights concern, affecting women across settings and socioeconomic groups. Most IPV is perpetrated by current or former intimate partners and occurs in all regions of the world (1,2). Globally, about 27% of ever-partnered women have experienced physical and/or sexual IPV during their lifetime, while 13% experienced it in the previous year (2). The consequences extend beyond the immediate experience of violence, affecting women's physical and mental

health and having implications for their children and households (3,4). The burden is particularly high in sub-Saharan Africa, although prevalence varies considerably across countries and population groups. Research in the region has linked IPV to socioeconomic conditions, gender norms, relationship characteristics and partner behaviours (5–7).

Two factors are particularly relevant to the socioeconomic distribution of IPV: household wealth and partner alcohol use. Women living in poorer households consistently report higher levels of violence than those in more affluent households (8,9). Partner alcohol use is also repeatedly associated with IPV. Studies from sub-Saharan Africa and other low- and middle-income countries have found higher levels of violence among women whose partners drink, with similar patterns reported in recent reviews (10–15). These findings suggest that socioeconomic position and partner drinking are both important dimensions of IPV, but they are generally examined separately. Consequently, less is known about how the distribution of partner drinking intersects with the socioeconomic distribution of IPV.

Evidence from Malawi similarly identifies partner alcohol use as an important correlate of IPV. Using the 2015–16 Malawi DHS, Chikhungu and colleagues (16) found that husband's alcohol consumption, together with women's ethnicity and working status, was associated with different forms and levels of abuse, including controlling behaviour, physical violence and emotional violence. Chilanga and colleagues (17), studying mothers of young children in central Malawi, identified partner extramarital affairs as a strong correlate of controlling and psychological violence, while partner alcohol use was specifically associated with sexual violence. Baruwa and colleagues (18), comparing Malawi and South Africa, found associations between IPV and education, household wealth, women's autonomy, gender

attitudes and partner alcohol use, with partner alcohol use among the stronger correlates in their analysis. Other research has linked IPV in Malawi to broader consequences, including fertility and women's well-being (19,20). These studies establish partner alcohol use as a recurring correlate of IPV in Malawi, but they provide limited evidence on how its relationship with IPV varies across socioeconomic groups.

This distinction is important because a stronger burden of alcohol-related IPV among poorer women can arise through different pathways. One possibility is that poorer women are more likely to have partners who become drunk, resulting in greater exposure to alcohol-related violence. This would represent a difference in the distribution of the exposure itself. Another possibility is that the association between partner drunkenness and IPV is stronger among poorer women because they may have fewer economic resources, fewer alternatives to an abusive relationship, or more limited access to support and protection (3,21). These mechanisms are not mutually exclusive, but they have different implications for understanding socioeconomic inequality in IPV. Evidence from the broader literature on the alcohol harm paradox provides a useful parallel: disadvantaged populations may experience greater alcohol-related harm even when their own alcohol consumption is similar to or lower than that of more advantaged groups (22,23). However, this literature has focused mainly on harms experienced by drinkers themselves and provides less insight into harms experienced by intimate partners exposed to another person's drinking.

The distinction between unequal exposure and differential vulnerability has therefore received limited attention in research on partner alcohol use and IPV. Existing studies

commonly estimate an average association between partner drinking and IPV across the population, while research on socioeconomic inequality in IPV documents a greater burden among poorer women. Few studies bring these two strands of evidence together to examine whether partner drunkenness is more common among poorer women, whether the association between drunkenness and IPV differs by household wealth, and how much partner drunkenness contributes to the socioeconomic distribution of IPV. Addressing these questions is particularly relevant in Malawi, where partner alcohol use and socioeconomic inequalities in IPV have both been documented but their intersection remains insufficiently understood. This study used data from the 2024 and 2015–16 Malawi Demographic and Health Surveys to examine the relationship between partner drunkenness, household wealth and IPV. We first assessed whether partner drunkenness and physical and/or sexual IPV were disproportionately concentrated among poorer women. We then examined whether household wealth modified the association between partner drunkenness and past-year physical and/or sexual IPV. Finally, we estimated the contribution of partner drunkenness to wealth-related inequality in IPV.

Methods

Study design and data sources

We conducted a cross-sectional secondary analysis of the 2024 Malawi Demographic and Health Survey. The 2024 survey was implemented by the National Statistical Office in collaboration with national health-sector partners, with technical assistance from Utica International and ICF through The DHS Program. Fieldwork took place from 13 May to 31

August 2024. The survey used a stratified two-stage cluster design and selected 792 clusters and approximately 23,760 households (24). We used the Women's Individual Recode (IR) file because it contains both the domestic-violence module and the partner-alcohol variables required for this analysis. The 2024 survey also included a separate Dzaleka refugee-camp domain. Standard national sampling weights are zero for this component and the MDHS reports it separately; these records were therefore excluded from all national estimates (24). The 2015-16 MDHS used the same DHS platform and comparable domestic-violence and partner-alcohol items.

Study population

The target population was women aged 15-49 years selected for the domestic-violence module who had a current or former intimate partner represented in the DHS partner-alcohol questions. In 2024, eligibility included women currently or formerly married or cohabiting and never-union women who reported a current or former non-cohabiting intimate partner. Nineteen records coded as a nullified union were excluded to reproduce the published domestic-violence denominator. The resulting primary analytic sample contained 15,130 women and represented 14,856 weighted observations. Exposure, outcome and wealth were complete in this sample. Sample characteristics are presented in Table 1.

Measures

Intimate partner violence

The primary outcome was any form of physical or sexual IPV by the referenced current or former intimate partner during the preceding 12 months. The DHS modified Conflict Tactics Scale records the frequency of specific acts. We classified codes indicating 'often' or 'sometimes' during the preceding year as past-year events and distinguished them from violence occurring only before the preceding 12 months. Physical IPV included pushing, slapping, punching, kicking or dragging, strangling or burning, attacks with a weapon, and arm twisting or hair pulling; sexual IPV included forced intercourse and other forced sexual acts. Secondary outcomes were severe physical IPV and emotional IPV (25,26).

Partner alcohol exposure

The primary exposure was partner drunkenness frequency. DHS records whether the referenced husband or partner drinks alcohol, and how often the partner becomes drunk among partners who drink. We created an ordered three-level measure: no drunkenness, sometimes drunk and often drunk. The reference category combined partners who did not drink with partners who drank but were reported never to become drunk (27).

Covariates

Household wealth quintile was the primary socioeconomic measure. DHS constructs its wealth index from household assets and housing characteristics and divides the weighted household population into quintiles from poorest to richest (28). Wealth was modelled categorically in interaction analyses. For concentration analysis, respondents were ranked

from poorest to richest using the continuous DHS wealth factor score. Woman's education was specified in advance as an alternative socioeconomic axis because it is less plausibly affected by contemporaneous partner drinking than household wealth. Covariates were selected substantively rather than by stepwise testing (29). The complete-core model adjusted for woman's age, education, current employment, parity, marital status, whether the referenced partner was current or former, urban/rural residence and region. The primary extended model additionally adjusted for witnessing parental violence (father ever beat mother) and acceptance of wife-beating for at least one reason. Partner age, partner education, age and education gaps, and relationship-duration measures were reserved for a current-husband/live-in-partner sensitivity analysis because missingness was largely structural outside current cohabiting unions. Partner controlling behaviour was excluded from the primary adjustment set because it may be on, or downstream of, pathways linking alcohol use and violence; it was added only in sensitivity analysis. Full variable definitions, the corresponding DHS source variables in each round and their cross-round harmonisation are set out in Additional file 1.

Statistical analysis

All analyses accounted for the complex survey design using the DHS domestic-violence sampling weights, primary sampling unit, and survey strata. Weighted prevalence estimates were calculated for partner drunkenness and past-year physical and/or sexual IPV. Socioeconomic inequality was assessed using the standard concentration index and Erreygers-corrected concentration index, with 95% confidence intervals obtained from 1,000 survey bootstrap replicates.

Survey-weighted logistic regression was used to estimate the association between partner drunkenness and IPV. Models were progressively adjusted for prespecified sociodemographic, relationship and gender-related factors. Effect modification by household wealth was assessed using drunkenness-by-wealth interaction terms on both multiplicative and additive scales; adjusted probabilities and risk differences were obtained through model standardisation. We estimated an association-based population attributable fraction (PAF) by comparing the observed IPV risk with the standardised risk under a counterfactual scenario in which all women were classified as having no partner drunkenness. Finally, wealth-related inequality in IPV was decomposed using a regression-based concentration-index approach to quantify the contribution of partner drunkenness and other covariates. Uncertainty for PAFs and decomposition estimates was assessed using 1,000 survey bootstrap replicates. Sensitivity analyses examined alternative exposure definitions, socioeconomic measures, study populations, IPV outcomes, adjustment sets, multiple imputation, and unmeasured confounding. Analyses of the 2015–16 MDHS using a matched denominator were conducted to assess consistency of the findings. All analyses were performed in R version 4.4.3 using two-sided tests and 95% confidence intervals.

Estimands

Let i index women, $Y_i \in \{0,1\}$ past-12-month physical and/or sexual IPV, $D_i \in \{0,1,2\}$ partner drunkenness, $W_i \in \{1, \dots ,5\}$ wealth quintile, R_i the weighted fractional wealth rank ordered poorest to richest, $\mathbf{X}_i$ the covariates and w_i the domestic-violence weight, with μ the weighted mean of Y.

The standard concentration index is twice the weighted covariance of the outcome with the fractional rank, scaled by the mean, and for an outcome bounded on [0,1] the Erreygers correction rescales it:

$$C = \frac{2}{\mu}\,\mathrm{Cov}_w(Y_i,\, R_i), \qquad E = 4\mu C \tag{1}$$

Negative values indicate concentration among poorer women. The interaction model was

$$\mathrm{logit}\Pr(Y_i = 1) = \alpha + \boldsymbol{\beta}^{\top}\mathbf{D}_i + \boldsymbol{\gamma}^{\top}\mathbf{W}_i + \boldsymbol{\delta}^{\top}(\mathbf{D}_i \otimes \mathbf{W}_i) + \boldsymbol{\theta}^{\top}\mathbf{X}_i \tag{2}$$

with effect modification tested as H_0: $\boldsymbol{\delta} = \mathbf{0}$. Because $\boldsymbol{\beta}$ describes the association within the reference quintile rather than a population-average association, interpretation uses standardised risks, which assign the exposure counterfactually while retaining each woman's observed covariates:

$$\hat{p}(d, v) = \frac{\sum_i w_i\, \widehat{\Pr}(Y_i{=}1 | D_i{=}d, W_i{=}v, \mathbf{X}_i)}{\sum_i w_i} \tag{3}$$

Writing $\hat{p}_{\mathrm{obs}}$ for the standardised risk under observed exposure and $\hat{p}_0$ for the risk after assigning all women to no drunkenness, the association-based population attributable fraction is

$$\mathrm{PAF} = \frac{\hat{p}_{\mathrm{obs}} - \hat{p}_0}{\hat{p}_{\mathrm{obs}}} \tag{4}$$

For the decomposition, a survey-weighted linear probability model represents $Y_i = \alpha + \sum_k \beta_k\, X_{ki} + \varepsilon_i$ with wealth entering only as the ranking variable. The concentration index then decomposes additively, and multiplying through by 4μ transfers it to the Erreygers scale, on which the mean cancels:

$$E \;=\; \sum_k 4\;\beta_k \bar{X}_k C_k \;+\; 4\,GC_\varepsilon \tag{5}$$

so determinant k contributes $4\beta_k \bar{X}_k C_k$, with percentage share $4\beta_k \bar{X}_k C_k / E \times 100$. Because $E < 0$, a determinant that reinforces pro-poor inequality has a negative contribution but a positive share. Finally, the poorest–richest gap attenuation is

$$\Delta \;=\; [\hat{p}_{\text{obs}}(1) - \hat{p}_{\text{obs}}(5)] - [\hat{p}_0(1) - \hat{p}_0(5)] \tag{6}$$

which rearranges to $\Delta = \text{AR}(1) - \text{AR}(5)$: the gap attenuation is identically the poorest-minus-richest difference in attributable risk, so the two are one estimate expressed in two ways.

Results

Sample characteristics

Table 1 presents the background characteristics of the 2024 analytic sample of 15,130 women, overall and by past-12-month physical and/or sexual intimate partner violence (IPV) status. Most women had primary education (65.4%), were currently working (54.5%), lived in rural areas (82.7%), and were married (58.5%). The mean age was 29.8 years (SE 0.11), and the mean number of children ever born was 2.76 (SE 0.03). Compared with women who reported no IPV, those reporting IPV had higher weighted proportions with primary education, rural residence, and membership in the two poorest wealth quintiles. They were also more likely to report a former husband or live-in partner as the referenced partner. Among women with available information, witnessing their father beat their mother was reported by 37.6% of women reporting IPV and 23.0% of those reporting

no IPV. Acceptance of wife-beating for at least one reason was reported by 26.1% and 15.8%, respectively. Partner drunkenness was also more common among women reporting IPV. A sometimes-drunk partner was reported by 24.2% of women with IPV, compared with 16.4% of women without IPV; the corresponding proportions for an often-drunk partner were 20.0% and 6.6%. These percentages are survey-weighted column proportions, shown alongside unweighted sample counts.

Table 1. Background characteristics of the 2024 analytic sample, overall and by IPV status

Characteristic	Overall (n=15,130)	No IPV (n=11,801)	IPV (n=3,329)
Age group, years			
15-19	1,816 (15.0)	1,429 (15.2)	387 (14.3)
20-24	3,302 (21.4)	2,507 (20.9)	795 (23.4)
25-29	2,889 (16.9)	2,208 (16.5)	681 (18.5)
30-34	2,432 (14.3)	1,879 (14.2)	553 (14.9)
35-39	1,966 (12.9)	1,574 (13.2)	392 (11.7)
40-44	1,606 (11.7)	1,296 (12.1)	310 (10.2)
45-49	1,119 (7.8)	908 (8.0)	211 (6.9)
Mean age, years (SE)	29.76 (0.11)	29.91 (0.12)	29.18 (0.21)
Mean children ever born (SE)	2.76 (0.03)	2.76 (0.03)	2.75 (0.05)
Woman's education			
No education	1,009 (7.4)	803 (7.6)	206 (6.5)
Primary	9,635 (65.4)	7,307 (63.7)	2,328 (71.3)
Secondary	3,989 (24.3)	3,249 (25.3)	740 (20.4)
Higher	497 (3.0)	442 (3.3)	55 (1.8)
Currently working			

Characteristic	Overall (n=15,130)	No IPV (n=11,801)	IPV (n=3,329)
No	6,932 (45.5)	5,461 (45.7)	1,471 (44.8)
Yes	8,198 (54.5)	6,340 (54.3)	1,858 (55.2)
Parity			
0	1,832 (14.7)	1,543 (15.7)	289 (11.2)
1-2	6,197 (38.5)	4,722 (37.5)	1,475 (42.0)
3-4	4,158 (25.4)	3,214 (25.2)	944 (26.3)
5 or more	2,943 (21.4)	2,322 (21.7)	621 (20.5)
Referenced partner			
Current husband/live-in partner	10,712 (66.7)	8,385 (67.3)	2,327 (64.7)
Current non-cohabiting intimate partner	1,161 (9.8)	1,000 (10.6)	161 (7.0)
Former husband/live-in partner	2,766 (19.4)	1,992 (17.7)	774 (25.7)
Former non-cohabiting intimate partner	491 (4.0)	424 (4.4)	67 (2.6)
Current marital status			
Never in union	1,652 (13.9)	1,424 (15.0)	228 (9.6)
Married	9,644 (58.5)	7,534 (58.7)	2,110 (57.5)
Living with partner	1,068 (8.3)	851 (8.6)	217 (7.2)
Widowed	417 (2.8)	359 (3.0)	58 (2.0)
Divorced	1,242 (8.8)	890 (8.0)	352 (11.4)
Separated	1,107 (7.8)	743 (6.6)	364 (12.3)
Household wealth quintile			
Poorest	2,912 (20.4)	2,163 (19.3)	749 (24.1)
Poorer	2,683 (19.2)	2,061 (18.6)	622 (21.4)
Middle	2,718 (19.2)	2,092 (19.2)	626 (19.1)
Richer	2,924 (18.9)	2,307 (19.5)	617 (16.9)
Richest	3,893 (22.3)	3,178 (23.4)	715 (18.5)
Residence			

Characteristic	Overall (n=15,130)	No IPV (n=11,801)	IPV (n=3,329)
Urban	3,372 (17.3)	2,733 (18.3)	639 (13.5)
Rural	11,758 (82.7)	9,068 (81.7)	2,690 (86.5)
Region			
Northern	3,046 (12.7)	2,252 (11.5)	794 (16.9)
Central	5,003 (42.8)	3,859 (42.0)	1,144 (46.0)
Southern	7,081 (44.5)	5,690 (46.6)	1,391 (37.1)
Father ever beat respondent's mother (n=13,715)			
No	10,085 (73.8)	8,255 (77.0)	1,830 (62.4)
Yes	3,630 (26.2)	2,451 (23.0)	1,179 (37.6)
Accepts wife-beating for at least one reason (n=14,833)			
No	12,355 (82.0)	9,894 (84.2)	2,461 (73.9)
Yes	2,478 (18.0)	1,668 (15.8)	810 (26.1)
Partner drunkenness			
No drunkenness	10,843 (72.5)	9,049 (77.1)	1,794 (55.8)
Sometimes drunk	2,832 (18.1)	1,979 (16.4)	853 (24.2)
Often drunk	1,455 (9.5)	773 (6.6)	682 (20.0)

Note. IPV denotes past-12-month physical and/or sexual intimate partner violence. Values are unweighted n with survey-weighted column percentages in parentheses, except for the two continuous rows, which are survey-weighted means with linearised standard errors. Percentages are calculated within column and sum to 100 within each characteristic. Denominators differ for the two variables with item missingness, as indicated.

Concentration of partner drunkenness and IPV by wealth quintile

The concentration curves showed that partner drunkenness and physical and/or sexual IPV were concentrated among poorer women (Figure 1). All three standard concentration indices were negative, indicating that each outcome was disproportionately concentrated toward the lower end of the household wealth distribution. The strongest concentration

was observed for often-drunk partners (C = −0.1260; 95% CI: −0.1699 to −0.0821), followed by physical and/or sexual IPV (C = −0.0822; 95% CI: −0.1092 to −0.0551) and sometimes/often-drunk partners (C = −0.0513; 95% CI: −0.0771 to −0.0254) (Table 2).

Table 2. Concentration indices for partner drunkenness and physical and/or sexual IPV, MDHS 2024

Indicator	Standard C (95% CI)	Erreygers E (95% CI)
Partner sometimes/often drunk	-0.0513 (-0.0771 to -0.0254)	-0.0565 (-0.0849 to -0.0280)
Partner often drunk	-0.1260 (-0.1699 to -0.0821)	-0.0477 (-0.0648 to -0.0306)
Physical or sexual IPV	-0.0822 (-0.1092 to -0.0551)	-0.0707 (-0.0947 to -0.0468)

Note. *Negative concentration indices indicate concentration among poorer women, since the wealth rank increases from poorest to richest. The Erreygers correction is applied to bounded binary indicators. Confidence intervals use 1,000 survey bootstrap replicates with the fractional wealth rank recalculated in each replicate.*

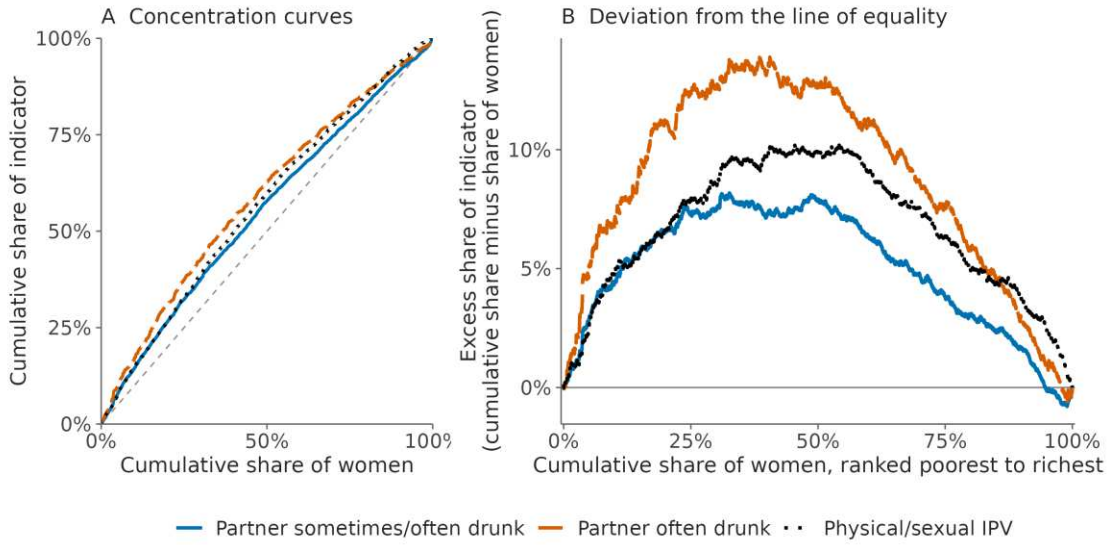


Figure 1. Socioeconomic concentration of partner drunkenness and IPV, MDHS 2024

Adjusted association of partner drunkenness and IPV with household wealth quintile

In the fully adjusted model (Model III), the odds of past-12-month physical and/or sexual IPV were higher among women reporting a sometimes-drunk or often-drunk partner than among women reporting no partner drunkenness, conditional on membership in the richest wealth quintile, the reference category for the interaction model (AOR = 1.50, 95% CI: 1.09–2.08, and AOR = 4.67, 95% CI: 3.15–6.93, respectively; Table 3). However, there was no statistically significant evidence that the association between partner drunkenness and IPV varied by household wealth. None of the eight partner-drunkenness-by-wealth interaction terms was statistically significant, and the global interaction tests were non-significant in Models I, II and III (p = 0.383, 0.503 and 0.508, respectively).

Table 3. Survey-weighted logistic regression of IPV on partner drunkenness, household wealth and their interaction, MDHS 2024

Term	Model I Unadjusted OR (95% CI)	Model II Adjusted OR (95% CI)	Model III Adjusted OR (95% CI)
Partner drunkenness (ref. no drunkenness)			
Sometimes drunk	1.69 (1.26-2.27)	1.61 (1.19-2.16)	1.50 (1.09-2.08)
Often drunk	4.68 (3.28-6.69)	4.47 (3.08-6.46)	4.67 (3.15-6.93)
Household wealth (ref. richest)			
Richer	1.03 (0.83-1.28)	0.80 (0.65-1.00)	0.82 (0.65-1.03)
Middle	1.19 (0.97-1.47)	0.88 (0.70-1.11)	0.90 (0.70-1.16)
Poorer	1.45 (1.15-1.82)	1.03 (0.80-1.32)	1.02 (0.79-1.33)

Term	Model I Unadjusted OR (95% CI)	Model II Adjusted OR (95% CI)	Model III Adjusted OR (95% CI)
Poorest	1.38 (1.13-1.69)	0.92 (0.73-1.15)	0.94 (0.73-1.20)
Woman's age, per year	-	0.97 (0.96-0.98)	0.97 (0.96-0.99)
Education (ref. no education)			
Primary	-	1.13 (0.90-1.43)	1.12 (0.88-1.43)
Secondary	-	0.91 (0.70-1.17)	0.95 (0.73-1.23)
Higher	-	0.75 (0.45-1.25)	0.91 (0.53-1.56)
Currently working	-	0.97 (0.88-1.08)	0.92 (0.82-1.03)
Parity, per birth	-	1.03 (0.98-1.07)	1.02 (0.97-1.07)
Marital status (ref. divorced)			
Living with partner	-	0.56 (0.35-0.90)	0.54 (0.32-0.92)
Married	-	0.65 (0.41-1.02)	0.65 (0.39-1.07)
Never in union	-	0.43 (0.29-0.63)	0.38 (0.25-0.59)
Separated	-	1.26 (0.97-1.64)	1.23 (0.93-1.61)
Widowed	-	0.59 (0.40-0.87)	0.62 (0.41-0.96)
Former partner (ref. current)	-	0.82 (0.54-1.23)	0.82 (0.52-1.29)
Rural residence (ref. urban)	-	1.29 (1.08-1.55)	1.20 (0.98-1.47)
Region (ref. Northern)			
Central	-	0.74 (0.60-0.90)	0.77 (0.62-0.95)
Southern	-	0.59 (0.49-0.71)	0.66 (0.54-0.81)
Father beat mother: yes	-	-	1.77 (1.56-2.01)
Accepts wife-beating for at least one reason	-	-	1.60 (1.35-1.90)
Drunkenness x wealth interaction			
Sometimes x Richer	1.35 (0.92-1.96)	1.34 (0.92-1.96)	1.35 (0.89-2.06)

Term	Model I Unadjusted OR (95% CI)	Model II Adjusted OR (95% CI)	Model III Adjusted OR (95% CI)
Often x Richer	1.01 (0.62-1.64)	0.95 (0.58-1.56)	0.80 (0.46-1.39)
Sometimes x Middle	1.39 (0.94-2.06)	1.39 (0.93-2.07)	1.43 (0.93-2.19)
Often x Middle	0.76 (0.46-1.25)	0.76 (0.45-1.27)	0.74 (0.42-1.32)
Sometimes x Poorer	1.14 (0.76-1.71)	1.14 (0.76-1.70)	1.30 (0.85-1.99)
Often x Poorer	0.71 (0.43-1.15)	0.75 (0.46-1.25)	0.71 (0.41-1.22)
Sometimes x Poorest	1.21 (0.85-1.73)	1.27 (0.89-1.83)	1.28 (0.85-1.91)
Often x Poorest	0.95 (0.61-1.48)	0.98 (0.62-1.55)	0.94 (0.57-1.54)
Unweighted n	15,130	15,130	13,452
Global interaction test	F=1.069; p=0.383	F=0.915; p=0.503	F=0.910; p=0.508

Note. The outcome is past-12-month physical and/or sexual IPV. Model I is unadjusted. Model II adjusts for age, education, current employment, parity, marital status, referenced partner status, residence and region. Model III additionally adjusts for witnessing parental violence and acceptance of wife-beating. The models account for the DHS domestic-violence weight, primary sampling unit and stratum. The reference categories are no partner drunkenness and the richest wealth quintile. The global interaction test is a design-based Wald test of the eight partner-drunkenness-by-wealth interaction terms.

In the poorest wealth quintile, standardised IPV risk was highest among women whose partners were often drunk (45.6%), followed by those whose partners were sometimes drunk (27.8%) and those reporting no partner drunkenness (17.1%) (Table 4). The same pattern was observed across all wealth quintiles, although the magnitude of the differences varied. Compared with no partner drunkenness, the risk difference for sometimes-drunk partners ranged from 6.5 to 12.6 percentage points, while that for often-drunk partners ranged from 22.7 to 30.6 percentage points (Figure 2). There was no statistically significant evidence of interaction between partner drunkenness and wealth on either the multiplicative scale (p = 0.508) or the additive scale (p = 0.317). The targeted interaction

tests were also non-significant for sometimes versus no drunkenness (p = 0.539), often versus no drunkenness (p = 0.602), and the ordinal drunkenness-by-wealth trend (p = 0.841).

Table 4. Standardised IPV risk by partner drunkenness and household wealth, MDHS 2024

Wealth quintile	No drunkenness, risk %	Sometimes, risk %; RD pp	Often, risk %; RD pp
Poorest	17.1 (15.1-19.1)	27.8 (23.5-32.1); +10.7 (6.0-15.3)	45.6 (38.8-52.5); +28.5 (21.8-35.2)
Poorer	18.3 (15.9-20.7)	29.7 (24.3-35.2); +11.5 (6.0-16.9)	41.0 (33.2-48.8); +22.7 (14.6-30.8)
Middle	16.5 (14.6-18.5)	29.2 (24.2-34.2); +12.6 (7.2-18.1)	39.3 (30.9-47.6); +22.7 (13.8-31.6)
Richer	15.3 (13.3-17.3)	26.3 (21.2-31.3); +11.0 (5.7-16.2)	38.9 (31.2-46.5); +23.6 (15.7-31.4)
Richest	18.0 (15.4-20.6)	24.4 (19.4-29.5); +6.5 (1.1-11.9)	48.6 (39.4-57.7); +30.6 (21.6-39.5)

Note. *Values are survey-standardised risks with 95% confidence intervals. RD is the within-wealth risk difference versus no partner drunkenness, in percentage points. Estimates are from the primary extended model (Model III in Table 3). Global multiplicative interaction p=0.508; additive-scale global interaction p=0.317.*

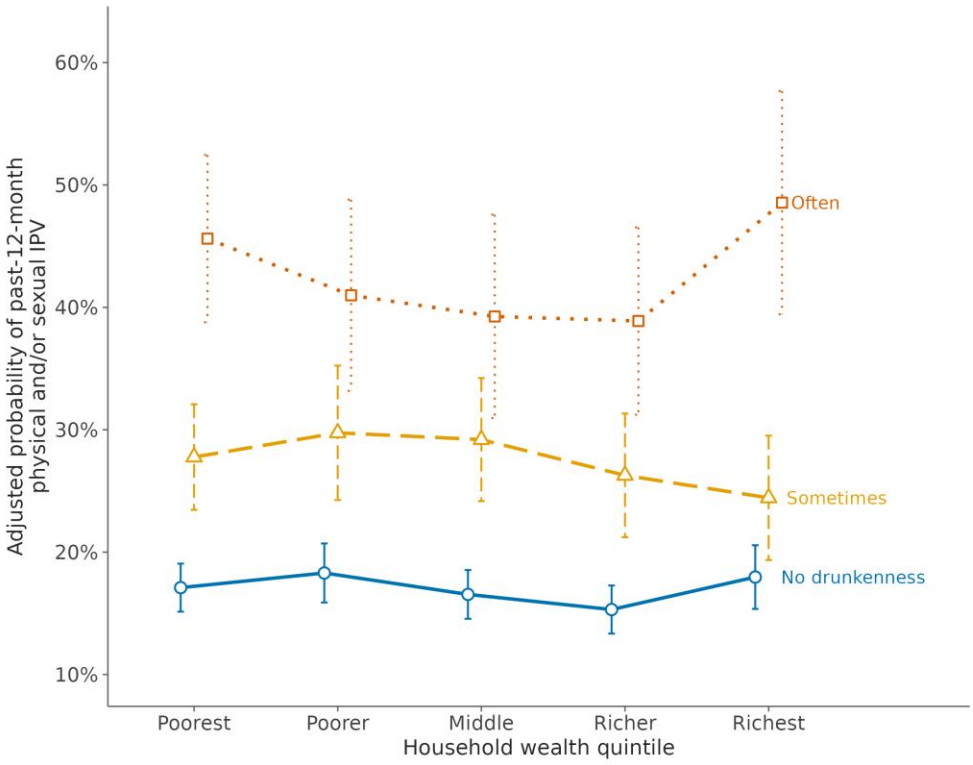


Figure 2. Adjusted IPV probability by partner drunkenness and household wealth. Survey-standardised probability of past-12-month physical and/or sexual IPV from the primary extended model. Error bars show 95% confidence intervals.

The difference-in-differences analyses provided no statistically significant evidence that the association between partner drunkenness and IPV differed between individual wealth quintiles and the richest quintile (Table 5). For sometimes versus no drunkenness, the estimated differences in risk differences ranged from 4.20 to 6.17 percentage points; for often versus no drunkenness, they ranged from −7.91 to −2.07 percentage points. All corresponding confidence intervals included zero, and the RERI estimates showed a similar pattern. The global test of all eight interaction terms was non-significant (F = 0.910, p = 0.508), as were the targeted tests for sometimes versus no drunkenness (F = 0.779, p =

0.539) and often versus no drunkenness (F = 0.686, p = 0.602). The ordinal drunkenness-by-wealth trend was also non-significant (F = 0.041, p = 0.841), as was the additive-scale interaction test from the survey-weighted linear probability model (p = 0.317). The trend model also bounds the modification more informatively than the individual contrasts: expressed as a poorest–richest comparison, the odds ratio for IPV per one-level increase in partner drunkenness among the poorest women was 1.02 times that among the richest (95% CI 0.82 to 1.27). On the absolute scale the individual contrasts remain imprecise, with 95% confidence limits spanning –20.5 to +13.6 percentage points across the eight contrasts; because these intervals are not centred on the null, their width is not a symmetric bound on what has been excluded.

Table 5. Difference-in-differences in standardised IPV risk by wealth quintile

Wealth	Contrast	Difference-in-differences, pp (95% CI)	RERI (95% CI)
Panel A			
Poorest	Sometimes vs No drunkenness	4.20 (-2.81 to 11.20)	0.234 (-0.150 to 0.617)
Poorest	Often vs No drunkenness	-2.07 (-13.37 to 9.22)	-0.115 (-0.745 to 0.514)
Poorer	Sometimes vs No drunkenness	4.98 (-2.60 to 12.55)	0.277 (-0.137 to 0.691)
Poorer	Often vs No drunkenness	-7.91 (-20.03 to 4.22)	-0.440 (-1.121 to 0.241)
Middle	Sometimes vs No drunkenness	6.17 (-1.26 to 13.60)	0.344 (-0.061 to 0.748)

Wealth	Contrast	Difference-in-differences, pp (95% CI)	RERI (95% CI)
Middle	Often vs No drunkenness	-7.88 (-20.49 to 4.73)	-0.439 (-1.146 to 0.268)
Richer	Sometimes vs No drunkenness	4.49 (-2.70 to 11.69)	0.250 (-0.146 to 0.646)
Richer	Often vs No drunkenness	-7.02 (-19.15 to 5.11)	-0.391 (-1.070 to 0.288)
Panel B			
Interaction test	**df (num, den)**	**F**	**P**
Omnibus test of all eight interaction terms (M2)	8, 681	0.910	0.508
Sometimes-vs-none interaction terms	4, 681	0.779	0.539
Often-vs-none interaction terms	4, 681	0.686	0.602
Ordinal drunkenness-by-wealth trend	1, 692	0.041	0.841

Note. *Panel A presents difference-in-differences and RERI estimates comparing each wealth quintile with the richest quintile. Panel B presents design-based Wald tests of the interaction. The additive-scale global test from the survey-weighted linear probability model was p = 0.317.*

Model-associated IPV burden linked to partner drunkenness

Under the observed exposure distribution, the overall standardised IPV risk was 21.5%, compared with 17.1% under the standardised no-drunkenness scenario. This corresponded to an attributed risk difference of 4.45 percentage points (95% CI: 3.76–5.15) and an association-based population attributable fraction (PAF) of 20.7% (95% CI: 17.6–23.8) (Table 6). The attributed risk difference was larger in the poorest quintile (6.32

percentage points; 95% CI: 4.65–7.99) than in the richest quintile (3.19 percentage points; 95% CI: 1.94–4.44). Their corresponding PAF estimates were 24.8% and 17.7%, respectively (Figure 3). The poorest quintile accounted for 29.4% of the total model-attributed burden, compared with 15.6% in the richest quintile. In the direct poorest–richest comparison, the difference in attributed IPV risk was 3.13 percentage points (95% CI: 1.01–5.25), whereas the difference in PAF was 7.14 percentage points (95% CI: −2.10 to 16.39). Thus, the attributed risk difference was greater in the poorest quintile, while the difference in PAF was not statistically distinguishable from zero. These estimates describe model-based associations under a standardised exposure scenario and should not be interpreted as causal effects or as the proportion of IPV that an intervention would prevent.

Table 6. Model-associated IPV burden linked to partner drunkenness, by wealth quintile

Group	Observed risk %	No-drunkenness risk %	Attributed risk, pp (95% CI)	PAF % (95% CI)	Burden share %
Panel A. Standardised risks, attributable risk and PAF by wealth quintile					
Overall	21.5	17.1	4.45 (3.76-5.15)	20.7 (17.6-23.8)	100.0
Poorest	25.4	19.1	6.32 (4.65-7.99)	24.8 (18.7-31.0)	29.4
Poorer	23.7	19.3	4.44 (2.91-5.96)	18.7 (12.5-24.9)	19.1

Group	Observed risk %	No-drunkenness risk %	Attributed risk, pp (95% CI)	PAF % (95% CI)	Burden share %
Middle	21.6	17.1	4.56 (3.00-6.12)	21.1 (14.0-28.2)	19.7
Richer	18.9	15.1	3.79 (2.50-5.07)	20.1 (13.4-26.8)	16.2
Richest	18.0	14.8	3.19 (1.94-4.44)	17.7 (10.8-24.6)	15.6

Panel B. Direct poorest-richest burden contrasts

Contrast	Estimate	95% CI	Unit
PAF: poorest minus richest	7.14	-2.10 to 16.39	percentage points of PAF
Attributed IPV risk: poorest minus richest	3.13	1.01 to 5.25	percentage points of IPV risk

Note. *PAFs and attributable risks are model-based, association-dependent estimates from the primary extended model. The standardised no-drunkenness scenario sets partner drunkenness to the reference category while retaining the observed covariate distribution. Confidence intervals are from 1,000 survey bootstrap replicates. Burden share is the share of total model-attributed weighted IPV burden. The poorest-richest attributable-risk difference in Panel B is arithmetically identical to the gap attenuation reported in Table 7 (equation 6).*

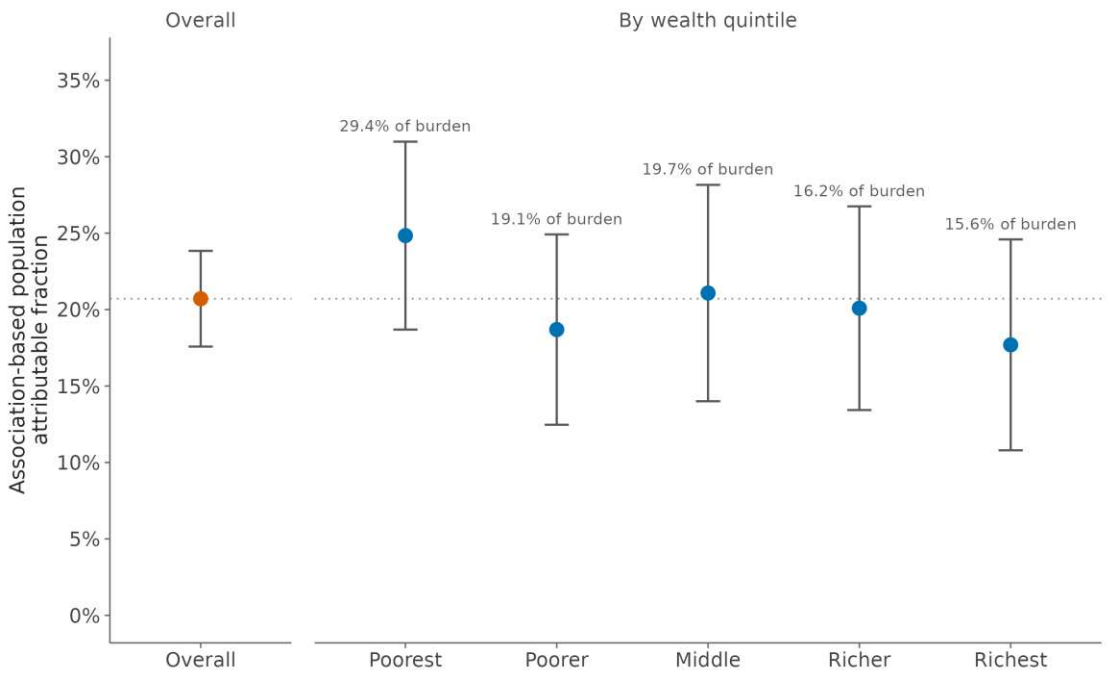


Figure 3. Association-based population attributable fraction by household wealth. Wealth-specific model-associated PAFs for past-12-month physical and/or sexual IPV linked to partner drunkenness. Error bars show 95% confidence intervals from 1,000 survey bootstrap replicates.

Contribution of partner drunkenness to wealth-related inequality in IPV

The Erreygers concentration index for physical and/or sexual IPV was −0.0688 (95% CI: −0.0927 to −0.0449) in the decomposition sample (Table 7). Partner drunkenness contributed −0.0135 (95% CI: −0.0193 to −0.0077), accounting for 19.6% (95% CI: 8.4–30.8) of the observed inequality. This was the second-largest measured contribution after marital status (23.5%; 95% CI: 10.8–36.2) (Figure 4). Wife-beating attitudes accounted for 12.0% (95% CI: 5.1–18.9), and woman's age accounted for 7.0% (95% CI: 2.2–11.8). Region offset part of the pro-poor inequality, with a contribution of −5.6% (95% CI: −11.2 to −0.1).

Although woman's education and urban/rural residence had sizeable point estimates, their confidence intervals included zero, so their contributions were not statistically distinguishable from zero. Witnessing parental violence likewise had a confidence interval spanning zero and should not be presented as an established contributor to wealth-related inequality. Under the observed exposure distribution, the standardised poorest–richest IPV risk gap was 7.42 percentage points (95% CI: 4.22–10.63). Under the standardised no-drunkenness scenario, the gap was 4.29 percentage points (95% CI: 1.06–7.53). The difference was 3.13 percentage points (95% CI: 1.01–5.25), equivalent to 42.2% (95% CI: 10.2–74.2) of the observed gap. The remaining gap indicates that standardising partner drunkenness alone did not eliminate the modelled wealth disparity. The 19.6% decomposition contribution and 42.2% gap attenuation represent distinct estimands: the former concerns inequality across the full wealth distribution, whereas the latter concerns the poorest–richest contrast.

Table 7. Decomposition of wealth-related inequality in physical/sexual IPV and attenuation of the poorest-richest gap

Component	Erreygers contribution (95% CI)	Share of observed inequality, % (95% CI)
Panel A. Decomposition of the Erreygers index (observed E=-0.0688, 95% CI -0.0927 to -0.0449)		
Partner drunkenness	-0.01350 (-0.01927 to -0.00773)	19.6 (8.4 to 30.8)
Marital status	-0.01617 (-0.02214 to -0.01019)	23.5 (10.8 to 36.2)
Woman's education	-0.01050 (-0.02146 to 0.00045)	15.3 (-0.9 to 31.4)

Component	Erreygers contribution (95% CI)	Share of observed inequality, % (95% CI)
Urban/rural residence	-0.01000 (-0.02203 to 0.00204)	14.5 (-2.1 to 31.2)
Wife-beating attitudes	-0.00825 (-0.01219 to -0.00430)	12.0 (5.1 to 18.9)
Woman's age	-0.00480 (-0.00783 to -0.00177)	7.0 (2.2 to 11.8)
Parity	-0.00166 (-0.00637 to 0.00304)	2.4 (-4.7 to 9.6)
Employment	-0.00042 (-0.00118 to 0.00034)	0.6 (-0.5 to 1.8)
Witnessed parental violence	0.00097 (-0.00149 to 0.00343)	-1.4 (-5.3 to 2.5)
Current/former partner	0.00143 (-0.00214 to 0.00500)	-2.1 (-7.6 to 3.4)
Region	0.00388 (0.00060 to 0.00715)	-5.6 (-11.2 to -0.1)
Residual / unexplained	-0.00978 (-0.02611 to 0.00654)	14.2 (-7.8 to 36.2)
Panel B. Poorest-richest adjusted IPV gap under exposure standardization	Estimate (95% CI)	
Observed poorest-richest gap	7.42 pp (4.22 to 10.63)	
Gap under no-drunkenness scenario	4.29 pp (1.06 to 7.53)	
Absolute gap attenuation	3.13 pp (1.01 to 5.25)	
Share of observed gap accounted for by drunkenness	42.2% (10.2 to 74.2)	

Note. *Contributions are on the Erreygers scale. Because the observed index is negative, a determinant that reinforces pro-poor inequality has a negative contribution but a positive percentage share. The sign of the Erreygers contribution indicates whether the determinant reinforces (negative) or offsets (positive) the observed pro-poor inequality. Blocks are ordered by the absolute size of their contribution. Bootstrap confidence intervals use 1,000 survey replicates with the wealth rank recalculated in each replicate. The observed Erreygers index differs marginally from the value in Table 2 (-0.0707) because the decomposition is estimated on the M2 complete-case sample (n = 13,452) rather than the full analytic sample (n = 15,130). The decomposition and gap attenuation are statistical, model-based quantities and should not be interpreted as causal mediation or as the proportion of IPV that an intervention would prevent.*

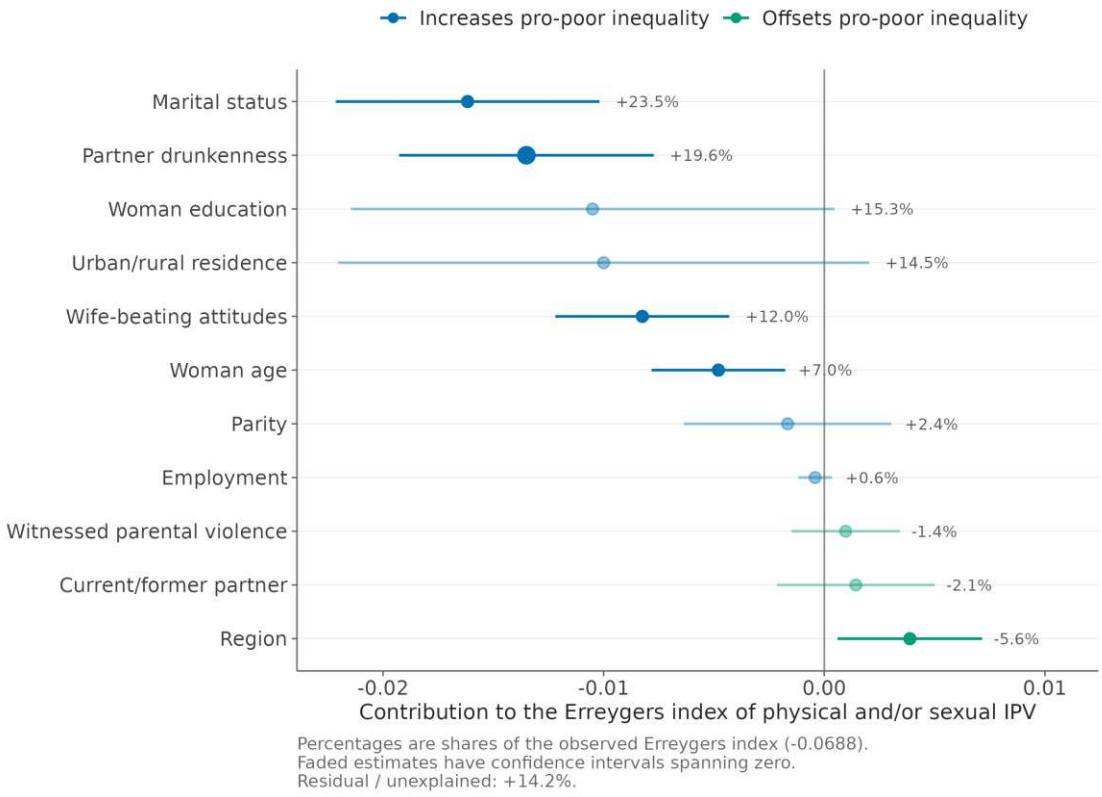


Figure 4. Contributors to wealth-related inequality in physical/sexual IPV. Absolute contributions to the Erreygers index from the measured determinant blocks.

Robustness, secondary outcomes and replication

The robustness analyses showed that the association between partner drunkenness and intimate partner violence (IPV) remained consistent across alternative model

specifications and subgroups, with no statistically significant evidence of socioeconomic effect modification (Table 8, Panel A). The interaction between partner drunkenness and household wealth was not statistically significant in the binary exposure model (p=0.686). Similarly, there was no evidence that the association varied by women's education (p=0.286) or urban/rural residence (p=0.275); the wealth-interaction result was also similar after excluding pregnant women (p=0.505). The findings were also consistent after adjusting for controlling behaviour (p=0.211), restricting the analysis to women with a current husband or live-in partner and including additional covariates (p=0.709), examining severe physical IPV (p=0.961) and emotional IPV (p=0.449), and using multiple imputation (p=0.523). These results support the consistency of the association across the examined specifications, although they do not establish that the association is identical across all groups.

Table 8. Robustness analyses and secondary interaction tests

Panel A. Global interaction tests across robustness specifications

Analysis	n	Statistic	Df	p value
Primary M2: drunkenness x wealth	13,452	F=0.910	8, 681	0.508
Binary D113 partner drinking x wealth	13,452	F=0.568	4, 686	0.686
Drunkenness x woman's education	13,452	F=1.235	6, 683	0.286
Exclude currently pregnant women	12,505	F=0.913	8, 681	0.505
Add controlling behaviour (sensitivity)	13,452	F=1.360	8, 680	0.211
Current husband/live-in partner + partner/union covariates	9,299	F=0.680	8, 680	0.709
Severe physical IPV: drunkenness x wealth	13,452	F=0.313	8, 681	0.961
Emotional IPV: drunkenness x wealth	13,452	F=0.982	8, 681	0.449

Analysis	n	Statistic	Df	p value
Drunkenness x urban/rural residence	13,452	F=1.295	2, 687	0.275
Multiple imputation: drunkenness x wealth	15,130	Chi-square=7.127	8	0.523

The magnitude of the association is further illustrated by the standardised risks and risk ratios presented in Table 8, Panel B. Compared with women reporting no partner drunkenness, the standardised IPV risk was higher among women whose partners were sometimes drunk (27.5% versus 17.1%; RR = 1.61, 95% CI: 1.45–1.78) and substantially higher among those whose partners were often drunk (42.8% versus 17.1%; RR = 2.51, 95% CI: 2.27–2.77). The corresponding E-values were 2.60 for sometimes drunkenness and 4.45 for often drunkenness, with confidence-limit E-values of 2.27 and 3.97, respectively. These values indicate the strength of an unmeasured confounder's association with both exposure and outcome that would be required, under the E-value assumptions, to explain away the observed associations. They do not rule out reverse causation, reporting differences, selection bias or measurement error.

Panel B. Standardised risk ratios and E-values

Contrast	Exposed risk %	Reference risk %	RR (95% CI)	E-value	CI-bound E-value
Sometimes vs No drunkenness	27.5	17.1	1.61 (1.45 to 1.78)	2.60	2.27
Often vs No drunkenness	42.8	17.1	2.51 (2.27 to 2.77)	4.45	3.97

The findings were also examined using the 2015–16 Malawi Demographic and Health Survey (MDHS) to assess whether the main patterns were evident in an earlier survey

round. The prevalence of women reporting that their partners were sometimes or often drunk was similar in 2015–16 and 2024 (28.8% and 29.5%, respectively), as was the prevalence of often drunkenness (10.8% and 10.5%). The prevalence of physical or sexual IPV was 24.1% in 2015–16 and 22.6% in 2024. In both rounds, partner drunkenness and IPV were concentrated among poorer women, as indicated by negative standard concentration indices (Table 9, Panel B). For sometimes/often partner drunkenness, the standard concentration index was −0.0760 (95% CI: −0.1132 to −0.0388) in 2015–16 and −0.0560 (95% CI: −0.0798 to −0.0322) in 2024. The corresponding standard concentration indices for IPV were −0.0738 (95% CI: −0.1216 to −0.0260) and −0.0722 (95% CI: −0.0984 to −0.0460). The standardised risks also showed a dose gradient in both survey rounds (Table 9). In 2015–16, the standardised IPV risk was 17.1% among women reporting no partner drunkenness, 33.0% among those whose partners were sometimes drunk (RR = 1.93, 95% CI: 1.65–2.25), and 53.7% among those whose partners were often drunk (RR = 3.14, 95% CI: 2.72–3.63). In the matched 2024 sample, the corresponding risks were 17.7%, 28.9% (RR = 1.63, 95% CI: 1.48–1.80) and 43.0% (RR = 2.43, 95% CI: 2.19–2.69). Although the magnitude of the associations differed between rounds, the overall pattern was similar: standardised IPV risk was higher with greater reported frequency of partner drunkenness. The wealth interaction was not statistically significant in either the 2015–16 analysis (p=0.141) or the matched 2024 analysis (p=0.736).

Table 9. Matched-denominator replication in the 2015-16 and 2024 MDHS

Panel A. Weighted prevalence

Indicator	2015-16 % (95% CI)	2024 matched % (95% CI)

Indicator	2015-16 % (95% CI)	2024 matched % (95% CI)
Partner drinks alcohol	30.9 (29.0 to 32.7)	31.1 (29.8 to 32.4)
Partner sometimes/often drunk	28.8 (27.0 to 30.5)	29.5 (28.3 to 30.8)
Partner often drunk	10.8 (9.5 to 12.0)	10.5 (9.8 to 11.2)
Physical/sexual IPV past 12 months	24.1 (22.5 to 25.8)	22.6 (21.5 to 23.6)
Severe physical IPV past 12 months	6.8 (5.8 to 7.8)	8.3 (7.7 to 9.0)
Emotional IPV past 12 months	23.0 (21.4 to 24.7)	19.5 (18.6 to 20.5)

448 Panel B. Concentration indices

Indicator	2015-16 C (95% CI)	2024 matched C (95% CI)
Partner sometimes/often drunk	-0.0760 (-0.1132 to -0.0388)	-0.0560 (-0.0798 to -0.0322)
Partner often drunk	-0.1296 (-0.1984 to -0.0607)	-0.1104 (-0.1533 to -0.0675)
Physical/sexual IPV past 12 months	-0.0738 (-0.1216 to -0.0260)	-0.0722 (-0.0984 to -0.0460)

449 Panel C. Standardised overall IPV risks and risk ratios

Drunkenness	2015-16 risk % (95% CI)	2015-16 RR	2024 risk % (95% CI)	2024 RR
No drunkenness	17.1 (15.3 to 18.9)	Reference	17.7 (16.6 to 18.8)	Reference
Sometimes	33.0 (29.2 to 36.8)	1.93 (1.65 to 2.25)	28.9 (26.5 to 31.2)	1.63 (1.48 to 1.80)
Often	53.7 (48.4 to 59.1)	3.14 (2.72 to 3.63)	43.0 (39.4 to 46.6)	2.43 (2.19 to 2.69)

450 *Note. Global wealth-by-drunkenness interaction: 2015-16 F=1.535, p=0.141; matched 2024 F=0.650, p=0.736. Separate-round estimates are*
451 *consistency analyses and do not test temporal change.*

452 Figure 5 presents the standardised IPV risks by partner drunkenness and household
453 wealth in the matched 2015–16 and 2024 samples. The figure illustrates the higher
454 predicted risks associated with more frequent partner drunkenness across wealth groups,
455 without clear statistical evidence that the association differed by wealth. Figure 6 compares
456 the Erreygers concentration indices for partner drunkenness and IPV across the two

survey rounds using a common scale. The negative indices in both rounds show that both outcomes were disproportionately concentrated among poorer women. These comparisons demonstrate consistency in the broad patterns across survey rounds; they should not, however, be interpreted as formal tests of change over time.

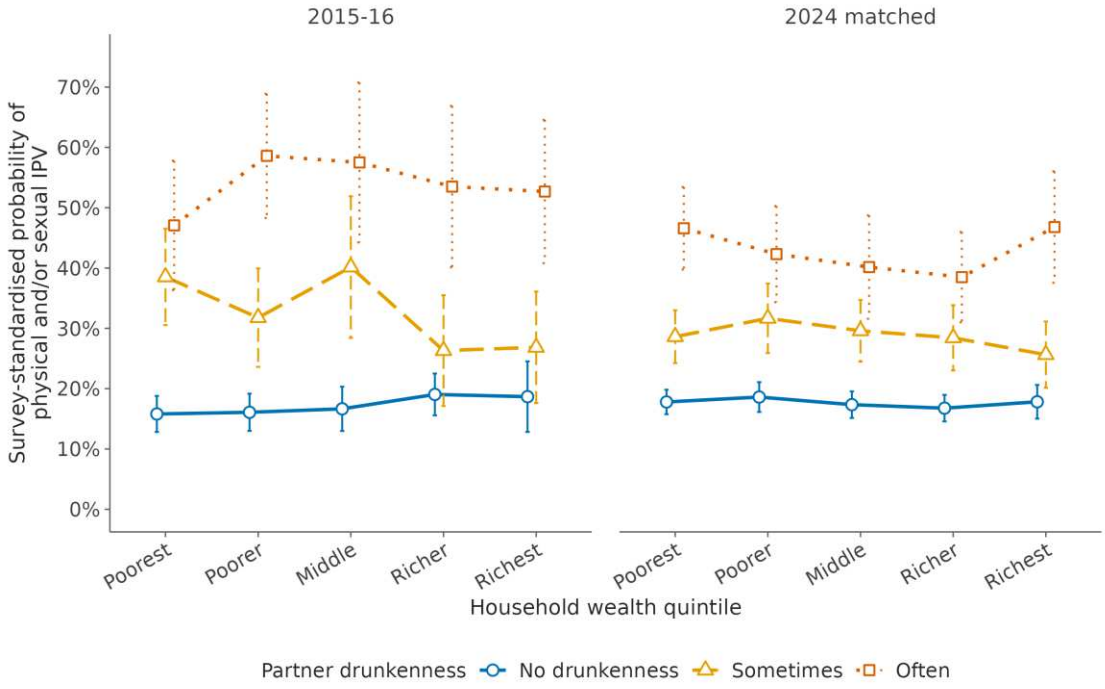


Figure 5. Adjusted IPV risk in matched 2015-16 and 2024 samples. Survey-standardised past-12-month physical and/or sexual IPV risks by partner drunkenness and household wealth in the matched replication samples. Error bars show 95% confidence intervals. The surveys were estimated separately; the figure is not a formal trend test.

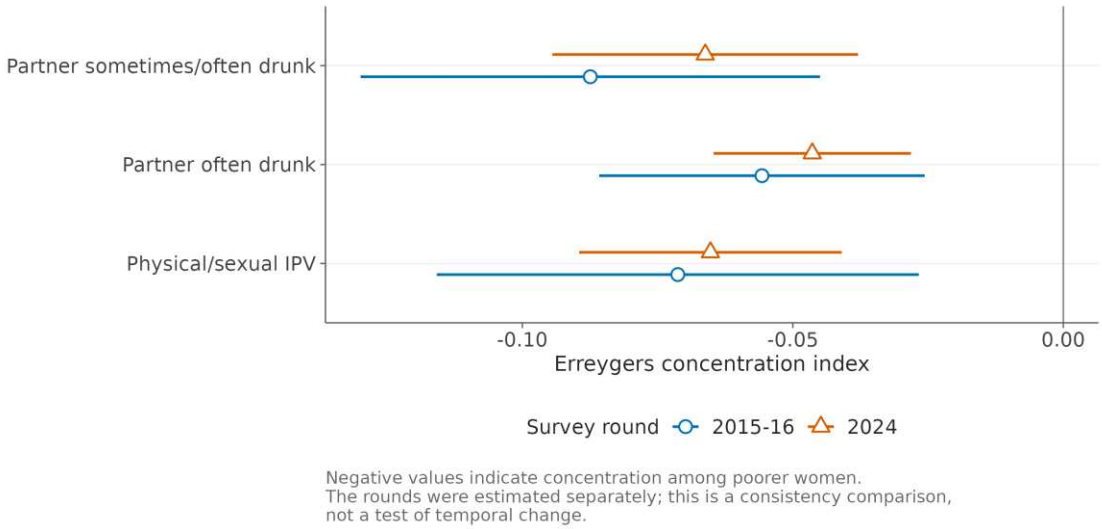


Figure 6. Erreygers concentration indices in the matched 2015-16 and 2024 samples. Negative values indicate concentration among poorer women. Both rounds are shown on a common scale. The rounds were estimated separately; this is a consistency comparison, not a test of temporal change.

Discussion

This study found a graded association between partner drunkenness and physical and/or sexual intimate partner violence (IPV), with higher standardised IPV risks among women whose partners were sometimes or often drunk than among those whose partners were not drunk. The association was strongest for frequent drunkenness. This pattern is consistent with evidence from Malawi and other sub-Saharan African settings (16,30,31). Repeated drunkenness may be associated with disinhibition, conflict over household resources and relationship difficulties, which have been described as possible pathways linking alcohol use to violence among couples in Durban (13). The stronger association

observed for frequent drunkenness than in studies using a simple measure of whether a partner drinks (10,11,18) may reflect differences between occasional alcohol consumption and repeated episodes of drunkenness. A similar distinction has been reported in high-income settings, where heavy and dependent drinking showed stronger associations with violence towards partners than occasional drinking (15). However, the cross-sectional design does not establish the temporal ordering of partner drunkenness and IPV, and the combined outcome of physical and sexual IPV does not allow us to determine whether the observed association differs by type of violence. This distinction is relevant given findings from central Malawi linking partner alcohol use specifically with sexual violence (17). The findings highlight the importance of distinguishing the frequency of partner drunkenness when examining its association with IPV.

Partner drunkenness and IPV were both disproportionately concentrated among poorer women, with the strongest socioeconomic concentration observed for frequent drunkenness. The greater burden of IPV among women in poorer households is consistent with evidence from Malawi, South Africa and other sub-Saharan African settings (18,32). The socioeconomic distribution of partner drunkenness also resembles the pattern described in the alcohol harm paradox, whereby disadvantaged groups may experience greater alcohol-related harm despite similar or lower levels of alcohol consumption than more advantaged groups (33,34). However, this literature largely examines harms experienced by drinkers themselves, and the mechanisms underlying socioeconomic differences remain debated (23). In the context of IPV, financial strain and conflict over a partner's inability to provide may be relevant, as suggested by evidence from Tanzania (35). Nevertheless, greater individual resources do not necessarily protect women from

abuse, as reported by Cools and Kotsadam (6). The concentration indices therefore describe how partner drunkenness and IPV are distributed across the wealth gradient; they do not establish that household wealth itself protects women from violence or explain why these socioeconomic patterns occur.

The association between partner drunkenness and IPV did not vary detectably by household wealth. Although the standardised risks differed across wealth groups, the formal interaction tests did not provide sufficient evidence that the association was stronger or weaker in any particular quintile. This finding contrasts with Greene and colleagues (10), who reported a stronger association among women of lower socioeconomic status across 14 sub-Saharan African countries. It is more consistent with evidence from Uganda, where partner drunkenness was associated with sexual IPV irrespective of disability status (31), and a meta-analysis that found no evidence of interaction between men's alcohol use and masculine norms in relation to IPV perpetration (36). Differences in study populations, study design and the measurement of partner alcohol use may partly account for these contrasting findings. Importantly, the absence of statistically detectable effect modification in this study should not be interpreted as proof that the association is identical across wealth groups. Rather, the analyses did not establish a statistically significant difference in the association by household wealth. The robustness checks also found no clear evidence of modification by women's education, residence or the other examined subgroups and model specifications.

Although the association between partner drunkenness and IPV did not vary detectably by wealth, partner drunkenness was more common among poorer women and was

statistically associated with the socioeconomic distribution of IPV. In the inequality decomposition, partner drunkenness accounted for 19.6% of the observed wealth-related inequality in IPV, with a confidence interval excluding zero. This estimate describes the contribution of partner drunkenness to the measured inequality under the specified model; it does not mean that eliminating drunkenness would necessarily reduce IPV inequality by 19.6%. Similarly, the model-based no-drunkenness scenario produced an association-based population attributable fraction (PAF) of 20.7%, representing the proportion of the modelled IPV burden associated with partner drunkenness under that scenario. This estimate should not be interpreted as the proportion of IPV that would certainly be prevented by an intervention, because the analysis cannot establish causality or fully account for unmeasured confounding and reverse causation.

The inequality analysis also estimated that the modelled poorest–richest IPV risk gap would be 42.2% smaller under the no-drunkenness scenario than under the observed exposure distribution. This estimate differs from the 19.6% contribution to the full-distribution Erreygers concentration index because the two measures address different aspects of inequality: one concerns the overall socioeconomic distribution of IPV, while the other concerns the difference in modelled risks between the poorest and richest quintiles. Neither estimate represents a causal effect. Other characteristics, including marital status and acceptance of wife-beating, also contributed to the observed wealth-related inequality. The estimated contribution of witnessing parental violence was less precise, and its confidence interval included zero; it should therefore not be treated as an established contributor to inequality in this analysis. Previous research has linked gender attitudes and childhood exposure to violence with IPV in Ethiopia and South Africa (37,38). Couple-level

549 evidence also suggests that IPV is less common when both partners reject its acceptability
550 (39). These findings are consistent with an ecological perspective in which individual,
551 relationship and wider social circumstances are relevant to understanding IPV (40). Taken
552 together, the results suggest that partner drunkenness is relevant to both the burden and
553 socioeconomic distribution of IPV, but it represents only one part of a wider pattern of
554 inequality.

555 The robustness analyses and replication using the 2015–16 Malawi Demographic and
556 Health Survey (MDHS) provide additional context for interpreting these findings. The
557 association between partner drunkenness and IPV remained evident across alternative
558 model specifications, and the earlier survey showed a similar pattern of increasing
559 standardised IPV risk with more frequent partner drunkenness. Partner drunkenness and
560 IPV were also disproportionately concentrated among poorer women in both survey
561 rounds. These consistencies suggest that the main patterns are not confined to the 2024
562 survey or to a single model specification. However, the comparisons between survey
563 rounds were not formal tests of temporal change, and differences in estimates should not
564 be interpreted as evidence that the association strengthened or weakened over time. The
565 E-values from the sensitivity analysis also indicate the strength of an unmeasured
566 confounder that would be required to explain away the observed risk-ratio associations
567 under the method's assumptions. They do not rule out reverse causation, differential
568 reporting, selection bias, measurement error or other sources of bias. The robustness
569 analyses therefore strengthen confidence in the consistency of the observed associations,
570 but do not establish a causal relationship.

Strengths and limitations

The use of the Malawi Demographic and Health Survey (MDHS) limits the type of analysis and inferences that can be made from the findings. Due to the cross-sectional nature of the data, we were unable to establish a causal relationship between partner drunkenness and intimate partner violence (IPV), or determine the temporal ordering of these experiences. As a secondary data analysis, we were also unable to examine factors not adequately captured in the survey, including the influence of cultural norms, relationship dynamics and drinking patterns beyond the reported frequency of partner drunkenness. Both partner drunkenness and IPV were self-reported, creating the possibility of recall and social desirability bias. Residual confounding may also have influenced the observed associations despite adjustment for measured characteristics. Furthermore, the inequality decomposition and standardisation analyses depend on the specified models and available variables; their estimates should therefore be interpreted as measures of statistical association rather than causal effects. Notwithstanding these limitations, the use of a nationally representative survey provides evidence on the relationship between partner drunkenness and IPV across the wealth distribution in Malawi. The analysis examined both the association with IPV risk and the contribution of partner drunkenness to observed socioeconomic inequality, providing complementary perspectives on the distribution of violence. The robustness analyses, including alternative model specifications and the replication using the 2015–16 MDHS, further assessed the consistency of the findings. Together, these analyses provide a useful basis for understanding the relationship between

partner drunkenness, IPV and socioeconomic inequality in Malawi, while recognising the limits of cross-sectional data for causal inference.

Policy implications

The findings point to a need for alcohol-related and IPV prevention strategies to be considered together in Malawi. Partner drunkenness was associated with IPV across wealth groups and was more common among poorer women, meaning that alcohol-related IPV interventions may have important distributional implications even where the strength of the association does not differ by wealth. Experience with alcohol-control measures in Malawi illustrates the challenges of relying on alcohol policy alone. The implementation and perceived effectiveness of the 2017 sachet alcohol ban have been contested (41). At the same time, evidence from Malawi suggests that interventions addressing economic and relationship factors can reduce violence among couples living with HIV, although that population differs from the broader population studied here (42). Prevention strategies should therefore combine attention to alcohol-related risk with approaches addressing relationship dynamics, gender norms and economic vulnerability. Given the concentration of partner drunkenness and IPV among poorer women, the distribution of intervention benefits should also be assessed rather than relying only on overall population effects.

Conclusions

In Malawi, partner drunkenness and intimate partner violence (IPV) were common and disproportionately concentrated among poorer women. Standardised IPV risk was higher

at greater levels of partner drunkenness, but there was no statistically significant evidence that household wealth modified this association. The observed inequality was consistent with the unequal socioeconomic distribution of partner drunkenness, without clear evidence of stronger wealth-specific associations among poorer women. Harmful partner alcohol use is therefore relevant to socioeconomic inequalities in IPV, but addressing alcohol-related risk alone is unlikely to eliminate them without attention to broader determinants, including poverty and gender norms that tolerate violence. Integrated alcohol-control and IPV-prevention strategies, with particular attention to disadvantaged women, are needed. Longitudinal studies and improved measures of partner alcohol use are warranted to strengthen evidence on temporality and intervention effectiveness.

List of abbreviations

CI: confidence interval or concentration index, as specified in context

DHS: Demographic and Health Survey

IPV: intimate partner violence

LMIC: low- and middle-income country

MDHS: Malawi Demographic and Health Survey

PAF: population attributable fraction

RERI: relative excess risk due to interaction

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

WHO: World Health Organization

Supplementary information

All tables and figures supporting the analyses are presented in the main article.

Additional file 1 — Variable definitions and cross-round harmonisation. File format: .docx (Microsoft Word). Description: a single table listing every analysis variable, the DHS source variable used in each of the 2024 and 2015–16 recodes, and its operationalisation, together with a note on the one construct that could not be harmonised across rounds.

Additional file 2 — Complete R analysis code. File format: .R (plain-text R script, readable in any text editor or in R, https://www.r-project.org). Description: the 19 analysis scripts concatenated in run order, covering variable construction, descriptive, concentration, regression, attributable-fraction, decomposition, robustness and replication analyses, and the generation of the figures and tables. Each script is delimited by labelled markers recording its length and SHA256 checksum, and the file carries a short routine that writes the scripts back out and verifies them. Random seeds are stated in the header.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. It used secondary, de-identified data from the 2024 and 2015-16 Malawi Demographic and Health Surveys. The original survey protocols received ethical approval from Malawi's

National Health Sciences Research Committee and the ICF Institutional Review Board, and informed consent was obtained from respondents before interview. The domestic-violence modules were administered under DHS privacy and safety procedures, which follow the World Health Organization's ethical and safety recommendations for research on domestic violence against women, including the random selection of one eligible woman per household and administration of the module only where complete privacy could be assured. Access to the anonymised microdata was granted by The DHS Program following registration and approval of the research project. The present analysis involved no direct participant contact and used no personally identifiable information.

Consent for publication

Not applicable. The manuscript contains no identifiable individual-level information.

Availability of data and materials

The datasets analysed during the current study are available from The DHS Program following registration and approval of a research request. Access was obtained through the standard DHS registration and approval process; no access privileges unavailable to other qualified researchers were used. The specific files analysed were the 2024 and 2015-16 Malawi individual recode datasets (43,44). The DHS Program does not issue digital object identifiers for its survey datasets, and under its data-use agreement the raw microdata cannot be redistributed by the authors, so they are not deposited with this article. All derived results necessary to interpret, replicate and build on the analyses are reported in

the article itself. The complete R analysis code, including the variable-construction, diagnostic and reporting scripts, is provided as Additional file 2.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SAM: Conceptualisation, Data curation, Formal analysis, Methodology, Software, Validation, Visualisation, Writing - original draft, Writing - review and editing. RM: Visualisation, Writing - original draft, Writing - review and editing. MR: Validation, Visualisation, Writing - original draft, Writing - review and editing. RG: Validation, Writing - review and editing. All authors read and approved of the final manuscript.

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