The extent of women's empowerment across rural-urban areas and wealth categories and its role in nutrition outcomes of family members in Uttar Pradesh, India

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Abstract

In the Indian family setting, women play a crucial role in the overall development of the households. Hence, development agencies and government programs mainly target women, assuming that empowering women would improve families. Given this background, we aim to construct a women's empowerment index (WEI) that encompasses all these domains and captures nutrition improvement for their and their family members. We assigned the weights based on principal component analysis (PCA). Then, we examine the extent of empowerment and nutrition outcomes of the family members across the wealth category and place of residence (rural-urban setting). Finally, we validate the WEI by analyzing the relationship between WEI and nutrition outcomes of family members through logit analysis. We used Uttar Pradesh data from National Family Health Survey (NFHS) -5 conducted in 2019-21 for the study. We found a positive relationship between household wealth and women's empowerment, indicating the vulnerability of women in poor families, especially in rural areas. Our results also suggested that women's empowerment differs across educational backgrounds and places of residence. Finally, we found that the prevalence of malnutrition is negatively associated with women's empowerment, especially children and women. These findings highlight the need for promoting women's empowerment-based policies and interventions to address the malnutrition problem.

Keywords: Women's empowerment, principal component analysis, logistic regression, wealth index, nutrition outcomes, India.

Introduction

In the Indian family setting, women play a crucial role in the overall development of the households. Hence, development agencies and government programs mainly target women, assuming that empowering women would improve families (Narayan et al., 2019; Kochar et al., 2022). In particular, the nutritional security of a woman and her family members depends on her, as most households are women involved in food preparation and service. Therefore, women's knowledge of health and its accessibility, socioeconomic freedom, and level of involvement in household decisions determine the nutritional outcome of the household members. Given this background, we aim to construct a women's empowerment

index (WEI) that encompasses all these domains and captures nutrition improvement for their and their family members. Then, we examine the extent of empowerment and nutrition outcomes of the family members across the wealth category and place of residence (rural-urban setting). Finally, we validate the WEI by analyzing the nutrition outcomes of family members, namely macronutrient (body mass index (BMI) - based) and micronutrient (Anemia) deficiencies as a function of WEI and other covariates. Specifically, the household wealth comprising the type of houses, access to fuel, electricity, drinking water, sanitation, and the place of residence is considered covariates for the analysis, as they are essential factors influencing the nutrition outcomes. The findings would help monitor the status of women's empowerment across the wealth and education category and rural and urban settings and develop an evidence-based policy for achieving desired nutrition outcomes.

Data and Methods

We purposively choose Uttar Pradesh state for the analysis. Because it is the most populous state in India, it still performed poorly concerning gender equality, human development, and nutritional outcome compared to most states. We use data from the National Family Health Survey (NFHS) -5 conducted during 2019-21 (GoI, 2023). We extracted the individual records of all the 70710 Uttar Pradesh sample households (of which 20% are urban and 80% rural) from the NFHS-5 survey. In this study, we aim to quantify women's empowerment using the five domains — health knowledge and accessibility; social independence; attitude to domestic violence and; economic independence; say in decision-making. We collected data on 38 relevant candidate indicators describing these five domains.

The indicators showing a positive association with women empowerment, for example, financial independence, we used the following formula for normalisation.

Normalisation = (Actual value – Minimum value) / (Maximum value – Minimum value)

Similarly, for indicators that have a negative association with women empowerment, such as domestic violence, the normalization of observations was done as follows:

Normalization = (Maximum value – Actual value) / (Maximum value – Minimum value)

We assigned weights using principal component analysis (PCA), the widely used technique in index construction (Rana et al., 2015; Ewerling et al.,2017; Sendhil et al., 2018). Some studies used only the first principal component's factor loadings for assigning weights (Kumar et al.,2016). We followed Kaiser's (1960) criterion, where we selected the principal components with an Eigenvalue of more than one for the Index to account for the maximum variation in the data (Ayyoob et al. (2013), Rana et al. (2015), Kale et al. (2016), and Mahida and Sendhil (2017). We calculated the weights using the following formula.

$W_i = \Sigma |L_{ij}| E_j$

where,

W_i is the weight of the ith variable

E_j is the Eigenvalue of the jth factor

L_{ij} is the loading value of the ith variable on jth factor

Finally, we worked out the women empowerment index (WEI) using the formula below. The value of WEI ranges between 0 and 1, and a higher value indicates better women empowerment.

$$\text{WEI} = \frac{\sum_{i=1}^{n} X_i W_i}{\sum_{i=1}^{n} W_i}$$

where,

X_i the ith indicator's normalized values, i, range from 1 to n (n=38), and Wi are the weights. We classified women's empowerment based on the distribution of WEI value into three categories: low, medium, and high, following Kale et al. (2016) and Ponnusamy et al. (2016) approach.

High $\qquad = \text{WEI} > (\bar{x} + 0.5\ \sigma)$
Medium $\qquad = (\bar{x} + 0.5\ \sigma) \leq \text{WEI} \leq (\bar{x} + 0.5\ \sigma)$
Low $\qquad = \text{WEI} < (\bar{x} - 0.5\ \sigma)$

Although 93,124 women respondents were in the survey, the complete information about all selected indicator variables was available only for 6948 women. Therefore, our WEI analysis was limited to these observations, but we used sample weights for all the analyses. To analyze the association between WEI and nutritional outcomes, we employed the logistic regression and multinomial logit, and ordinal logit models depending on the outcome variables. This data set based on the women respondents, so all the data corresponding to her only, it is a balanced dataset. While, for men and children analysis, in some respondent (women) households there is a possibility of more than one child (or man) or no child (or no man), hence so data set is unbalanced. Therefore, we have taken ratio of undernutrition children (men) to total children (or men) and applied logistic regression. On the other hand. For analyzing women nutritional outcomes, Women's BMI is a multinomial class, such as underweight, normal, and overweight and employed multinomial regression. Whereas, anemic status is ordered, i.e., not anemic, low, mild, and severe hence we used ordered logit model. The number observations will vary for each analysis depends upon the data sets. We analyzed the association between nutrition outcomes and WEI after controlling for the effects of household wealth, place of residence, age, education, and sex of the head of the households. The chi-square test values indicated that all the fitted models were significant. The Hosmer–Lemeshow tests suggest that our models fit reasonably well.

Results and Discussion

The extent of women's empowerment

Fig.1 displays the extent of women's empowerment across the place of residence, education, and wealth. In urban areas, about 14 % of women are low empowered, but 32 % of rural women are. The rates of low-empowered women are worse in the poorest households than in the rates of the wealthiest. Most women (43%) in the poorest households are low-empowered, and about two-thirds of women in the most affluent families are high empowered. It is in line with a study conducted in Kenya, where they reported that only about 7 percent of women in the poorest segment of households are likely to be empowered (UN,2020). Disaggregation by the level of education of the head of the household suggests that the

magnitude of high empowerment (67%) is larger for women in higher education. And the extent of low empowerment (40%) increases for those who belonged to no education class.

Fig.1. Extent of women's empowerment
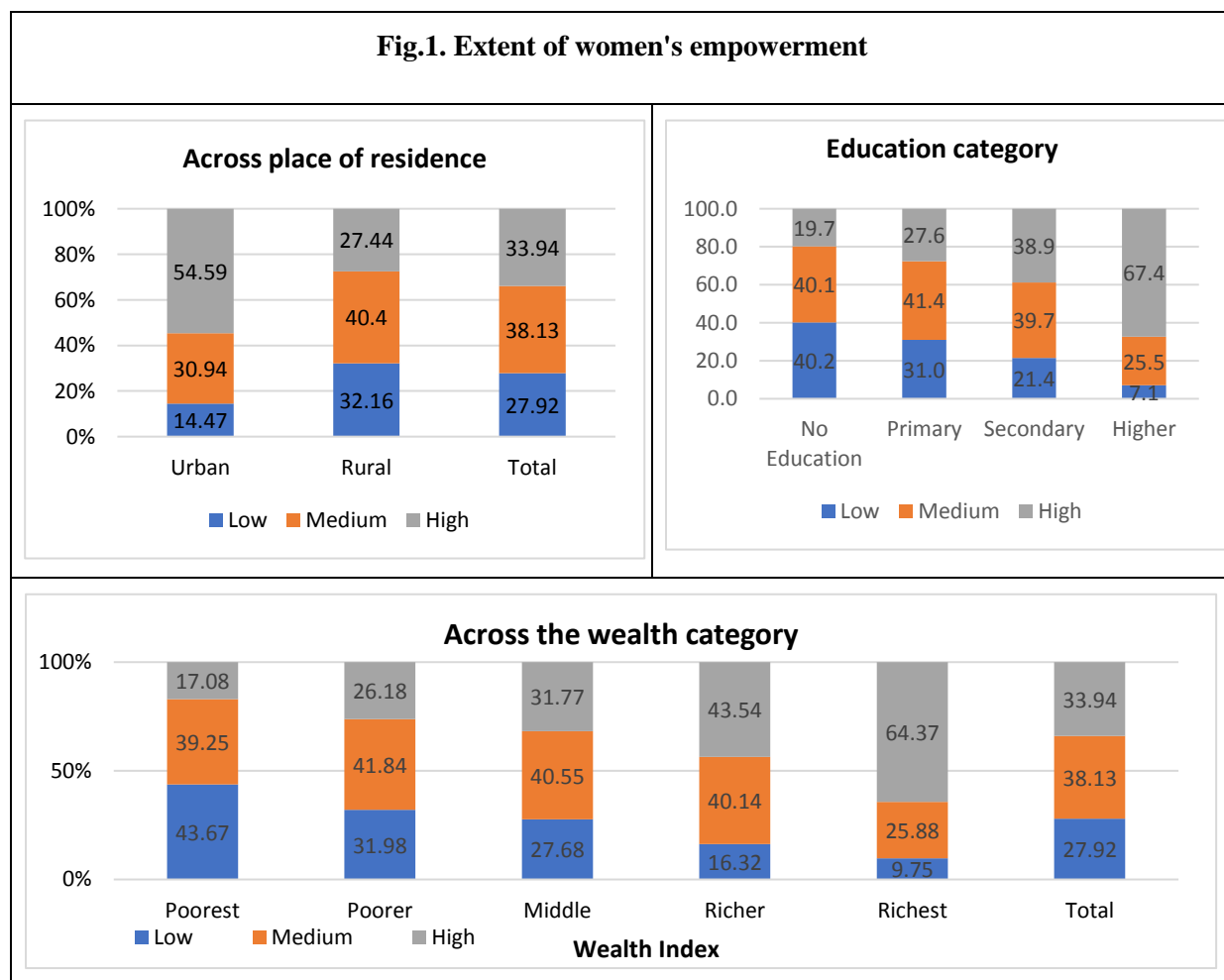
The nutritional status of children and adults

Children

Th incidence of wasting among children were slightly higher in urban areas (19%) than rural areas (17%) (Fig.2). Similar to our finding, a study in Maharashtra also reported that the prevalence of wasting, stunting and underweight were more seen in an urban slum than a rural area (Murarkar et al 2020). The children belong to higher WEI household's relatively less wasted (15%) than low WEI household (18%).

The Fig.2. clearly shows the negative relationship between wealth and education and wasting incidence among children. Whereas, the inverse relations of wealth, education and women empowerment was more prominent in children underweight (Fig.3.). That is, as wealth increases the underweight declines, similarly education and WEI. And incidence of underweight is slightly more in rural than urban. However, there are no significant differences in the incidence rate of anemia across wealth, education, and place of residence (Fig.4). It reflects the lack of awareness about the micronutrient category across all types of households.

Fig.2. Proportion of children wasted
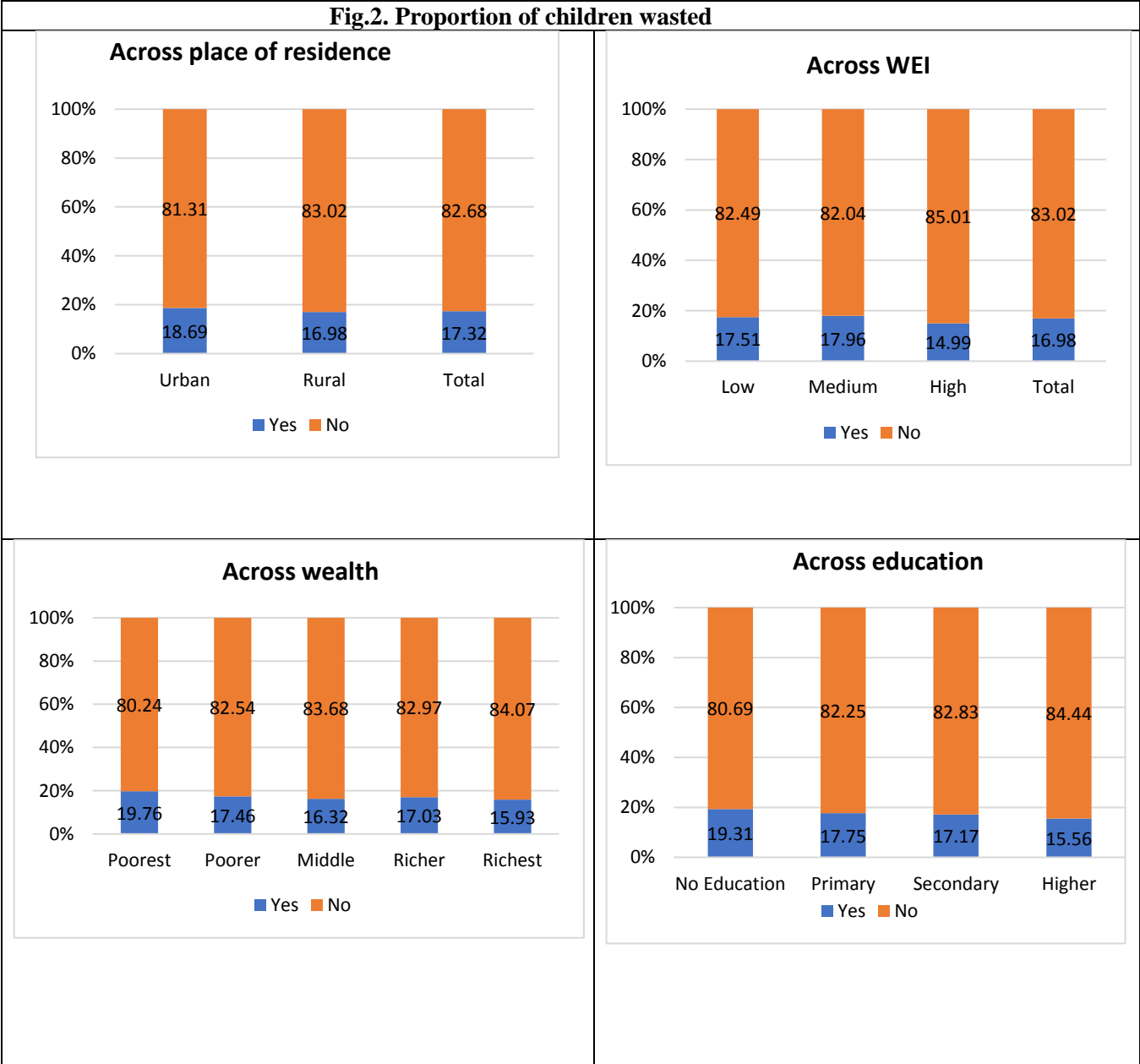
Fig. 3. Proportion of children underweight

Across place of residence

	Urban	Rural	Total
No	71.83	66.89	67.86
Yes	28.17	33.11	32.14

Across WEI

	Low	Medium	High
No	64.39	66.47	73.35
Yes	35.61	33.53	26.65

Across wealth

	Poorest	Poorer	Middle	Richer	Richest	Total
No	59.04	65.46	70.32	73.53	77.89	67.33
Yes	40.96	34.54	29.68	26.47	22.11	32.67

Across education

	No Education	Primary	Secondary	Higher	Total
No	60.49	64.85	69.76	76.2	67.33
Yes	39.51	35.15	30.24	23.8	32.67

Fig.4. Children's Anemia status
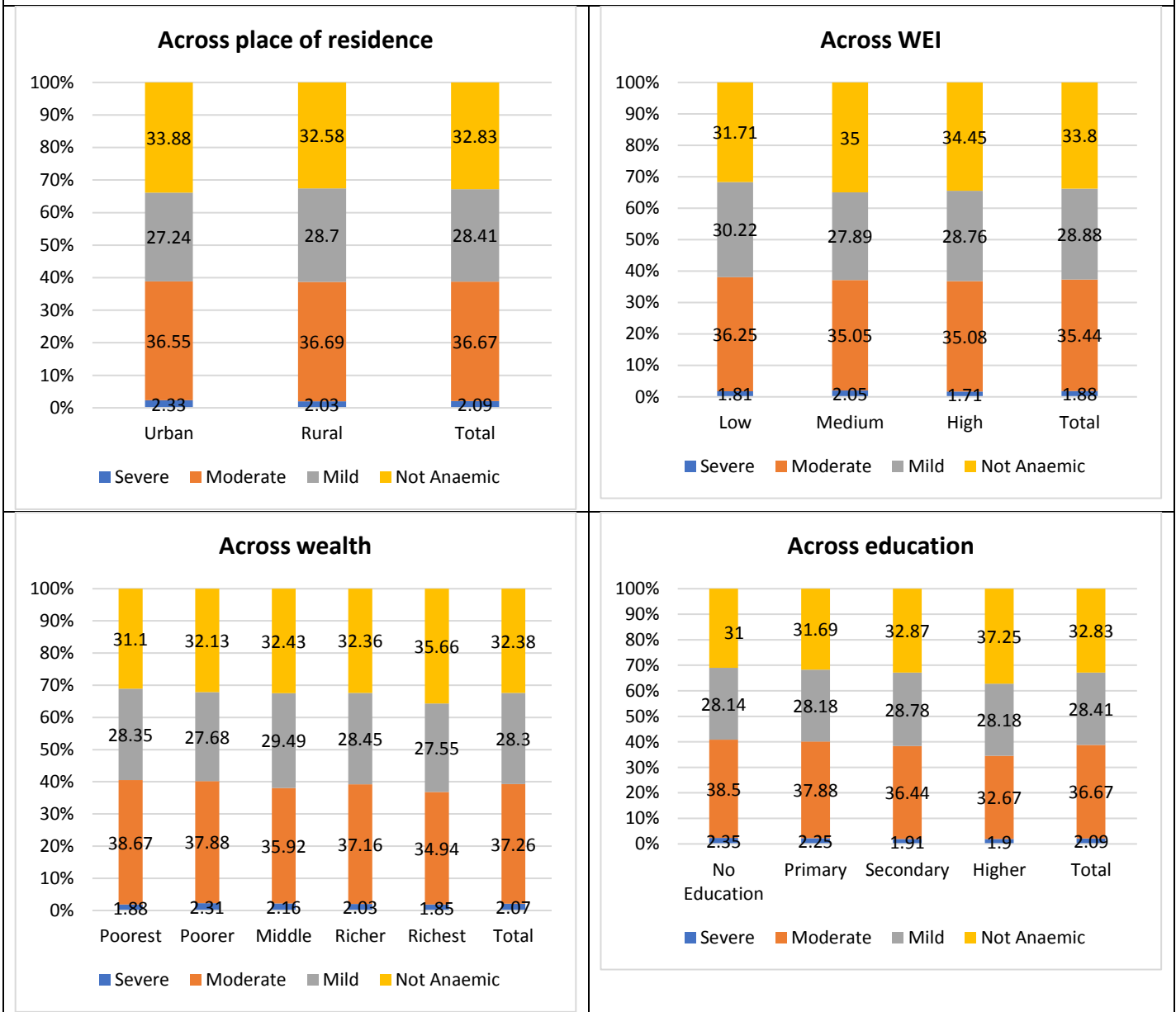
Adults

Interestingly the malnutrition incidence is slightly lower for women in rural (38%) than urban (43%) areas (Fig.5). Being overweight is a major concern for urban women (31%) and underweight (20%) for rural women. The women in the wealthiest families (36%) were more prone to being overweight than the poorest (11%). A reverse trend in underweight was observed — 26 % of the poorest households'

women are underweight, and 10 % of women in the case affluent households. The incidence of underweight declined with increase in women empowerment. While, increasing obesity was observed with women's empowerment. The mixed relationship was observed between education and women's malnutrition.

Fig.5. Women's malnutrition status

Across place of residence

|	Urban	Rural	Total
Underweight	13.3	20.14	18.49
Overweight	30.52	18.31	21.26
Normal	56.19	61.55	60.25

Normal Overweight Underweight

Across WEI

	Low	Medium	High	Total
Underweight	19.18	13.16	9.64	13.66
Overweight	19.05	27.73	33.63	27.29
Normal	61.77	59.11	56.73	59.05

Normal Overweight Underweight

Across wealth

	Poorest	Poorer	Middle	Richer	Richest	Total
Underweight	25.95	21.02	17.81	14.32	10.12	18.49
Overweight	11.29	15.88	20.87	27.15	36.34	21.26
Normal	62.76	63.1	61.32	58.53	53.54	60.25

Normal Overweight Underweight

Across edcucation

	No Education	Primary	Secondary	Higher	Total
Underweight	15.15	17.69	22.58	13.85	18.49
Overweight	22.81	22.61	18.44	25.24	21.26
Normal	62.05	59.7	58.98	60.91	60.25

Normal Overweight Underweight

The malnutrition trend among men also observed the similar trend to their counterparts (Fig.7). That is proportion normal men is more in rural than urban areas and overweight is more problem for urban

men than rural. This result is consistent with a study conducted in Myanmar (Thapa et al., 2021). Also, with the increase in wealth and education, obese incidence also raises. The difference between men and women in anemic is starker as 50% of the women are anemic with various grades, while only 22% of men are. But anemic incidence didn't vary significantly across various type of household, indicating low awareness of micronutrient deficiency across the households (Fig. 6 and 8).

Fig.7. Men's malnutrition status
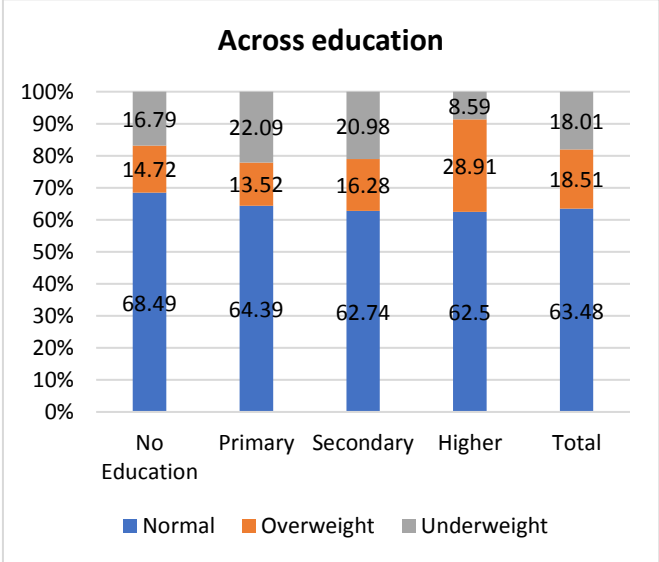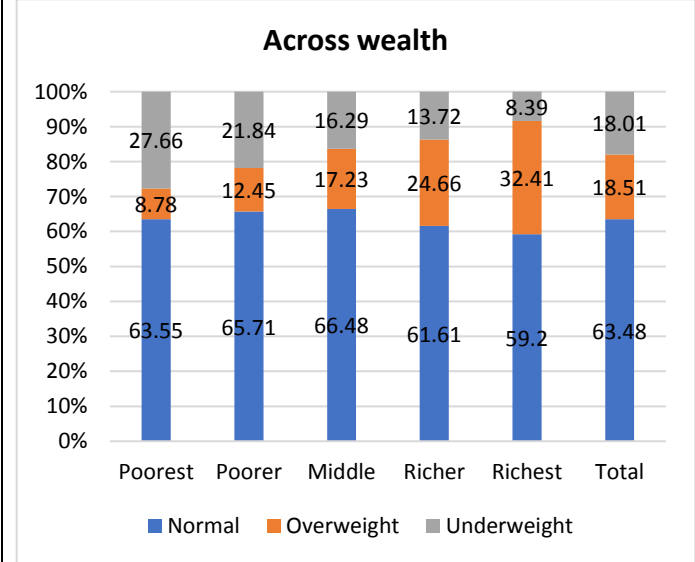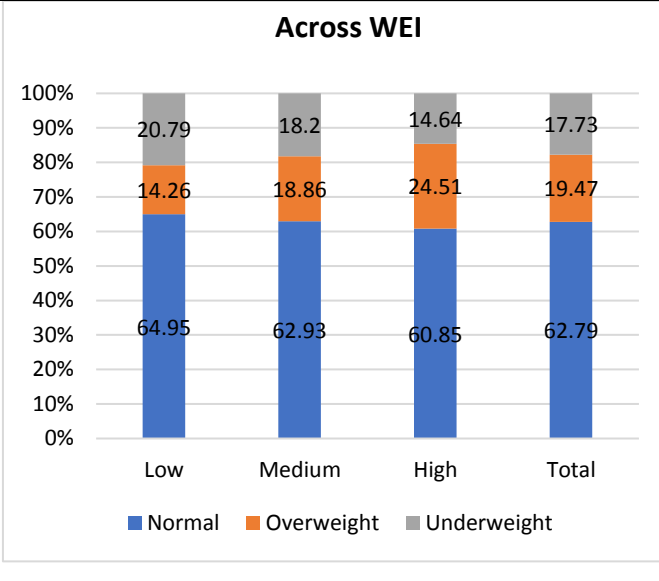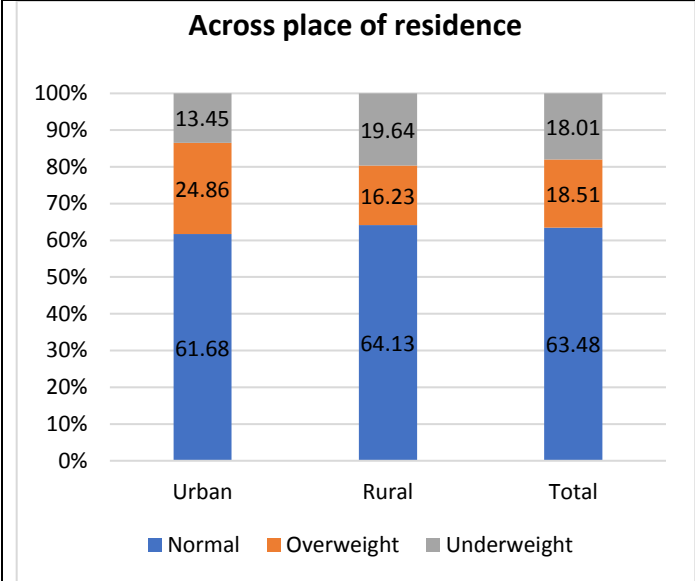
Fig.8. Men's Anemia status
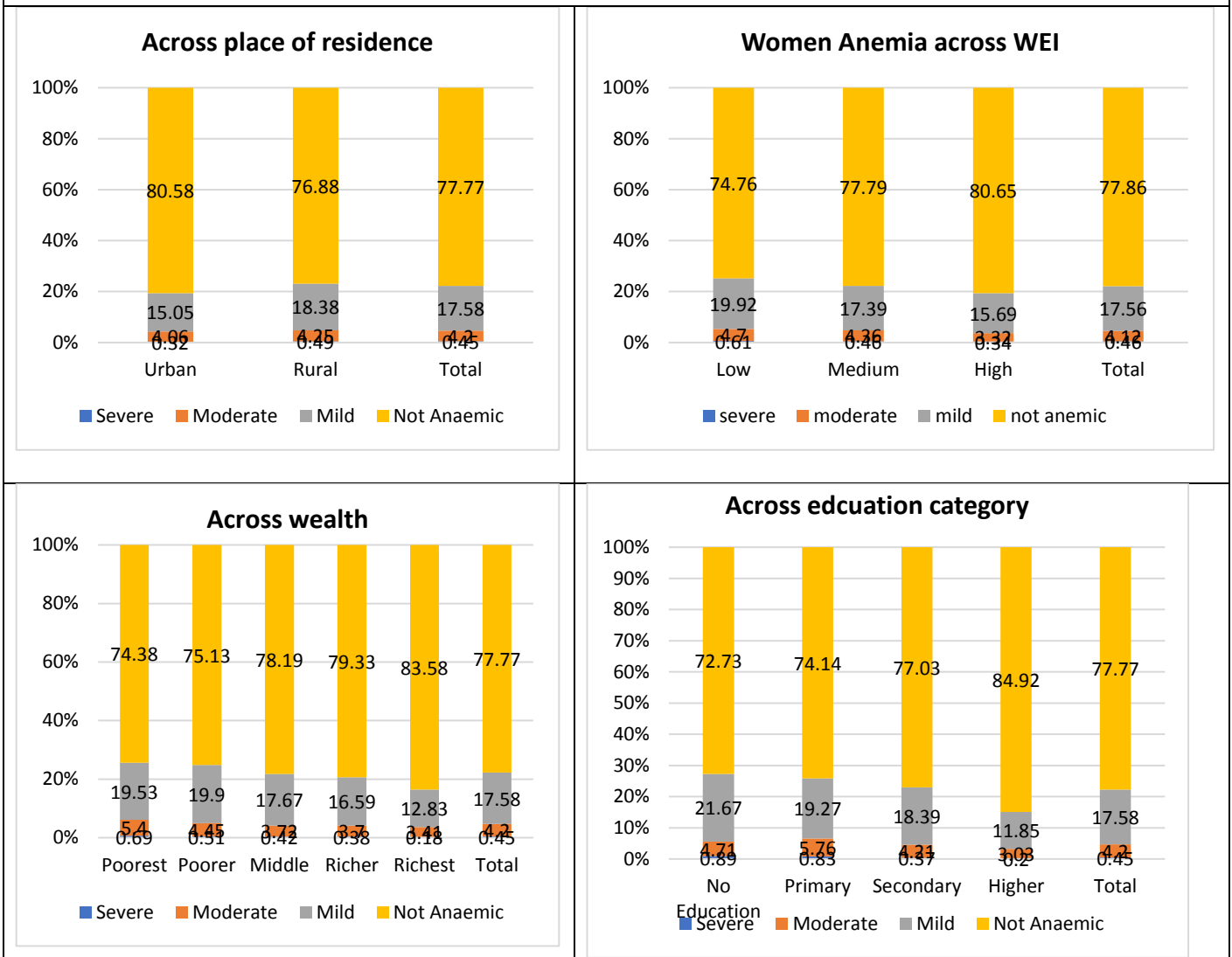
Association between nutritional outcome and women's empowerment

We analysed the associations between women's empowerment with nutritional outcomes of family members by using logit models. And examined how these associations differ by age, education and sex of the head of the households, wealth and family size. The logit analyses clearly indicate that women's empowerment has a significant role in a woman's health status and her children's (Table.1) . The children from the most empowered women households were 3.5 times less likely to be stunted, 2.4 times less likely

to be underweight, and three times less likely to be anemic at a 5% significance level, given the other variables in the model are held constant.

Table 1. Results of logistic regression analysis of children's malnutrition

Variable	Child Stunt		Child Wasted		Child Under Weight		Child Anaemia	
	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value
Wealth index	1.00	0.000	1.00	0.021	1.00	0.000	1.00	0.543
Sex of the head of the household 0"Male" 1 "Female."	1.20	0.109	1.00	0.985	1.08	0.463	1.03	0.805
Age of the head of the household	0.99	0.000	1.00	0.439	0.99	0.000	0.99	0.021
Household size	1.10	0.000	1.04	0.024	1.08	0.000	1.07	0.001
Education of Head of household								
Primary	0.85	0.162	0.96	0.794	0.82	0.096	0.81	0.116
Secondary	0.79	0.015	0.83	0.109	0.74	0.002	0.85	0.171
Higher	0.69	0.024	0.82	0.319	0.86	0.346	0.71	0.057
WEI	**0.29**	**0.005**	**0.58**	**0.301**	**0.42**	**0.048**	**0.33**	**0.035**
Place of Residence	1.14	0.247	0.70	0.006	0.93	0.560	1.23	0.114
_cons	1.52	0.304	0.71	0.473	1.35	0.466	3.84	0.005
Pseudo R2	0.042		0.007		0.028		0.009	
Number of observations	2929		2877		2964		2640	

Similarly, a one-unit increase in women empowerment scores would result in a 2.8-unit increase in the ordered log odds of being in a non-anemic category at a 10% significance level, while the other variables in the model are held constant (Table.2). The relative risk ratio (RRR) of multinomial logit analysis indicates that the risk of being underweight decreases as women's empowerment increases at a 1% significance level. However, the risk of becoming obese increases, showing negative relationships. The hypothesis of women's empowerment declines undernutrition is well supported by many studies (Alemayehu et al 2015; Karaoğlan et al. 2018; Poulain et al. 2019; Madzorera and Fawzi, 2020; Abreha et al. 2020; Mekonnen et al 2021). On the other hand, there is no consensus on association of women's empowerment with obesity. Some studies reported inverse relations between them (de Soysa and Lewin, 2019 ; Tumas et al, 2022;); while others argued disproved this hypothesis (Fox et al. 2019; Jones et al.,2020). Our findings are consistent with later hypothesis. The divergence in results plausible due to the methodological approach, cultural difference and dietary preferences. But the obese are influenced by many factors besides empowerment, like psychological and hormonal changes that need further probing (Tumas et al, 2022). The WEI is not significant in determining men's BMI status. On the other hand, higher women's empowerment was associated with a lower prevalence of men's anemia at a 1% significance level. In the case of men, we found no significant association between women empowerment and prevalence of malnutrition

Table 2. Results of multinomial logit, ordinal logit and logistic regression analysis of adults malnutrition

Variables	Women				Men					
	Women BMI – Multinomial logit model (Base=Normal BMI, Overweight, Underweight)		Women Anaemia Level -(Ordinal Logistic Model)		Men Under Weight (logistic)		Men Over Weight (logistic)		Anaemia (logistic)	
	RRR	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value
Normal BMI	(Base Outcome)									
Overweight										
Wealth Index	1.00	0.000	1.00	0.502	1.00	0.000	1.00	0.000	1.00	0.177
Sex of head of the household 0 "Male" 1 "Female."	1.19	0.025	1.07	0.243	1.47	0.001	0.98	0.901	0.74	0.127
Age Of The Head Of The Household	1.01	0.003	1.00	0.228	1.01	0.047	1.01	0.026	1.00	0.257
Household Size	0.96	0.001	0.98	0.102	1.07	0.000	1.05	0.001	1.10	0.000
Education Of Head Of Household										
Primary	1.12	0.177	0.95	0.502	1.15	0.182	1.08	0.522	0.86	0.343
Secondary	1.25	0.001	0.96	0.243	1.05	0.594	1.45	0.000	0.92	0.505
Higher	1.23	0.038	1.17	0.228	0.78	0.112	1.47	0.003	0.87	0.536
Women Empowerment Index	**2.75**	**0.001**	**2.86**	**0.102**	**0.72**	**0.392**	**1.75**	**0.144**	**0.37**	**0.087**
Place Of Residence	0.78	0.000	1.16	0.502	1.23	0.060	1.19	0.058	1.07	0.657
_Cons	0.24	0.000	-	-	0.09	0.000	0.08	0.000	0.38	0.077
Underweight										
Wealth Index	1.00	0.000	-	-	-	-	-	-	-	-
Sex of head of the household 0 "Male" 1 "Female."	0.88	0.208	-	-	-	-	-	-	-	-
Age Of The Head Of The Household	1.00	0.325	-	-	-	-	-	-	-	-
Household Size	1.01	0.370	-	-	-	-	-	-	-	-
Education Of Head Of Household			-	-	-	-	-	-	-	-
Primary	1.10	0.306	-	-	-	-	-	-	-	-
Secondary	0.98	0.842	-	-	-	-	-	-	-	-
Higher	0.71	0.047	-	-	-	-	-	-	-	-
Women Empowerment Index	**0.29**	**0.001**	-	-	-	-	-	-	-	-
Place Of Residence	1.17	0.144	-	-	-	-	-	-	-	-
_Cons	0.41	0.013	-	-	-	-	-	-	-	-
Pseudo R2	0.045		0.002		0.026		0.075		0.019	
Number Of Observation	6678		6549		4654		4913		2095	

Conclusion

In summary, we found a positive relationship between household wealth and women's empowerment, indicating the vulnerability of women in poor families, especially in rural areas. Our results also suggested that women's empowerment differs across educational backgrounds and places of residence. Finally, we found that the prevalence of malnutrition is negatively associated with women's empowerment, especially children and women. These findings highlight the need for promoting women's empowerment-based policies and interventions to address the malnutrition problem.

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