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Resonating progress? Analysis of women's empowerment on poverty reduction in Sudan: focus on household income poverty and multidimensional poverty

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This study explored the profound impact of women's empowerment on household well-being, including health and nutrition, living conditions, and education. Utilizing data from the 2022 Sudan Labor Market Panel Survey (SLMPS-2022), we restricted the sample to 4,267 married women to investigate the relationship between women's empowerment and poverty reduction in Sudan. Descriptive analysis revealed significant deprivations in education, nutrition, access to safe drinking water, and adequate sanitation facilities, within Sudanese households. Our findings demonstrate a strong positive correlation between women's empowerment and improved household well-being. Increased women's empowerment scores, women's education, freedom to work outside the home, income autonomy, control over household purchases, and participation in decision-making, were significantly associated with increased household income and a simultaneous reduction in both income poverty and multidimensional poverty. Conversely, domestic gender violence and limited participation in paid employment exerted a detrimental impact, significantly decreasing household income and increasing both income poverty and multidimensional poverty. In the main, our results underscore the crucial role of women's empowerment in reducing income and multidimensional poverty in Sudan. To effectively enhance women's empowerment, the Sudanese government should prioritize investing in education, particularly by implementing nationwide school feeding programs, providing free primary education, and offering subsidies for secondary education to improve educational outcomes and increase female literacy rates.

Keywords: women empowerment, multidimensional poverty, income poverty

Can we salvage the 2030 Agenda from the brink of collapse? As the world grapples with a myriad of challenges, gender inequality persists as a formidable obstacle to sustainable development. The *Sustainable Development Goals [SDGs] (2024) Report* highlights that only 17% of SDG targets are on track, while nearly half show minimal or moderate progress, and over a third of the Goals have stalled or even regressed. However, there is still hope to achieve these ambitions by 2030 if we swiftly enhance our efforts. In this context, achieving gender equality is a key goal of the 2030 Agenda for SDGs, as women and girls continue to face significant discrimination worldwide (UN, 2015). An essential aspect of women's empowerment is its connection to improving health and nutrition, ensuring food security, eliminating hunger, and reducing poverty (Wei et al., 2021; Malapit–Quisumbing, 2015). Poverty is defined as “deprivation of well-being”, with “well-being” measured by education, assets, housing, health, nutrition, and certain human rights (Malmberg et al., 2001). Women empowerment and enhancing their status can significantly contribute to achieving sustainable development and fostering positive societal change (Gupta–Yesudian, 2006).

Globally, women make up about 43% of the total agricultural labor force (Doss, 2014) and contribute to 50% of total food production (FAO, 2011). Evidence shows that when women have greater control over household income, the proportion spent on healthy food increases, as women tend to prioritize nutritious and high-quality foods over unhealthy options (Sraboni et al., 2014; Wouterse, 2016). Thus, to deliver the promise of Agenda 2030, women empowerment is key to rural transformation and development, primarily aimed at reducing household vulnerability to poverty and food insecurity (Action Aid International, 2011; Sharaunga et al., 2015). Moreover, empowering women is a crucial strategy in the fight against multidimensional poverty, especially in developing countries like Sudan (Sharma et al., 2012; Faborode–Alao, 2016).

Sudan continues to grapple with high poverty levels and the need to improve the socio-economic conditions of its impoverished citizens. According to the most recent Multidimensional Poverty Index (MPI) estimates, 52.3% of the population in Sudan (23,892 thousand people in 2021) is considered multidimensionally poor, while an additional 17.7% is deemed vulnerable to multidimensional poverty (8,063 thousand people in 2021). The average deprivation score among those living in multidimensional poverty is 53.4%. The MPI value, which reflects the proportion of the population that is multidimensionally poor adjusted for the

intensity of deprivations, stands at 0.279 (UNDP, 2024). These statistics indicate that Sudan is facing a severe poverty crisis, with 52.3% of the population experiencing multiple deprivations across areas such as health, education, and standard of living. Furthermore, the 17.7% classified as vulnerable to multidimensional poverty highlights a significant risk of falling into poverty. The intensity of deprivations at 53.4% suggests that those living in poverty endure significant limitations in education, health, and living standards.

Moreover, almost half of Sudan's unemployed population is under the age of 25, with women being disproportionately impacted. Sudanese women face significant restrictions in their legal rights, encounter challenges from patriarchal customs, and have limited access to finance and decision-making authority; for instance, only 3% of firms in Sudan have a woman in a top managerial role. Furthermore, literacy rates in Sudan are low, with a male literacy rate of 65.44% compared to 56.06% for females. The situation is particularly severe among young women, as approximately 45.2% of girls and women aged 15–24 are illiterate (UNICEF, 2020). Although women constitute slightly more than half of Sudan's population, their social status remains very low, making their empowerment essential for achieving positive changes in line with the Sustainable Development Goals on poverty eradication and gender equality.

Poverty remains a persistent challenge, particularly in developing regions like Sudan. While women's empowerment has been recognized as a potential solution, the quantification of its direct impact on household income poverty and multidimensional poverty remains unclear in Sudan. Whereas previous studies have examined the multifaceted impact of women's empowerment (e.g., Akter *et al.*, 2017; Oladokun *et al.*, 2018; Sinharoy *et al.*, 2019; Sraboni–Quisumbing, 2018), our study aims to quantify the specific effects of women's empowerment on both the household income poverty and multidimensional poverty. We aim to contribute to the broader discourse on the SDGs by providing empirical evidence that extends beyond existing descriptive literature, to inform policies and interventions that can effectively address poverty and promote sustainable development.

Our contribution is twofold. First, we analyze the impact of women's empowerment on the household's income, using the poverty line approach based on Foster *et al.*'s (1984) poverty indicators. Here, we convert household income from Sudanese pounds to US dollars using a purchasing power parity exchange rate of 1 USD = 2,000 Sudanese pounds (Bank of Khartoum, 2024). Second, to assess household deprivation across various poverty dimensions and their capacity to meet basic needs, we employ the weighted MPI approach following UNDP (2013) and Alkire–Santos (2014). We calculate different MPI measures for each sample household, assigning one and zero values to each of the MPI indicators.

Initially, we determine the “total deprivation score for each household” by summing the weighted values of each indicator. Next, we create a “multidimensional poverty dummy,” which takes a value of one if a household's total deprivation score is equal to or exceeds a threshold of 0.33, and zero otherwise (*Alkire–Santos, 2014*). Lastly, we compute a “multidimensional poverty intensity” score, which equals the deprivation score if the household is multidimensionally poor (MPI dummy equals 1) and zero otherwise. For our empirical strategy, we apply Ordinary Least Squares (OLS) estimators for continuous dependent variables i.e., income, poverty gap, and multidimensional poverty intensity. As well, we apply Logistic regression model for binary dependent variables i.e., income poverty dummy and MPI dummy.

1. Literature review

1.1 Poverty and women's status in Sudan

Across the African continent, women disproportionately face poverty and hunger due to entrenched systemic discrimination in accessing education, healthcare, employment, and asset ownership (*World Bank, 2012*). Addressing these inequalities by placing women at the forefront of Africa's development agenda is vital for effective poverty reduction (*Elsheikh–Elamin, 2016*). Sudan ranks 128th out of 146 countries on gender equality, underscoring stark disparities in social status and economic opportunities between men and women (*Asia, 2023*). In Sudan, only 33% of working-age women are active in the labor force, compared to 75% of men. Even among those who participate, women experience significantly higher unemployment rates and earn just 60% of what their male counterparts earn, on average (*Etang Ndip–Lange, 2019*). The situation is even more dire for urban women living in poverty, particularly those without assets (79%), private businesses (94.2%), or education (93%). Women with high levels of economic dependency are especially vulnerable, with 90% living below the poverty line (*Elsheikh–Elamin, 2016*). Beyond economic hardship, Sudanese women endure profound social and cultural challenges. A staggering 87% of women aged 15–49 have undergone some form of female genital mutilation (FGM), though this drops to 32% for girls aged 0–14. Moreover, most women lack autonomy in making critical decisions regarding their family's economic well-being, perpetuating cycles of dependency and poverty (*Elsheikh–Elamin, 2016*).

These persistent barriers highlight the urgent need for targeted interventions to uplift and empower women in Sudan.

1.2 Empirical studies

The concept of women's empowerment is multifaceted and often intertwined with related terms like gender equality, female autonomy, and women's status (*Narayan, 2005*) which all emphasize women's power and control in making life choices. Women's empowerment is a process through which women acquire knowledge and skills, and access valuable resources to shape their lives (*Cornwall, 2016*). It not only improves women's lives but also influences broader developmental outcomes, including poverty (*Moyo et al., 2012*). The concept of empowerment is inherently linked to power dynamic and the struggle for agency (*Sen, 1997*). However, women's empowerment is distinct from the empowerment of other marginalized groups, largely due to the specific intra-household power dynamics (*Doepke–Tertilt, 2014*).

Women's empowerment and gender equality are often viewed as interconnected; advancing gender equality necessitates women's empowerment, while women's empowerment also fosters greater gender equality (*Wei et al., 2021*). In contexts of gender inequality or discrimination, women often face exclusion and limited access to decision-making and resources (*Sundar, 2017*). Definitions of women's empowerment generally refer to women's ability to control their own lives, make independent decisions, and influence their life choices. This often involves acquiring and controlling various resources, including not just material and financial assets, but also social and human resources that enhance a woman's capacity to exercise her choices (*Wei et al., 2021*). However, it is important to note that empowerment is multidimensional, and women may be empowered in some areas but not in others (*Sharaunga et al., 2019*). Noteworthy, women empowerment requires both resources and the ability to make choices (agency) to effectively have a decent livelihood. This agency includes decision-making authority, financial control, and freedom of movement. While there is no single definition of women's empowerment in the literature, it is often conceptualized as a process, an outcome, an end state, or a means to an end, and as a capacity to gain power and exercise agency (*Alsop et al., 2006; Njoh–Ananga, 2016*).

Studies have investigated various aspects of women's empowerment, including education (*Takayanagi, 2006*), political participation (*Grabe, 2015*), gender-based domestic violence (*Wekwete et al., 2014*), resource control (*Rao, 2017; Solanke et al., 2018; Ragsdale et al., 2018*), entrepreneurship (*Kapinga–Montero, 2017*),

well-being (*Fielding–Lepine, 2017*), household decision-making (*De Brauw et al., 2014; Maligalig et al., 2019*), time poverty (*Bain et al., 2018*), and health (*Badejo et al., 2017*). While women's empowerment is fundamentally essential for individual and societal well-being, evidence from developing countries demonstrate that women's empowerment enhances children's health and education (*World Bank, 2012*), reduce child mortality (*Gakidou et al., 2010*), improve the effectiveness of organizations (*McKinsey Company, 2017*), boost agricultural productivity (*FAO, 2014*), and stimulate sustainable growth while alleviating poverty (*OECD, 2012*). Moreover, empirical evidence suggests that empowerment is crucial for reducing both household income and multidimensional poverty (*Alsop et al., 2006*). Empowering women within a poor household not only benefits them but also empowers the entire household, making this a significant area for research in developing countries like Sudan.

2. Methods

2.1 Data

We utilized data taken from the 2022 Sudan Labor Market Panel Survey (SLMPS 2022), the first phase of a longitudinal study investigating human resource development in the Sudanese economy. The survey is designed to investigate the intricate relationship between labor market dynamics and a range of socioeconomic factors within the Sudanese economy. These factors include education, training, family formation, migration, gender equality, enterprise development, housing acquisition, and intergenerational mobility. Drawing upon the Living Standards Measurement Study Plus (LSMS+) framework, the SLMPS 2022 surveyed a nationally representative sample of 5,000 households across 18 states and 189 localities. Guided by 2020 population estimates derived from remote sensing data, a stratified cluster sampling method was employed to divide the 5000 households into 250 primary sampling units, encompassing refugee camps, IDP camps, IDP areas, non-refugee/non-IDP rural areas, and urban areas. To focus on the specific experiences of married women, our analysis was limited to this population, as conventional measures of empowerment often center on marital experiences (*Wei et al., 2021*). Empowerment within marriage significantly impacts women's economic well-being and health, as well as the well-being of

their families (Yount, 2005). After excluding observations with missing data, the final sample for this study consisted of 4,267 married women.

2.2 Variable description

2.2.1 Women empowerment indicators

Based on existing literature, we identified several key indicators of women's empowerment: household decision-making, gender attitudes and beliefs, physical mobility, control over resources, and relative freedom from family dominance (Habibov *et al.*, 2017; Gupta–Yesudian, 2006; Ganle *et al.*, 2015; Malapit–Quisumbing, 2015; Sraboni–Quisumbing, 2018).

Table 1

Indicators of women empowerment

Dimension	Indicator	
Household decision-making	Making decisions on daily household needs	1, if a woman participated in decision-making, either alone or jointly with their husband, 0 otherwise
	Making decisions on visits to family, friends, and relatives	
	Making decisions on access to household money	
	Making decisions on visiting doctor for their own treatment	
	Making decisions on their own healthcare	
Attitude towards wife-beating	Wife-beating is justified if wife talks to other men	1, if a woman responded negatively, 0 otherwise
	Wife-beating is justified if wife argues with her husband	
	Wife-beating is justified if wife refuses to have sex with her husband	
	Wife-beating is justified if wife burns the food while cooking	
	Wife-beating is justified if wife neglects the children	
Physical mobility	Going alone to the market	1, if a woman responded positively, 0 otherwise
	Going alone to visit friends' and relatives' homes	
	Going alone to take children to the doctor	
	Going alone to a doctor for treatment	
Control over resources	Going alone to places outside of their home	1, if a woman responded positively, 0 otherwise
	Decision on the sale or purchase of major household items	
	Ownership of assets	
	Having access to formal loans applications	
Relative freedom from family domination	Participation in paid employment	1, if a woman responded positively, 0 otherwise
	Whether their income is paid to them directly	
	Whether they are allowed to work	

Source: authors' construction based on Wei *et al.* (2021).

2.2.2 Household and multidimensional poverty indicators

We examined the poverty levels of the women and their households using two approaches: (1) the classical income poverty approach, and (2) the multidimensional poverty index (MPI). For income poverty, we assessed household income on a daily basis and converted it into US dollars. In our analysis, the MPI incorporates non-monetary indicators across three dimensions of poverty: education, health, and living standards (*Alkire–Santos, 2014*). The MPI consists of 10 indicators within these three dimensions, which align with global standards (*UNESCO, 2010*). In the education dimension, we considered two indicators: school attendance for children of school age and the completion of at least five years of schooling by all household members. For the health dimension, we included nutrition and child mortality as key indicators. Nutrition was assessed using the Body Mass Index (BMI) for adults and weight-for-age measurements for children. Child mortality was indicated by the death of any child under five years old within the household. The standard of living was evaluated based on factors such as access to electricity, sanitation facilities, drinking water sources, floor type, cooking fuel, and asset ownership (*Alkire–Santos, 2014*).

Table 2

MPI dimensions, indicator, deprivation cut-off, and weights

Dimension	Indicator	Deprivation cut-off	Relative weights
Education	Years of schooling	No household member has at least 5 years of schooling	1/6
	Child's school attendance	Any school-aged child not attending school in grades 1 to 8	1/6
Health	Child mortality	Any child who has died in the household	1/6
	Nutrition	Any malnourished adult or child	1/6
Living standards	Electricity	The household has no electricity	1/15
	Sanitation	The household sanitation is not improved (according to SDGs guidelines) or it is improved but shared with another household	1/15
	Drinking water	The household does not have access to safe drinking water (according to SDGs guidelines) or safe drinking water is more than 30 km from home (round trip)	1/15
	Cooking fuel	The household cooks with dung, coal, or wood	1/15
	Asset ownership	The household does not own one of the following assets: radio, TV, motorbike, refrigerator, telephone, bicycle, or does not own a car or truck	1/15

Note: a household is considered to have access to improved sanitation if it has some type of flush toilet or latrine, or ventilated improved pit or composting toilet, provided that they are not shared. A household has access to safe drinking water if the water source is any of the following types: piped water, public tap, borehole, or pump, protected well, protected spring or rainwater, and it is within a distance of a 30-min walk (round-trip).

Source: authors' construction based on *Wei et al. (2021)*.

2.3 Empirical strategy

Next, we examine the impact of women's empowerment on the income poverty using the poverty line approach based on *Foster et al.'s (1984)* poverty indicators. Here, we convert household income from Sudanese pounds to US dollars using a purchasing power parity exchange rate of 1 USD = 2000 Sudanese pounds. If the household's income exceeded the poverty threshold of \$2.15 per day, income poverty is automatically assigned a score of zero; one otherwise. Following *Ogutu–Qaim (2019)*, we calculated the income poverty gap as a continuous variable ranging from zero to one as follows:

$$X_i = \frac{\rho - y_i}{\rho}, \quad (1)$$

where X_i is the income poverty gap, ρ is the poverty line threshold, and y_i is the per capita income of household i . Next, to examine the effect of women's empowerment on the household income and poverty gap, which is a continuous variable, we employ baseline Ordinary Least Square (OLS) estimators as follows:

$$y_i = \alpha_0 + \alpha_1 WE_i + \alpha_2 X_i + \varepsilon_i, \quad (2)$$

where y_i is the household per capita income signaling the poverty status of household i , WE_i is the total women's empowerment score, X_i represents the indicators of women's empowerment, while ε_i is the random stochastic term. Importantly, we isolate the impact of women's empowerment on poverty by analyzing separate models for each poverty indicator, while controlling for other relevant household and socioeconomic factors. Hence, we also assess the specific effect of women's empowerment on the binary income poverty using a logistic regression model as follows.

$$\text{Logit}(X_i) = \alpha_0 + \alpha_1 WE_i + \alpha_2 X_i + \varepsilon_i, \quad (3)$$

where $\text{Logit}(X_i)$ is the binary income poverty gap with a value of 0 if household income lies above the poverty line; one otherwise. Here, the binary income poverty is assumed to be linearly related to women empowerment indicators.

To assess household poverty deprivation and their ability to meet basic needs, we used the Multidimensional Poverty Index (MPI) approach developed by *Alkire–Santos (2014)* in collaboration with the United Nations Development Programme (2013). Among various methods for measuring multidimensional poverty, such as cluster analysis, factor analysis, weighting procedures, and ordinal approaches (*Alkire–Santos, 2014; Arndt et al., 2012*), we employed the weighting procedure proposed by *Alkire–Santos (2014)*. This approach identifies households experiencing deprivation and quantifies the intensity of poverty. The MPI provides measures of absolute poverty levels (in terms of intensity) that facilitate the comparison of poverty across different contexts.

The MPI weighting procedure assigns equal weight to each dimension and indicator. The poverty cut-off is set at deprivation threshold of 33.33% to define the poor, meaning that individuals with a deprivation score of 33.33% or higher are considered multidimensionally poor (Alkire–Santos, 2014). For this study, we calculate various MPI measures for each household using binary values (0 or 1) for each of the 10 indicators. First, we compute the “total deprivation score” for each household by summing the weighted values of each indicator, using weights between 0 and 1 (see Table 2). Second, we create a “multidimensional poverty dummy” with a value of 1 for households with a total deprivation score of 0.33 or higher, and 0 otherwise (Alkire–Santos, 2014). Lastly, we calculate the “multidimensional poverty intensity”, which equals the deprivation score for multidimensionally poor households (MPI dummy = 1) and 0 for others. The interpretation of this multidimensional poverty intensity is analogous to the poverty gap (Ogutu–Qaim, 2019).

To examine the effect of women's empowerment on multidimensional poverty, a continuous variable, we employ baseline Ordinary Least Square (OLS) estimators as follows:

$$y_i = \beta_0 + \beta_1 WE_i + \beta_2 X_i + \varepsilon_i, \quad (4)$$

where y_i is the multidimensional poverty intensity, WE_i is the total women's empowerment score, X_i represents the indicators of women's empowerment, while ε_i is the random stochastic term. In the same inclines, we also assess the specific effect of women's empowerment on the binary MPI dummy using a logistic regression model as follows.

$$\text{Logit}(MPI_i) = \beta_0 + \beta_1 WE_i + \beta_2 X_i + \varepsilon_i, \quad (5)$$

where $\text{Logit}(MPI_i)$ is the binary multidimensional poverty with a value of 1 for households with a total deprivation score of 0.33 or higher, and 0 otherwise. Here, the binary MPI is assumed to be linearly related to women empowerment indicators. All in all, the key coefficients of interest are those associated with women's empowerment (β_1 and α_1), which measure its impact on household income and multidimensional poverty. We expect a positive relationship (income-increasing effect) between women's empowerment and household income and a negative relationship (poverty-reducing effect) between empowerment and poverty indicators. To ensure national representativeness, we use household sampling weights in our analysis.

3. Results and discussions

The study analyzed data from the 2022 Sudan Labor Market Panel Survey (SLMPS), which included 4,267 married women (Table 3). The youngest age group (16–29 years) comprised the largest proportion (33.0%), reflecting the prevalence of early customary marriages in Sudan. Education levels varied significantly, with a high proportion (51.3%) of married women being illiterate. Other categories included “reads and writes (14.34%)”, “primary (15.14%)”, “secondary (11.93%)”, “post-secondary (0.47%)”, “university (6.35%)”, and “postgraduate (0.47%)”, with lower representation in higher education levels. The majority of married women (86.12%) were not employed in the past three months and the average household size was six members (Table 3).

Table 3

Socio-demographic indicators

Variable		Percentage	Mean	Standard deviation
Education	Illiterate	51.30	2.17	1.513
	Reads and writes	14.34		
	Primary	15.14		
	Secondary	11.93		
	Post-secondary	0.47		
	University	6.35		
	Post-graduate	0.47		
Age	16–29	33.0	2.27	1.119
	30–39	27.0		
	40–49	20.22		
	50 and above	19.78		
Employment status	Participated in paid job	13.88	1.86	0.346
	Not participated	86.12		
Household size			5.67	2.532
Number of observations		4,267		

Source: author’s computation based on SLMPS-2022.

Descriptive statistics were employed to assess women's empowerment status (Table 4), aligning with the empowerment indicators outlined in Table 1. Results demonstrated significant levels of women's empowerment in certain areas. For instance, a substantial proportion of women (62.81%) had decision-making power regarding social visits, while 43.6% and 58.31% had some level of decision-making authority over daily household needs and access to household finances, respectively. Notably, 60.41% of women had the autonomy to make decisions

about their own healthcare. However, the findings also revealed concerning levels of intimate partner violence. According to customary beliefs, a significant proportion of respondents justified wife-beating when a wife argues with her husband (7.50%), talks to other men (14.42%), burns food (5%), neglects children (8.7%), or refuses sex (7.4%). These findings are consistent with previous studies by *Wei et al. (2021)* and *Schuler et al. (2013)*. Regarding mobility, Sudanese women exhibits a substantial freedom in visiting hospitals alone (76.23%), relatives and friends (88.7%), and other places outside their homes (73.34%). However, their freedom to independently take children to doctor's appointments was more limited (71.7%). In terms of resource control, 69.42% of women owned assets, and 40.63% had some level of decision-making authority over major household purchases and sales. However, access to formal loan applications was limited, with only 0.02% of women having such access. Furthermore, 90.2% of married women received their income directly, and 76.9% were permitted to work, indicating some degree of freedom from family domination.

Table 4

Women's economic empowerment

		(%)
Dimension	Indicator	Yes
Household-decision making	Making decisions on daily household needs	43.60
	Making decisions on visits to family, friends, and relatives	62.81
	Making decisions on access to household money	58.31
	Making decisions on visiting doctor for their own treatment	60.41
Attitude towards wife-beating	Wife-beating is justified if wife talks to other men	14.42
	Wife-beating is justified if wife argues with her husband	7.50
	Wife-beating is justified if wife refuses to have sex with her husband	7.41
	Wife-beating is justified if wife burns the food while cooking	5.02
	Wife-beating is justified if wife neglects the children	8.70
Physical mobility	Going alone to the market	81.06
	Going alone to visit friends' and relatives' homes	88.70
	Going alone to take children to the doctor	71.71
	Going alone to a doctor for treatment	76.23
	Going alone to places outside of their home	73.34
Control over resources	Decision on the sale or purchase of major household items	40.63
	Ownership of assets	69.42
	Having access to formal loans applications	0.02
	Participation in paid employment	13.88
Relative freedom from family domination	Whether their income is paid to them directly	90.21
	Whether they are allowed to work	76.89

Notes: "Yes" indicates a positive outcome for indicators of women's participation in household-decision making, physical mobility, control over resources, and relative freedom from domination by the family; as well, "Yes" implies negative outcome for indicators of attitude towards wife-beating.

Source: author's computation based on SLMPS-2022.

The analysis revealed that a significant portion of the households are still multidimensionally poor (Table 5), as defined by indicators such as years of schooling, child school attendance, child mortality, nutrition, sanitation, drinking water, cooking fuel, and electricity. Alarming, a significant proportion of households (67%) are deprived of years of schooling, while 53% faced challenges in ensuring child school attendance. These findings align with the relatively low literacy rate in Sudan (60.7%), particularly among young women (45.2%) (UNICEF, 2020). While child mortality rates were relatively low (7.2%), a substantial proportion of households (42.5%) experienced nutritional deficiencies. Access to safe drinking water remained a challenge for 30% of households, despite the availability of various water sources such as underground wells, manual pump water, dam water, canals/running water/springs, which are not in line with SDG guidelines. Furthermore, 30% of households are deprived of sanitation facilities, often relying on shared toilets (balady) or lacking proper sanitation altogether. Cooking fuel usage also presented a significant challenge, with 67% of households relying on traditional fuels such as firewood, animal waste, coal, and straw. Moreover, access to electricity was limited, with 30% of households lacking access to electricity as their primary source of lighting, with a significant proportion lacking any form of lighting.

Table 5

Multidimensional poverty

MPI indicator	Deprived	Non-deprived	Mean	Standard deviation
	%			
Years of schooling	66.64	33.36	0.6664	0.472
Child’s school attendance	53.20	46.80	0.532	0.498
Child mortality	7.12	92.80	0.0712	0.257
Nutrition	42.57	57.43	0.425	0.494
Electricity	29.30	70.70	0.293	0.455
Sanitation	29.28	70.72	0.292	0.455
Drinking water	29.96	70.04	0.299	0.458
Cooking fuel	67.10	32.90	0.671	0.469
Asset ownership	34.77	65.23	0.347	0.476

Source: author's computation based on SLMPS-2022

In what follows, we present the results of the effect of women's empowerment on household income, income poverty, and multidimensional poverty. Table 6 presents the results of the effect of women's empowerment indicators on household income. Our findings indicate a significant positive association between women's empowerment scores and household income. A one percentage point increase in

the women's empowerment score is associated with approximately 0.46 percentage point increase in household income, *ceteris paribus*. Surprisingly, the results revealed that women's education had a negative impact on household income, although this effect is insignificant, contradicting findings from previous studies (Wei *et al.*, 2021). Additionally, domestic gender violence was found to have a significant negative impact on household income. Furthermore, several empowerment indicators exhibited significantly synergistic effects on the household income, including control over major household purchases, access to household income, freedom to work outside the home, and household size. Unexpectedly, employment engagement was found to have significant negative effect on household income. This could be explained by the low rate (14%) of women who had participated in paid employment in the last three months before data collection.

Table 6

Women empowerment and household monthly income

Variable	Log of household monthly income (OLS estimates)
Women empowerment score	0.00457*** (3.93e-05)
Education (years of schooling)	-0.0278 (0.000325)
Asset ownership	-1.148*** (0.00675)
Employment participation	-0.221*** (0.00482)
Domestic gender violence	-0.0177*** (0.000245)
Control over purchase of household items	0.0102*** (0.000155)
Access to household income	0.0355*** (0.00460)
Freedom work outside home	0.328*** (0.00265)
Income freedom	0.0130*** (0.000291)
Access to healthcare	-0.270*** (0.00211)
Child mortality	0.00350 (0.000814)
Household size	0.0359*** (0.000921)
Constant	11.31*** (0.0187)
Observations	4,267
R-squared	0.129

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Note: all elements of women empowerment are dummy variables while education (years of schooling), women empowerment scores, and household size are continuous variables.

Source: author's computation based on SLMPS-2022.

Table 7 demonstrates the effect of women's empowerment on multidimensional poverty reduction in Sudan. Our results reveal that increased women's empowerment, higher levels of women's education, greater women's decision-making power within the household, improved women's access to household

income, and reductions in child mortality rates, significantly contribute to lower levels of multidimensional poverty and its intensity. Conversely, experiencing gender violence, limited women's asset ownership, restricted access to healthcare, and unemployment were found to significantly exacerbate both multidimensional poverty and its intensity. Table 8 reveals a nuanced relationship between women's empowerment and income poverty reduction in Sudan. The findings suggest that increased women's empowerment, greater decision-making power within the household, improved access to household income, and women's freedom to work outside the home significantly contribute to a reduction in the income poverty gap. Conversely, factors such as experiencing gender violence, limited women's education, restricted access to healthcare, child mortality, limited asset ownership, and unemployment were found to significantly exacerbate income poverty. Furthermore, the results highlight that limited women's empowerment, limited asset ownership, restricted access to household money, and larger household size significantly contribute to higher levels of income poverty. On the contrary, increased women's education, reduced incidences of domestic gender violence, women's decision-making power in household purchases, freedom to work, and access to healthcare were found to significantly reduce income poverty in Sudan.

Table 7

Women empowerment and multidimensional poverty

Variable	Multidimensional poverty dummy (Logit estimates)	Multidimensional poverty intensity (0–1) (OLS estimates)
Women empowerment score	–0.00520*** (0.000159)	–0.000195*** (6.12e–06)
Education (years of schooling)	–0.357*** (0.00125)	–0.0336*** (5.05e–05)
Asset ownership	2.605*** (0.0390)	0.158*** (0.00105)
Employment participation	0.277*** (0.0182)	0.0174*** (0.000751)
Domestic gender violence	0.0308*** (0.00134)	0.00174*** (3.81e–05)
Purchase of major household items	–0.0233*** (0.000637)	–0.00153*** (2.40e–05)
Access to household money	–0.0941*** (0.0153)	–0.0251*** (0.000716)
Freedom work outside home	–0.475*** (0.0108)	0.00140*** (0.000413)
Income freedom	0.00182 (0.00357)	–0.00174*** (4.53e–05)
Access to healthcare	0.594 (0.00740)	0.0470 (0.000328)
Child mortality	–0.730*** (0.0133)	–0.00830*** (0.000127)
Household size	0.107*** (0.00320)	–0.00699*** (0.000143)
Constant	1.564*** (0.0695)	0.314*** (0.00292)
Pseudo R-squared	0.62	0.699

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Note: all elements of women empowerment are dummy variables while education (years of schooling), women empowerment scores, and household size are continuous variables.

Source: author's computation based on SLMPS-2022.

Table 8

Women empowerment and income poverty

Variable	Income poverty (dummy) (Logit estimates)	Income poverty gap (0–1) (OLS estimates)
Women empowerment score	0.0681*** (0.00186)	–0.000489*** (7.07e–06)
Education (years of schooling)	–0.204*** (0.00328)	0.00600*** (5.84e–05)
Asset ownership	4.608*** (0.247)	0.122*** (0.00121)
Employment participation	–	0.00911*** (0.000867)
Domestic violence	–0.123 (0.0271)	0.00168*** (4.40e–05)
Purchase of major household items	–0.141*** (0.00444)	–0.00129*** (2.78e–05)
Access to household money	3.259 (0.152)	–0.0464*** (0.000827)
Freedom work outside home	–2.671*** (0.0576)	–0.0781*** (0.000477)
Income freedom	–	–0.00154*** (5.24e–05)
Access to healthcare	–0.538*** (0.0232)	0.0305*** (0.000379)
Child mortality	–3.443*** (0.0866)	0.000153 (0.000146)
Household size	1.006*** (0.0192)	–0.00791*** (0.000165)
Constant	10.12*** (0.407)	0.714*** (0.00337)
Pseudo R-squared	0.458	0.115

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Note: all elements of women empowerment are dummy variables while education (years of schooling), women empowerment scores, and household size are continuous variables.

Source: author's computation based on SLMPS-2022.

Our findings demonstrate a significant positive relationship between women's empowerment and improved household well-being. Specifically, a 1 percentage point increase in women's empowerment scores was associated with a 0.46 percentage point increase in household income, a 0.049 percentage point reduction in income poverty, and a 0.52 percentage point reduction in multidimensional poverty (Tables 6–8), *ceteris paribus*. Women's education emerged as a significant factor in poverty reduction through its negative effect on income poverty and multidimensional poverty. Explicitly, women's education decreases income poverty and multidimensional poverty by 20.4 percentage points and 35.7 percentage points, respectively, *ceteris paribus*. Consistent with existing literature (Akerle–Adewuyi, 2011), education enhances women's participation in the labor market, leading to increased economic independence and improved household well-being (Schuler–Nazneen, 2018; Conroy, 2014). Educated women are more likely to secure better employment opportunities, make informed healthcare decisions for themselves and their children, and resist practices such as domestic violence (Bizzego., et al., 2021). Furthermore, educated individuals, particularly within households, possess a greater understanding of poverty

reduction strategies (Awotide *et al.*, 2011). Our findings also align with those of Alkire–Fang (2019), which highlight the significant role of educated couples in reducing household poverty. Furthermore, our results indicate that households with a higher number of dependents experience higher levels of multidimensional poverty, consistent with the findings of Alkire–Santos (2014). Generally, our results underscore the crucial role of women's empowerment in reducing income poverty and multidimensional poverty in Sudan, aligning with the findings of Sell–Minot (2018) and Wei *et al.* (2021).

While Heath (2014) argues that asset ownership contributes to long-term economic stability rather than income measure, our findings suggest a more nuanced relationship. Specifically, we found that women's asset ownership was associated with an increase in both multidimensional poverty (by 15.8%) and income poverty (by 12.2%), *ceteris paribus*, contrary to the findings of Wei *et al.* (2021) and the DHS (2018), which reported an increase in asset ownership in Bangladesh. Further research is needed to explore the specific types of assets owned by women and their impact on poverty outcomes. For instance, while assets such as sewing machines or livestock incubators can empower women economically (Oladokun *et al.*, 2018), other types of assets may not necessarily contribute to poverty reduction.

Our analysis, presented in Table 4, reveals that only 14% of women were engaged in paid employment. This limited employment participation may negatively impact women's empowerment, leading to a decrease in household income by 0.221 log points, *ceteris paribus*. Consequently, this contributes to an increase in the income poverty gap (0.911 percentage points) and multidimensional poverty intensity (1.74 percentage points), *ceteris paribus*, as shown in Tables 6–8. However, when women have the freedom to engage in diverse forms of employment outside home, a significant positive impact is observed. Household income increases by 32.8%, leading to substantial reductions in multidimensional poverty (47.5%) and income poverty (267.1%), *ceteris paribus*. These findings highlight the crucial role of the nature of women's employment. For many Sudanese women, employment often involves informal sectors such as entrepreneurship, street vending, tailoring, and livestock rearing, frequently facilitated by initiatives like table-banking and microcredit from NGOs. These income-generating activities not only empower women within the household but also contribute significantly to poverty reduction (Ganle *et al.*, 2015).

Our findings demonstrate a significant negative impact of domestic gender violence on household well-being. Specifically, we found that women's experience of domestic violence reduces household income by 1.77 percentage points, increases multidimensional poverty by approximately 3%, and widens the income

poverty gap by 0.168% (Tables 6–8), *ceteris paribus*. This finding aligns with the high prevalence of intimate partner violence in Sudan, as documented in Table 4, which is often rooted in deeply ingrained cultural beliefs and practices. Intimate partner violence, encompassing physical, sexual, psychological, and emotional abuse, has severe consequences. It not only deteriorates mental health and happiness (Bonilla-Algovia *et al.*, 2020) but also violates women's fundamental rights and limits their empowerment (Gupta–Yesudian, 2006). While poverty can increase the risk of violence against women (Muluneh *et al.*, 2021; Gillum, 2019), empirical evidence also suggests that men's reliance on their wives' financial contributions and a higher standard of living may reduce the incidence of domestic violence (Schuler–Nazneen, 2018). Furthermore, economic advancements in rural areas have been associated with reduced poverty and lower rates of domestic violence (Heath, 2014).

Similar to the positive impact of freedom to work outside the home, our findings indicate that 90% of women receiving their income directly also contributes positively to household well-being. This increased income independence leads to a 1.3% increase in household income (Table 6), consequently reducing multidimensional poverty intensity by 0.174% and the income poverty gap by 0.154% (Tables 7 and 8), *ceteris paribus*. This aligns with existing literature that emphasizes the importance of women's economic independence for their empowerment (Gurman *et al.*, 2016). Earning and managing their own income provides women with greater freedom of mobility, enhances their decision-making power, increases their awareness of their rights, and boosts their self-confidence. Our findings are consistent with those of Wei *et al.* (2021), which highlight the negative impact of restrictions on women's employment on household income and overall well-being. While women in Sudan often contribute significantly to household labor through unpaid work such as farming and childcare, their economic dependence on their husbands remains a concern. However, studies have shown that women's income significantly contributes to overall household income, often being pooled with their husbands' earnings (Akter *et al.*, 2017). Furthermore, women contribute to household income through various income-generating activities, such as entrepreneurship and informal sector employment, often facilitated by initiatives like microcredit (Schuler–Nazneen, 2018). As World Vision Ghana (Ganle *et al.*, 2015) emphasizes, empowering women through economic opportunities not only improves their own well-being but also contributes significantly to reducing family poverty and breaking cycles of economic dependence.

Our results further revealed that women's participation in household decision-making and their control over household purchases significantly contributes to improved household well-being. These factors were associated with a 0.0102 log

point increase in per capita household income, while simultaneously reducing income poverty by 0.141 log points and multidimensional poverty by 0.0233 log points (Tables 6–8), *ceteris paribus*. Similarly, increased women's access to household money was associated with higher per capita income and a reduction in both income poverty by -0.0464 log points and multidimensional poverty by -0.0941 log points, *ceteris paribus*. These findings underscore the importance of women's agency and decision-making power within the household. Previous studies support these findings, emphasizing the significant role of women in household food security, children's education, and overall household well-being (Schuler–Nazneen, 2018; Akter et al., 2017). However, the impact of women's empowerment on household well-being can vary across contexts. In some settings, such as poor Ghanaian communities, male dominance within the household may limit women's agency and hinder their ability to contribute to household well-being (Ganle et al., 2015). Furthermore, studies like Wouterse (2016) have shown that when women have greater control over household expenditure, they prioritize the purchase of nutritious food, leading to improved household health and well-being.

Lastly, our findings reveal a significant association between child mortality and poverty in Sudan. Table 5 demonstrates a low deprivation rate of child mortality, which is linked to a substantial reduction in both multidimensional poverty (0.73 log points) and income poverty (-3.443 log points), *ceteris paribus*. This positive relationship is likely influenced by factors such as women's access to healthcare. Our analysis (Table 4) indicates that women in Sudan have relatively high rates of healthcare accessibility, which contributes to improved child health outcomes. However, inequalities in access to education, employment, finance, decision-making power, and basic healthcare services disproportionately affect women, particularly those from poor backgrounds (Zaky, 2014). These inequalities contribute to poorer health outcomes for both women and their children. Furthermore, Lachaud (2004) revealed that low living standards, characterized by limited access to assets, are associated with higher child mortality rates, particularly in rural areas. Additionally, living in poverty or near the poverty line, coupled with a lack of health insurance coverage, significantly increases the risk of adverse health outcomes for children.

All in all, our findings demonstrate that the selected indicators of women's empowerment significantly contribute to improved household income and a reduction in various dimensions of poverty. Educated women have greater opportunities to participate in income-generating activities, engage in household decision-making, and gain greater control over resources. This empowerment enhances their awareness of their own rights and the well-being of their family members. Empowering women through education and by creating a supportive

policy environment that promotes gender equality is crucial. Such an environment would foster a virtuous cycle of women's empowerment, leading to improved social and economic outcomes for women, their families, and society as a whole.

4. Conclusions

This study examines the critical link between women's empowerment and poverty reduction in the Sudanese context. Utilizing data taken from the 2022 Sudan Labor Market Panel Survey (SLMPS-2022), which encompassed 5,000 nationally representative households, our analysis focused on married women ($n = 4267$). To measure women's empowerment, income poverty, and multidimensional poverty, and following the extant literature, we used different indicators. Descriptive analysis revealed significant deprivations within Sudanese households. Education was a major concern, with a substantial proportion of households lacking adequate years of schooling and experiencing challenges in ensuring child school attendance. While child mortality rates were relatively low, nutritional deficiencies remained prevalent among households. Furthermore, access to safe drinking water, adequate sanitation facilities, and reliable electricity sources remained significant challenges for many households. Our findings demonstrate a significant positive association between women's empowerment and improved household well-being. Increased women's empowerment scores were associated with higher household income, lower income poverty, and reduced multidimensional poverty. While women's education did not significantly impact household income, it significantly contributed to reducing multidimensional and income poverty. We contend that educated women are better equipped to make informed healthcare decisions for themselves and their children and are less likely to tolerate domestic violence.

Notably, women's freedom to work outside the home, their freedom to receive their income directly, their participation in household decision-making and control over household purchases, and access to quality healthcare for themselves and their children have been shown to significantly increase household income while simultaneously reducing income poverty and multidimensional poverty. Conversely, domestic gender violence and limited employment opportunities were found to have a detrimental impact, significantly decreasing household income, and increasing both income poverty and multidimensional poverty. It is fundamental to acknowledge that domestic gender violence remains a significant challenge in Sudan, deeply rooted in cultural norms and practices. This pervasive

issue constitutes a serious human rights violation, hindering women's empowerment and contributing to poverty. However, our findings suggest that women's empowerment through education, income generation, and decision-making power, effectively mitigate the impact of gender-based violence. We think that educated women with economic independence, access to healthcare, and freedom of movement are less likely to experience domestic violence and are better equipped to navigate challenges and improve their overall well-being.

Based on our findings, government and non-governmental organizations should prioritize programs that enhance women's economic empowerment, focusing on increasing their participation in the workforce and decision-making within households. Addressing the issue of low literacy rates, particularly among young women, is crucial. This necessitates a concerted effort to improve educational outcomes through initiatives such as nationwide school feeding programs and free primary education. Furthermore, providing incentives like subsidized secondary education can significantly increase the transition rate from primary to secondary education. We think that by empowering women through education and economic opportunities, Sudan can create a virtuous cycle of development, leading to reduced poverty and improved well-being for women, their families, and the entire Sudanese society.

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