



## Women's empowerment and child nutrition in South-Central Asia; how important is socioeconomic status?

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### ABSTRACT

Women's empowerment has been identified as an important strategy for improving children's nutrition outcomes in many settings. Empowerment indexes that are built from cross-country routine surveys are increasingly being developed, and further disaggregated analyses of such indexes are needed to examine in-depth, the relationship between women's empowerment and outcomes including children's nutrition. The Demographic and Health Surveys across five countries in South-Central Asia was used to examine the relationship between women's empowerment and children's nutrition outcomes. Empowerment was measured using the three domains (attitude to violence, social independence, and decision-making) in the Survey-based Women's Empowerment (SWPER) index. Main and interaction effects between the SWPER domains and women's wealth index were examined to check if there is a differential positive impact of empowerment for poorer women on children's nutrition outcomes. Outcome measures were children's height-for-age, weight-for-age, and weight-for-height z-scores. Marginal effects of logistic regression and OLS were used to examine main effects and linear probability models and OLS for interaction effects. Analyses were cluster-adjusted, sample-weighted, and important control variables were included. Significance was established at 95% and 99% confidence intervals. In South-Central Asia, to reduce stunting wasting and underweight rates, empowering women through improving their social independence and decision-making power might be important. Furthermore, targeting poorer women for empowerment in social independence and decision-making appears to confer positive benefits towards the reduction of stunting, wasting, and underweight rates in children. However, the main and interaction effects of women's empowerment and wealth index on children's nutrition outcomes vary across the countries examined. These variations suggests that exogenous contextual factors might play a role in the empowerment-nutrition and empowerment-wealth-nutrition associations and interactions.

### Introduction

Children's nutrition outcomes are areas of high priority in human development due to the short-, middle, and long-term effects of adverse nutrition outcomes, which include stunting, wasting, and underweight (Assaf & Pullum, 2018; Mahy, 2003; Walker et al., 2007; World Health Organization, 2018). These effects include impaired cognitive development (Walker et al., 2007), growth faltering (Caulfield et al., 2006), restricted future economic potential (Hoddinott et al., 2013), and increased burden of noncommunicable diseases (Sawaya et al., 2004).

Empowering women as primary caregivers has been identified as a key strategy to achieve better nutrition outcomes for children (Malhotra et al., 2002, pp. 1–59; Onah, 2020). To this end, numerous attempts have been made to define and conceptualise women's empowerment (Alsop et al., 2006; Kabeer, 2001). There is consensus that

empowerment is a complex, relational, and multidimensional concept however, there is yet no consensus on how it should be measured and on which domains and indicators are most relevant for specific outcomes including children's nutrition (Ewerling et al., 2019; Ibrahim & Alkire, 2007; Kabeer, 1999; Malhotra & Schuler, 2005; Miedema et al., 2018). Nevertheless, studies have shown a strong link between improved women's empowerment (across numerous domains of empowerment, including economic, autonomy, social independence, and agency), and children's dietary diversity (Aemro et al., 2013; Malapit & Quisumbing, 2015; Na et al., 2015; Onah, 2020), and nutrition outcomes (stunting, wasting, and underweight) (Cunningham et al., 2015; Jones et al., 2020; Malapit & Quisumbing, 2015; Santoso et al., 2019).

Approaches to measuring women's empowerment have evolved over the past decade from including empowerment modules and questions in standardized routine cross-country surveys to a more systematic

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development of empowerment indexes that is grounded in theory and practice. Numerous women's empowerment indexes have been developed (Alkire et al., 2013; Amin & Becker, 1998; Ewerling et al., 2017; Lemke et al., 2003; Meinzen-Dick et al., 2017, 2019; Miedema et al., 2018; Vaz et al., 2016). One of the most prominent index includes the women's empowerment in agriculture index (WEAI) (Alkire et al., 2013; Meinzen-Dick et al., 2017), which has been adapted for use in project management (Malapit et al., 2019) and livestock raising (Galiè et al., 2019). The WEAI and its adaptations has advanced the knowledge in measuring the effects of empowerment initiatives. However, they are restricted to rural women in agrarian settings and are not developed out of available routine survey data hence, applicability is limited. To develop empowerment indexes that are survey-based and could easily be used for cross country comparison, women's empowerment indexes that are based on readily available cross-country routine surveys, including the Demographic and Health Surveys (DHS), are increasingly being developed (Ewerling et al., 2017, 2019; Miedema et al., 2018). Since these indexes are relatively new, they have drawn some criticism on the conceptualisation of the empowerment domains and indicators and the need for more in-depth disaggregated examination and appraisal of the tools (Raj, 2017; Yount et al., 2018). Furthermore, a recent systematic review of available literature has suggested more nuances in the examination of the relationship between women's empowerment and important contextual factors on key development outcomes (Santoso et al., 2019).

To add to these identified gaps in knowledge, the present study used the Survey-based Women's emPOWERment (SWPER) index to examine the main and interaction effects of women's empowerment, women's socioeconomic status, and children's nutrition outcomes in South-Central Asia (SCA). The SWPER index was initially developed for use in Africa (Ewerling et al., 2017) and updated for use in other developing countries with a recent DHS survey (Ewerling et al., 2019). The primary objective of the present study was not only to examine the relationship between women's empowerment and children's nutrition anthropometric outcomes but also to examine the interaction effects between women's empowerment and wealth index as measured by the DHS using pooled and disaggregated analyses approaches to test the research hypotheses.

#### Overview of the survey-based Women's EmPOWERment index (SWPER)

The Survey-based Women's emPOWERment (SWPER) index was developed to provide a single consistent survey-based measure of women's empowerment that could allow for wider comparisons across developing countries and world regions (Ewerling et al., 2019). The SWPER index was developed using questions that can be found in cross-country surveys including the DHS. Three broad domains have been developed to measure women's empowerment, attitude towards violence, social independence, and decision-making roles/power. Using a similar approach to Miedema et al. (2018), Ewerling et al. (2019) conceptualised these three domains to reflect enabling preconditions, instrumental agency and intrinsic agency for women. Enabling preconditions are considered conditions that allow a woman to gain more power (including education and age), instrumental agency is the woman's ability to make choices at the household level, and intrinsic agency is related to women's attitudes and beliefs regarding gender norms such as acceptability of spousal violence.

To develop the domain on attitudes towards violence, questions related to the respondent's opinion about whether 'wife-beating' was justified or not in various scenarios were used. To develop the social independence domain, questions relating to women's education level, access to information (frequency of reading newspaper or magazine), age (at first child's birth and at first cohabitation), and the difference between the respondent and her male spouse's education and age were asked. For decision-making domain, questions on women's participation in household decision-making were used. The major differences

between the SWPER for Africa (Ewerling et al., 2017) and the updated global SWPER (Ewerling et al., 2019) are in the decision-making domain where joint and sole decision-making for women were given an equal power-loading as against a lower loading in the previous index, and the removal of women's employment history in the social independence domain. The coding structure of the SWPER index can be found in Table 1. In total, 14 items are extracted from the DHS and principal component analysis and factor loadings is used to construct the index. Empowerment scores are described as standard deviations and negative scores are considered disempowering while increases in positive scores suggest moderate to full empowerment. More information on the development of the index and its validation can be found in Ewerling et al. (2017, 2019).

#### Data, empirical specification, and variables

##### Data

To investigate the relationship between women's empowerment, its interaction with women's socioeconomic status, and children's nutrition outcomes, data were extracted from the latest DHS in five countries in South-Central Asia: Kyrgyzstan (KGZ), Tajikistan (TJK), Pakistan (PAK), Bangladesh (BGD), and Nepal (NPL).

##### The demographic and Health Survey

The DHS is funded by the United States Agency for International Development Agency and implemented by ICF international (DHS, 2012). The survey is primarily administered to female respondents as indicators covered in it relate largely to maternal and child health outcomes. There are ten modules in the DHS questionnaire, including a module on women's status and other gender-related questions including perception of domestic violence. The five countries examined have DHS surveys that cover Phase 6 (2008–2013) and Phase 7 (2013–2018) survey rounds. In total, 62,015 married women of reproductive age (17, 863 in Bangladesh, 8208 in Kyrgyzstan, 12,862 in Nepal, 1 in Pakistan,

**Table 1**

Coding system for the variables included in the composition of the SWPER index.

DHS questions	Code or unit
Attitude towards violence	
Beating justified if wife goes out without telling husband	Justified = -1; don't know = 0; not justified = 1
Beating justified if wife neglects the children	Justified = -1; don't know = 0; not justified = 1
Beating justified if wife argues with husband	Justified = -1; don't know = 0; not justified = 1
Beating justified if wife refuses to have sex with husband	Justified = -1; don't know = 0; not justified = 1
Beating justified if wife burns the food	Justified = -1; don't know = 0; not justified = 1
Social independence	
Frequency of reading newspaper or magazine	Not at all = 0; <once a week = 1; ≥once a week = 2
Woman's education	Years
Education difference: woman's minus husband's years of schooling	Years
Age difference: woman's minus husband's age	Years
Age at first cohabitation	Years
Age of respondent at 1st birth	Years
Decision making	
Who usually decides on respondent's health care	Husband or other alone = -1; joint or respondent alone = 1
Who usually decides on large household purchases	Husband or other alone = -1; joint or respondent alone = 1
Who usually decides on visits to family or relatives	Husband or other alone = -1; joint or respondent alone = 1

(source: Ewerling et al., 2019)

and 10,718 in Tajikistan) provided information on questions used in the SWPER index. Children's anthropometric nutrition status data for stunting, wasting, and underweight were available for 24,712 children (7318 in Bangladesh, 4,574 in Kyrgyzstan, 2416 in Nepal, 4361 in Pakistan, and 6043 in Tajikistan). The number of observations for specific regressions vary because of missing information for children under the age of five. Actual estimation samples are presented in the relevant tables.

#### Outcome variables

Children's anthropometric nutrition outcome variables – Three nutrition outcomes (underweight, wasted, and stunted) for children under the age of five were investigated using the WHO standard deviations of z-scores (Wang & Chen, 2012; WHO, 2006, p. 312). These outcome variables were examined as binary and continuous variables. The binary outcome variables were created using the WHO thresholds and children were classified as underweight (scores less than  $-2$  standard deviation weight-for-age z-scores), wasted (scores below  $-2$  standard deviation weight-for-height z-scores), and stunted (scores less than  $-2$  standard deviation height-for-age z-scores).

#### Key independent variables

The SWPER index - The three domains of the SWPER index were used as the key independent variables. These domains examine women's empowerment in decision-making, attitude towards violence, and social independence. The initial hypothesis in line with Ewerling et al. (2017, 2019) was that each domain might have different associations with the outcome variables. In addition, the presented study tested the hypothesis that each domain of the index would interact differently with women's socioeconomic status in the association with the outcome variables. To test this, regression models for main and interaction effects for each of the three nutrition outcome measures were built.

Wealth index – The wealth index as a measure of household socioeconomic status exists in the DHS where households are categorised into five quintiles ranging from poorest to richest. The wealth index was developed using principal component analysis where household ownership of a range of valuable items had been pooled to develop a composite measure of household socioeconomic status. The assumption was that the lowest five wealth categories will have different effects on children's nutrition outcomes. Further, the three empowerment domains would perform differently across different wealth quintiles and hence would have different effects on children's nutrition outcomes. To test this, the main effects of the wealth index on children's nutrition outcomes and its interaction effects with the SWPER index were explored. About 20% of households belong to each wealth quintile and the richest quintile was used as the reference category in the main effects regression analyses. For ease of interpretation of the interaction effects, the quintiles were recalculated into a binary variable by grouping the lowest three quintiles (i.e. the poorest 60% of households) into a lower quintile (Q1) and the highest two quintiles (i.e. the richest 40% of households) into a higher quintile (Q2).

#### Control variables

Many of the known socio-demographic control variables (age, cohabitating status, education level, and access to media) were included in the development of the SWPER index. Hence, the present study limited the demographic and socioeconomic control variables to sex of child, women's work history, urban/rural location, sex of household head, household size, and current breastfeeding status. These key control variables are also known to be associated with children nutrition outcomes in literature (Gutiérrez-Camacho et al., 2019; Ngandu et al., 2020).

#### Empirical specification

Evidence suggest that children within households where women experience improved empowerment are more likely to have improved nutrition outcomes. The assumption was that higher scores on the SWPER index would be associated with improved nutrition outcomes for children. To test this for the pooled and disaggregated analyses, the following models were specified:

Let  $Y_i$  be the outcome variable (children's anthropometric nutritional status) estimated as:

$$Y_i = \beta_0 + \beta_1 \text{SWPER} + \beta_2 \text{Wealth} + \beta_3 C + \varepsilon \quad (1)$$

where  $C$  is a vector of control variables,  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are the estimated parameters vectors, and  $\varepsilon$  is the error term.

Estimating the interaction effect of the SWPER index and socioeconomic (wealth) status:

$$Y_i = \beta_0 + \beta_1 \text{SWPER} + \beta_2 \text{Wealth} + \beta_3 C + \beta_4 (\text{SWPER} \times \text{Wealth}) + \varepsilon \quad (2)$$

where  $C$ ,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ , and  $\varepsilon$  are as above. The impact of women's empowerment and wealth on children's nutrition outcomes is the sum of the coefficients of the empowerment and wealth variables and the coefficient of the interaction term with the wealth index dummy ( $\beta_1 + \beta_4$ ). I tested this using the two richest groups as the reference group and the three poorest groups as the comparator. If the nests of the test of the differential impact of women's empowerment, represented by the coefficient of the interaction term ( $\beta_4$ ) is significantly different from zero, then this suggests that women's empowerment has differential effects between lower and higher wealth quantiles.

Stata version 15.1 was used to analyse the data. Descriptive analyses were used to describe the study sample and means, percentages, and standard deviations were reported. Ordinary least squares (OLS) and marginal effects of logistic regression models were used to examine the relationship between the SWPER domains, wealth index, and the three outcome variables. Linear probability models (LPMs) for binary and OLS for continuous outcome variables were used to examine the interaction effects. All regression models were adjusted for the effects of specified control variables, controlled for cluster sampling effects and appropriate sampling weights during the analysis were applied. Significance was established at 95% and 99% confidence intervals and more focus was given to significant associations in the pooled analyses. For the pooled analyses, country dummy variables were included in the regression models.

## Results

### Sample characteristics

On average, women's education was about 4.5 years and husband's education was about 5.8 years. Women had an average age of 28.5 years and husbands' age was about 33.7 on average. Sixty-seven percent of households were located in rural areas, 63% were located in the lowest three socioeconomic group based on their wealth index, and about 38% of women with an index child who was alive were currently breastfeeding. On average, 79% of women were unemployed and each household had eight members. Further disaggregation of the sample characteristics can be found in Table 2.

### Children anthropometric nutrition status

In total, 9% of children were wasted, 19% were underweight, and 28% were stunted. Bangladesh recorded the highest proportion of children who were wasted (14%) and Kyrgyzstan recorded the lowest (3%). Bangladesh recorded the highest proportion of underweight children (33%) and Kyrgyzstan recorded the lowest proportion (3%). Bangladesh and Pakistan recorded the highest proportion of children

**Table 2**  
Sample characteristics.

Variable	Pooled (n = 62,015)				Nepal (2016; n = 12,862)				Kyrgyzstan (2012; n = 8208)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Women's education	4.5	5.2	0	21	5.3	4.3	0	11	12.3	2.5	0	21
Husband's education	5.8	5.2	0	21	6.9	3.7	0	11	11.7	2.5	0	21
Women's age	28.5	6.6	15	49	26.4	5.7	15	49	29.4	6.3	16	49
Husband's age	33.7	8.2	15	95	30.5	6.8	16	95	33.5	6.9	17	73
Rural location	0.67	0.5	1	2	0.42	0.5	1	2	0.74	0.4	1	2
Lower quintile [Q1]	0.63	0.5	1	2	0.67	0.5	1	2	0.66	0.5	1	2
Current breastfeeding	0.38	0.5	0	1	0.76	0.4	0	1	0.47	0.5	0	1
Not employed	79%				40%				75%			
Household size	8	4.5	2	48	6	2.8	2	38	6	1.9	2	18

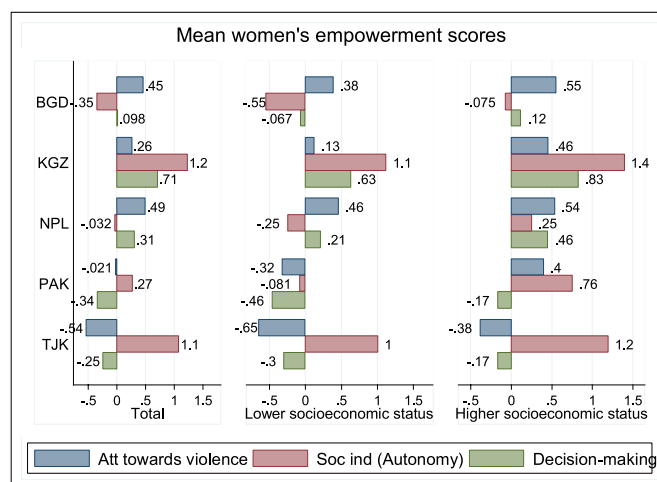
  

Variable	Tajikistan (2017; n = 10,718)				Pakistan (2018; n = 12,364)				Bangladesh (2014; n = 17,863)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Women's education	10.4	3	0	19	4.5	5.3	0	16	6.2	3.9	0	17
Husband's education	5.4	1.5	0	7	7	5.2	0	16	5.7	4.7	0	18
Women's age	28.6	5.7	18	48	29.8	6.4	15	49	25.6	6	15	49
Husband's age	32.6	6.8	19	95	34.8	7.9	16	81	34.1	7.9	16	85
Rural location	0.66	0.5	1	2	0.55	0.5	1	2	0.68	0.5	1	2
Lower quintile [Q1]	0.46	0.5	1	2	0.36	0.5	1	2	0.59	0.5	1	2
Current breastfeeding	0.43	0.5	0	1	0.48	0.5	0	1	0.56	0.5	0	1
Not employed	81%				82%				72%			
Household size	8	3.4	2	23	9	4.7	2	44	6	2.7	2	25

who were stunted (36%) and Kyrgyzstan and Tajikistan recorded the lowest proportion (18%) (Fig. 1).

*Mean empowerment scores for SWPER domains*

There were changes in mean empowerment scores across the three domains when analyses were disaggregated by socioeconomic status using the wealth index (Fig. 2). Women were moderately to fully empowered across the three empowerment domains in Kyrgyzstan, moderately empowered in attitude towards violence and decision-making, but disempowered in social independence in Bangladesh and Nepal, and moderately empowered in social independence, but disempowered in attitude towards violence and decision-making in Pakistan and Tajikistan. Disaggregation by wealth index (SES) suggests that the magnitude of empowerment is larger for women who belonged to a higher SES and for those who belonged to a lower SES, the magnitude of disempowerment also increases. Furthermore, there is an improvement in empowerment for women who belonged to a higher SES as they are moderately empowered in social independence in Nepal and in attitude towards violence in Pakistan. Women who belonged to a lower SES experienced a decline in empowerment as they are disempowered in decision-making in Bangladesh and in social



**Fig. 2.** Mean empowerment scores for SWPER domains\*  
\*Bivariate associations significant at chi-squared p-value <0.05.

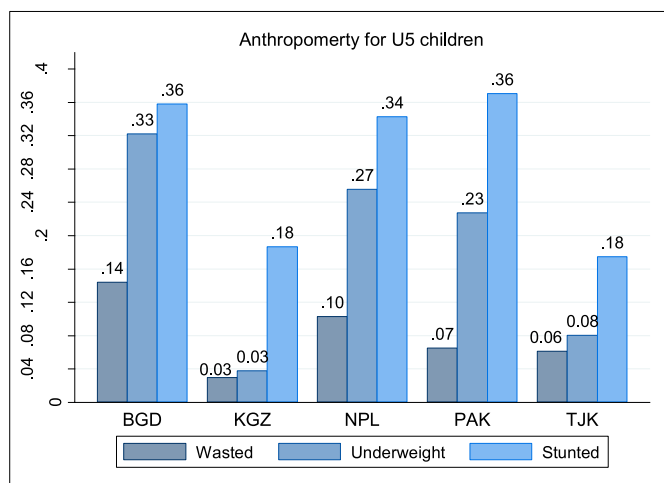
independence in Pakistan.

*Women's empowerment, wealth index, and children's anthropometric status*

The marginal effects of the logistic regression with stunting, wasting, and underweight are presented in Tables 3–5 and the OLS results are presented in supplementary Tables 1–3.

Empowerment in attitude towards violence was negatively associated with the likelihood of children being stunted, wasted, and underweight although the magnitude of association was small (0.02% – 1.8%). A unit increase in the standard deviation of attitude towards violence score was associated with a 2.9-points increase in stunting z-scores, 4.2-points increase in wasting z-scores, and 7.7-points increase in underweight z-scores. However, these associations were not statistically significant in the pooled and disaggregated analyses.

A unit increase in the standard deviation of social independence score was associated with a 6.6%-point decrease in the likelihood of a child being stunted, 2.4%-point decrease in the likelihood a child being wasted, and a 7.5%-point decrease in the likelihood of a child being



**Fig. 1.** Children anthropometric status.

**Table 3**  
Marginal effects of logistic regression – Stunting.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	All	Kyrgyzstan	Tajikistan	Pakistan	Nepal	Bangladesh
Att to violence score	−0.002 (0.005)	−0.022 (0.016)	0.011 (0.008)	−0.013 (0.019)	−0.069* (0.034)	0.008 (0.019)
Social independence	−0.066*** (0.005)	−0.015** (0.016)	0.009 (0.012)	−0.045** (0.019)	−0.025 (0.020)	−0.032** (0.021)
Decision-making	−0.023*** (0.005)	−0.039** (0.017)	−0.013 (0.010)	−0.036** (0.022)	−0.031** (0.017)	−0.012 (0.012)
<u>Wealth index [Ref: Richest]</u>						
Poorest	0.168*** (0.019)	0.025** (0.050)	0.051** (0.041)	0.170** (0.077)	0.294*** (0.063)	0.279*** (0.044)
Poorer	0.106*** (0.017)	0.049*** (0.051)	0.020** (0.038)	0.139** (0.070)	0.150*** (0.057)	0.213*** (0.039)
Middle	0.076*** (0.017)	0.025 (0.049)	0.042 (0.035)	0.045 (0.071)	0.119** (0.060)	0.163*** (0.032)
Richer	0.032 (0.015)	0.008 (0.043)	−0.024 (0.029)	0.036 (0.061)	0.127* (0.061)	0.097** (0.033)
<u>Control variables</u>						
Female index child	0.004*** (0.000)	0.002** (0.001)	0.002** (0.001)	0.004** (0.002)	0.005*** (0.001)	0.004*** (0.001)
Age of child (months)	−0.055*** (0.013)	−0.016 (0.041)	−0.067** (0.031)	−0.017 (0.045)	−0.031 (0.036)	−0.065** (0.031)
Rural location	0.006** (0.003)	0.011* (0.006)	0.011 (0.009)	0.009 (0.012)	−0.006 (0.009)	−0.005 (0.006)
Current breastfeeding	0.059*** (0.014)	−0.021 (0.035)	0.016 (0.029)	0.034 (0.048)	0.102** (0.045)	0.111*** (0.038)
Female household head	0.017 (0.013)	0.024 (0.031)	−0.015 (0.025)	−0.030 (0.055)	0.042 (0.036)	0.018 (0.038)
Not employed	0.019 (0.013)	0.034 (0.035)	0.021 (0.024)	−0.178*** (0.052)	−0.014 (0.038)	−0.049* (0.028)
Household size	0.003* (0.002)	−0.001 (0.006)	0.006** (0.003)	0.004 (0.004)	0.024*** (0.007)	0.004 (0.004)
Observations	9391	1805	2167	1256	1019	2891
McFadden's Pseudo R <sup>2</sup>	0.43	0.43	0.44	0.47	0.44	0.40
ML (Cox-Snell) R <sup>2</sup>	0.41	0.41	0.41	0.42	0.41	0.38

Standard errors in parentheses.

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

underweight. Further, unit increase in the standard deviation of social independence score was associated with a 19.2-points increase in stunting z-scores, a 14.6-points increase in wasting z-scores, and a 32.4-points increase in underweight z-scores. These associations were statistically significant in the pooled analyses. Further disaggregation suggests a variation in the association between empowerment in social independence and improvement in children's anthropometric nutrition outcomes in the countries examined. Empowerment in social independence was positively associated with stunting in Kyrgyzstan, Pakistan, and Bangladesh, with wasting in Nepal, and with underweight in Tajikistan and Nepal.

A unit increase in the standard deviation of decision-making score was associated with a 2.3%-point decrease in the likelihood of a child being stunted, 2.4%-point decrease in the likelihood of a child being wasted, and a 3.7%-point decrease in the likelihood of a child being underweight. Also, a unit increase in the standard deviation of decision-making score was associated with a 21.1-points increase in stunting z-scores, a 21.0-points increase in wasting z-scores, and a 33.5-points increase in underweight z-scores. These associations were statistically significant in the pooled analyses. Further disaggregation also suggests a variation in the association between empowerment in decision-making and improvement in children's anthropometric nutrition status across the countries examined. Empowerment in decision-making was positively associated with stunting in Kyrgyzstan, Pakistan, and Nepal, with wasting and underweight were found in Kyrgyzstan and Nepal.

Belonging to the lowest three SES (poorest, poorer, and middle) based on wealth index was associated with a 16.8%-points, 10.6%-points, and 7.6%-points increase in the likelihood of a child being stunted relative to the highest (richest) SES. Also, belonging to the

lowest three SES (poorest, poorer, and middle) was associated with a 95.3-points, 65.4-points, and 65.9-points decrease in stunting z-scores, respectively. These associations were statistically significant in the pooled analyses with slight variation in the disaggregated analyses (Table 3 and supplementary Table 1). Although not statistically significant, belonging to the richer SES was also associated with an increased likelihood of children being stunted, although the magnitude of association was smaller (3.2%-points).

Although there was no statistically significant association between wealth index and the likelihood of children being wasted and the magnitude of association was small, women who belonged to the poorest and richer SES were more likely to have a child classified as wasted, while women who belong to the poorer and middle SES were less likely to have a child classified as wasted.

Belonging to the lowest three SES (poorest, poorer, and middle) based on wealth index was associated with a 14.1%-points, 6%-points, and 7.4%-points increase in the likelihood of a child being underweight relative to the highest (richest) SES. Further, belonging to the lowest three SES (poorest, poorer, and middle) was associated with a 52.8-points, 44.8-points, and 53.9-points decrease in underweight z-scores, respectively. These associations were statistically significant in the pooled and significance varied in the disaggregated analyses (Table 4 and supplementary Table 2). Although not statistically significant, belonging to the richer SES was also associated with an increased likelihood of children being underweight and a reduction in underweight z-scores.

**Table 4**  
Marginal effects of logistic regression – Wasting.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	All	Kyrgyzstan	Tajikistan	Pakistan	Nepal	Bangladesh
Att to violence score	-0.007* (0.004)	-0.005 (0.006)	0.006 (0.006)	-0.001 (0.008)	-0.025 (0.016)	0.002 (0.012)
Social independence	-0.024*** (0.005)	0.005 (0.004)	-0.008 (0.010)	-0.006 (0.012)	-0.021** (0.006)	0.018 (0.012)
Decision-making	-0.024** (0.004)	-0.025*** (0.006)	0.003 (0.007)	0.012 (0.009)	-0.021*** (0.009)	-0.000 (0.009)
<u>Wealth index [Ref: Richest]</u>						
Poorest	0.004 (0.014)	-0.128 (0.087)	-0.022 (0.024)	0.076*** (0.026)	0.041 (0.037)	0.100*** (0.032)
Poorer	-0.012 (0.013)	-0.126 (0.087)	-0.023 (0.024)	0.066*** (0.022)	0.007 (0.033)	0.067** (0.028)
Middle	-0.016 (0.012)	-0.113 (0.089)	-0.011 (0.023)	0.021 (0.017)	0.034 (0.037)	0.016 (0.026)
Richer	-0.009 (0.013)	-0.121 (0.084)	-0.041** (0.019)	0.043** (0.020)	0.061* (0.037)	0.052* (0.029)
<u>Control variables</u>						
Female index child	-0.000 (0.000)	-0.001*** (0.000)	-0.001** (0.001)	-0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Age of child (months)	0.002 (0.009)	0.045** (0.021)	-0.028* (0.015)	-0.009 (0.019)	0.021 (0.022)	-0.012 (0.021)
Rural location	-0.003* (0.002)	-0.000 (0.002)	-0.004 (0.006)	0.005 (0.003)	-0.011* (0.006)	-0.004 (0.004)
Current breastfeeding	-0.033*** (0.011)	-0.002 (0.010)	-0.008 (0.022)	-0.007 (0.024)	0.030 (0.025)	-0.060** (0.032)
Female household head	-0.011 (0.010)	-0.029 (0.018)	-0.003 (0.018)	-0.080** (0.034)	-0.001 (0.020)	0.031 (0.024)
Not employed	-0.015 (0.012)	-0.036** (0.017)	-0.023 (0.022)	0.016 (0.018)	0.029 (0.023)	-0.021 (0.028)
Household size	-0.004*** (0.001)	-0.001 (0.002)	-0.001 (0.002)	-0.000 (0.002)	0.006 (0.004)	-0.007** (0.003)
Observations	9,138	1,805	2,162	1,262	1,018	2,891
McFadden's Pseudo R <sup>2</sup>	0.35	0.35	0.35	0.37	0.31	0.30
ML (Cox-Snell) R <sup>2</sup>	0.32	0.32	0.32	0.34	0.29	0.27

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

#### Summary of associations between control variables and children's anthropometric nutrition status

The sex of index child (female), rural location, and current breastfeeding status were associated with the likelihood of a child being stunted and a unit increase in age of child was associated with a less likelihood of stunting. Being currently breastfed, and in households headed by a female were associated with decreases in stunting z-scores. Being unemployed was associated with increases in stunting z-scores and the reduced likelihood of a child being stunted. These associations were statistically significant in the pooled and significance varied in the disaggregated analyses. Although not statistically significant, belonging to a household headed by a female, being currently unemployed, and a unit increase in household size were associated with the increased likelihood of child being stunted and having lower stunting z-scores.

Current breastfeeding status and increase in household size was significantly associated with decreases in wasting z-scores and the likelihood of a child being classified as wasted and having lower wasting z-scores in the pooled analyses also with variations in the disaggregated analyses. Although not statistically significant, age, sex, and location of index child, or in households headed by a female or a head employed in the last year was positively associated with the likelihood of child being classified as wasted.

Sex of index child (female), current breastfeeding status, and increase in household size were significantly associated with the likelihood of a child being underweight, belonging to a mother residing in a rural area or unemployed were less likely to be classified as underweight. Likewise, the sex of index child (female), current breastfeeding status, and increase in household size were associated with decreases in

underweight z-scores and belonging to an unemployed mother or mother residing in a rural area were associated with an increase in underweight z-scores. These associations were significant in the pooled analyses with variations in significance in the disaggregated analyses. Although not statistically significant, age of index child and residing in a female-headed household were associated with decreased likelihood of a child being underweight.

#### Interaction effects between the SWPER domains and wealth index, and children's anthropometric nutrition outcomes

The interaction effects between the SWPER domains and wealth index with stunting, wasting, and underweight are presented in Figs. 3–5 and supplementary Tables 4–6.

A unit increase in social independence standard deviation score for women who belonged to the lower SES was significantly associated with a 3.4%-points decrease in the likelihood of their index child being stunted in the pooled analyses and in Kyrgyzstan and Pakistan. A unit increase in social independence standard deviation score for women who belonged to the lower SES was significantly associated 2.1%-points decrease in the likelihood of child being wasted in the pooled analyses and in Nepal only. A unit increase in social independence standard deviation score for women who belonged to the lower SES was significantly associated with a 4.8%-points decrease in the likelihood of child being underweight in the pooled analyses and in Tajikistan and Nepal. Furthermore, empowerment in social independence for women who belonged to the lower SES was associated with a 23.8-points increase in stunting z-scores, an 18.2-points increase in wasting z-scores, and a 10.3-points increase in underweight z-scores.

**Table 5**  
Marginal effects of logistic regression – Underweight.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	All	Kyrgyzstan	Tajikistan	Pakistan	Nepal	Bangladesh
Att to violence score	−0.018 (0.006)	0.001 (0.006)	0.011 (0.007)	−0.021 (0.014)	−0.045 (0.029)	0.012 (0.016)
Social independence	−0.075*** (0.007)	0.005 (0.007)	−0.022*** (0.010)	−0.019 (0.017)	−0.057*** (0.022)	0.010 (0.021)
Decision-making	−0.037*** (0.005)	−0.022*** (0.008)	−0.004 (0.007)	−0.017 (0.017)	−0.044*** (0.016)	−0.017 (0.012)
<u>Wealth index [Ref: Richest]</u>						
Poorest	0.141*** (0.022)	0.001 (0.015)	0.011** (0.029)	0.246*** (0.058)	0.108** (0.076)	0.335*** (0.040)
Poorer	0.060*** (0.022)	0.016 (0.019)	0.009 (0.025)	0.175*** (0.050)	0.054 (0.071)	0.200*** (0.036)
Middle	0.074*** (0.019)	0.036** (0.022)	0.033 (0.029)	0.034 (0.046)	0.126** (0.071)	0.136*** (0.032)
Richer	0.043 (0.019)	−0.001 (0.012)	0.037** (0.017)	0.086* (0.049)	0.032 (0.064)	0.127*** (0.036)
<u>Control variables</u>						
Female index child	0.003*** (0.001)	0.000 (0.000)	−0.000 (0.001)	0.001 (0.001)	0.005*** (0.001)	0.004*** (0.001)
Age of child (months)	−0.006 (0.014)	0.008 (0.019)	−0.020 (0.020)	−0.049 (0.038)	0.005 (0.036)	−0.009 (0.027)
Rural location	−0.007** (0.003)	0.004* (0.003)	0.009 (0.007)	0.008 (0.008)	−0.012 (0.009)	−0.009 (0.007)
Current breastfeeding	0.104*** (0.019)	0.011 (0.012)	0.014 (0.028)	0.030 (0.040)	0.139*** (0.039)	0.136*** (0.051)
Female household head	−0.005 (0.015)	−0.001 (0.011)	−0.003 (0.025)	−0.086 (0.053)	0.067* (0.034)	0.015 (0.034)
Not employed	−0.054*** (0.015)	0.004 (0.011)	−0.010 (0.022)	−0.130*** (0.046)	−0.031 (0.037)	−0.064** (0.030)
Household size	−0.003 (0.002)	−0.001 (0.003)	0.001 (0.002)	0.000 (0.004)	0.028*** (0.007)	−0.001 (0.004)
Observations	9162	1804	2179	1285	1025	2869
McFadden's Pseudo R <sup>2</sup>	0.39	0.39	0.39	0.38	0.33	0.30
ML (Cox-Snell) R <sup>2</sup>	0.34	0.34	0.34	0.36	0.30	0.29

Standard errors in parentheses.

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

A unit increase in decision-making standard deviation score for women who belonged to the lower SES was significantly associated with a 2.6%-points decrease in the likelihood of their index child being stunted in the pooled analyses and in Pakistan, and a 4.6%-points decrease in the likelihood of child being underweight in the pooled analyses and in Nepal. Further, empowerment in decision-making for women who belonged to the lowest SES was associated with a 13.1-points increase in stunting z-scores in the pooled analyses and in Tajikistan and Nepal.

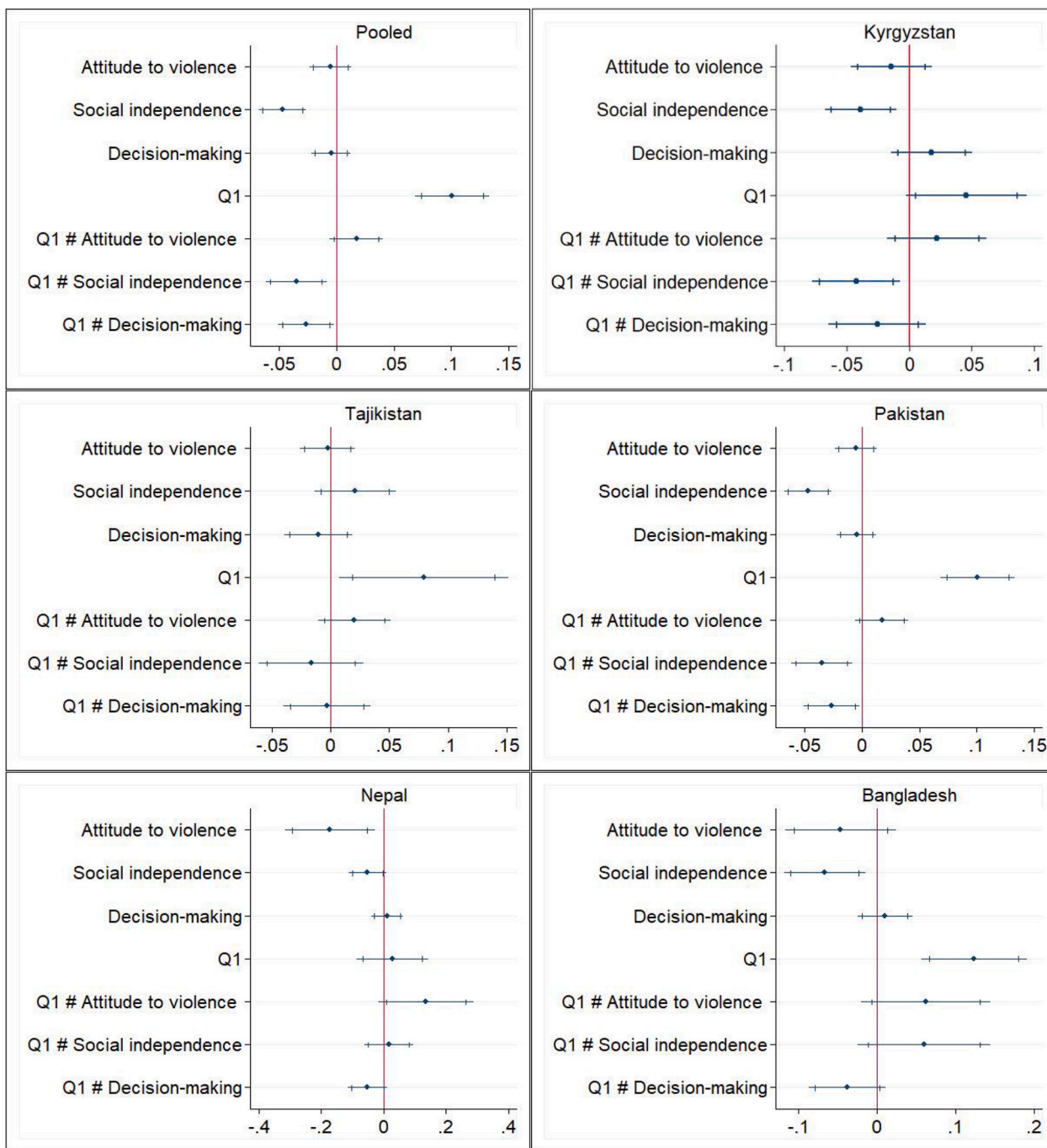
## Discussion

In South-Central Asia, to reduce stunting, wasting, and underweight rates, empowering women through improving their social-independence and decision-making power appear to be important. This is since empowering women in social independence and decision-making appear to not only reduce the probability of children being stunted, wasted, or underweight, empowerment in these two domains can potentially increase children's anthropometric nutrition z-scores. Further, targeting poorer women for empowerment in social independence and decision-making also appear to confer positive benefits towards the reduction of stunting and underweight rates, and to a lesser extent, wasting rates in children. However, these associations differ across the countries examined and perhaps points to a variation in empowerment needs in different settings and the possible effects of other contextual factors on women's ability to gain and express empowerment. While Kyrgyzstan is considered an exemplar country that has managed to harness its limited resources to drive down stunting rates (Bhutta et al., 2020; Wigle et al., 2020), SCA is still one of the

leading regions in stunting, wasting, and underweight cases globally hence, women's empowerment can be a crucial tool towards improving these rates.

Efforts to empower women should be country-and context-specific since the present study found varying degrees of (dis)empowerment across the three empowerment domains in the countries examined. In general, while women would benefit more from improving their attitude towards violence and decision-making in Tajikistan and Pakistan, women would benefit more from improvement in social independence in Nepal and Bangladesh, and only Kyrgyzstan reports moderately to empowered women across the three empowerment domains. In relation to improving children's nutrition outcomes, empowerment in social independence and decision-making appear to be more consistently associated with better nutrition outcomes. This further suggests that while women's empowerment needs vary in SCA, in relation to children's nutrition, empowerment needs are perhaps more consistent. This buttresses the need to ensure that empowerment efforts are tailored to addressing contextual factors that disempower women in different settings. Considering that social independence measures the reduction in the age and education gap between married men and women, increase in age at cohabitation and first birth for women, and access to media, closing these gender gaps for women and improving their decision-making roles and power appears to be key towards better nutrition outcomes for their children.

The present study is one of a few that have examined the benefits of empowering poorer women towards improved children's nutrition outcomes. Although using mediating effect against interaction effect as in the present study, Jones et al. (2020) using the DHS in East Africa found that improving intrinsic agency for women who belonged to a



Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%

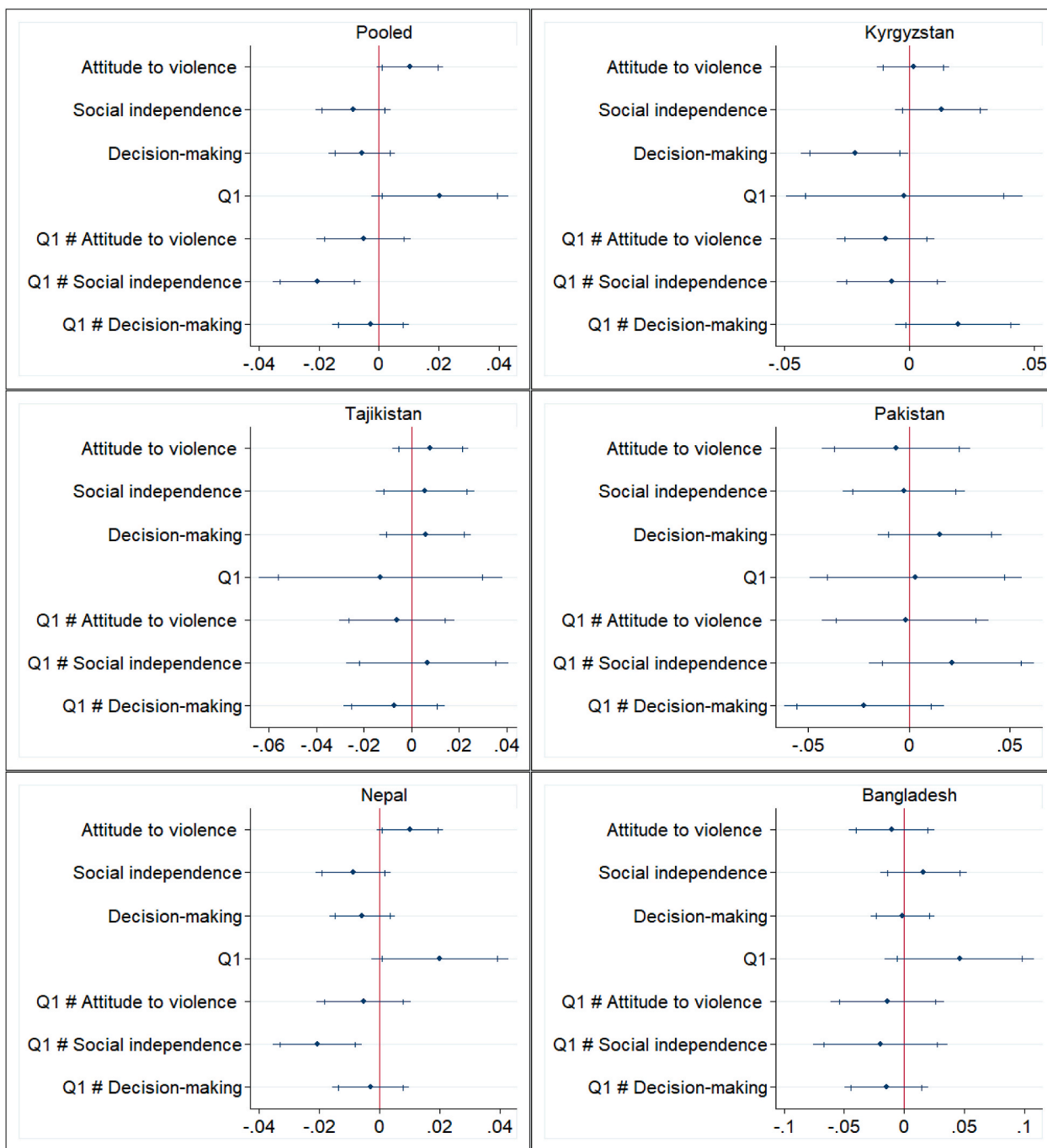
Fig. 3. Interaction effects between SWPER domains and wealth index – Stunting  
 Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%.

lower socioeconomic status was associated with a reduction in childhood stunting. The similarities between the findings by Jones et al. (2020) and the present study is that the two studies used the same survey data across different countries and similar questions to measure empowerment to suggest the need for empowering women of lower socioeconomic status for improved nutrition outcomes for children in developing countries.

A major constraint in the comparability of women’s empowerment studies is the vast nature of indicators, domains, and questions used to measure empowerment or in the development of empowerment indexes. In a systematic review of 62 studies in developing countries, Santos

et al. (2019) identified about 220 unique empowerment indicators and while some indicators have the same name (e.g. decision-making), there were important variations in the questions used and coding and weights given to women’s responses to empowerment questions. These variations which Santos et al. (2019) attributed to the differences in aggregation and operationalization of women’s empowerment indicators has also been suggested by other studies (Cornwall & Edwards, 2010; Malhotra et al., 2002, pp. 1–59; Onah, 2020). While there are numerous indexes and domains that examine women’s empowerment, the associations found in the present study between women’s empowerment and children’s anthropometric nutrition outcomes are consistent with



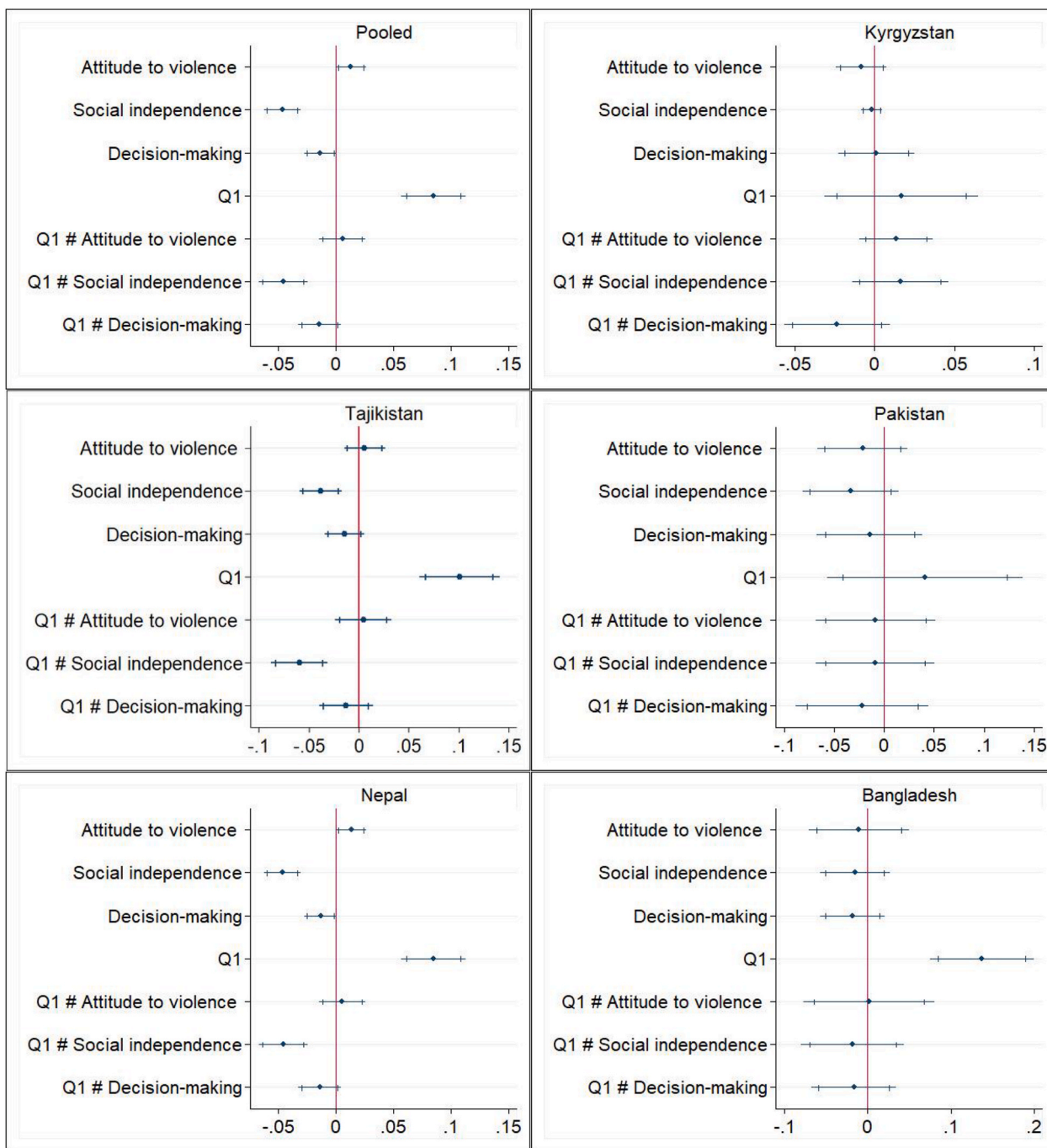


Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%

Fig. 4. Interaction effects between SWPER domains and wealth index – Wasting  
 Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%.

literature (Cunningham et al., 2015; Jones et al., 2020; Malapit et al., 2015; Malapit & Quisumbing, 2015; Siddhanta & Chattopadhyay, 2017). Of the 62 studies containing 220 unique women’s empowerment indicators reviewed by Santoso et al. (2019), p. 70 positive associations between empowerment and reduced stunting were found in 39 studies, 34 positive associations for reduction in childhood wasting in 22 studies, and positive associations with the reduction in underweight rates. In rural India, Imai et al. (2014) found that improving women’s bargaining power through reducing the education gap between married men and women is important for increasing children’s anthropometric nutrition z-scores in the short and long term. In Bangladesh, Siddhanta and

Chattopadhyay (2017) found that empowering women in decision-making regarding household production and in public speaking was associated with higher children’s height-for-age z-scores and a decreased probability of stunting while in Ghana, Malapit and Quisumbing (2015) found sex disparities which favour boys in the association between closing the gender parity gap and stunting. The present study findings add to the growing consensus that to improve children’s nutrition outcomes, women’s empowerment initiatives should be an area of investment for optimal results. Areas for future studies perhaps include further disaggregated analyses to examine the role of other contextual factors on the empowerment-nutrition relationship.



Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%

Fig. 5. Interaction effects between SWPER domains and wealth index – Underweight.

Note: demographic and economic control variables included in models; Lines indicate confidence intervals at 90% and 95%.

The limitations in the DHS in estimating women’s empowerment are evident in the present study. The SWPER index like other indexes developed using the DHS data is restricted in the types of empowerment indicators and domains it can measure. Some important indicators of empowerment which might be crucial for children’s nutrition are missing, including for example time use and allocation as suggested by the systematic reviews conducted by Santoso et al. (2019) and Cunningham et al. (2015). Also, other potential control variables including sanitation and women’s food consumption that might have an impact on children’s anthropometric outcomes were not available in the DHS data and not included in the analyses.

Women’s empowerment needs in SCA are diverse and the differences found across the five countries examined suggest that policies designed to empower women and improve children’s nutritional status need to be based on understanding which specific domains of women’s empowerment matter for particular nutrition outcomes in specific contexts. The SWPER index is now available for use in all countries with a recent DHS and MICS survey hence is an important measure of women’s empowerment. Further analyses of the index is needed, and the present study contributes to this gap in knowledge. Empowerment gaps existing in the five countries examined and also across women of different SES and these findings may be an important first step towards suggesting an area

of potential benefit for evidence-based and culture- and context-sensitive policies and programs. Women's empowerment initiatives that target children's nutrition outcomes in SCA should perhaps target the reduction of existing gender gaps including in age and education between married men and women, increase the age at cohabitation and at first birth for women, better access to media, and improved women's decision-making roles.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2020.100718>.

## Authors' contributions

**Michael N Onah;** Conceptualization, Methodology, Software, Data curation, Validation, and Visualisation, and Writing original draft and edits.

This is a sole authored manuscript.

## Ethical statement

The present study was conducted using secondary data from the Demographic and Health Survey, for which the ethics approvals for each country was obtained prior to surveys. The data is de-identified and hence the analyses presented here do not require additional human subjects review and ethics approval.

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