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Authors

Alaofè, Halimatou
Zhu, Min
Burney, Jennifer
[et al.](#)

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Halimatou Alaofè, PhD¹, Min Zhu, MS²,
Jennifer Burney, PhD³, Rosamond Naylor, PhD⁴,
and Taren Douglas, PhD¹

Abstract

Background: Evidence on effectiveness of women's empowerment (WE) to reduce undernutrition is limited in sub-Saharan Africa, and few studies incorporate multidimensional measures of WE.

Objective: To examine whether a WE status, in sum and across leadership, decision-making, mobility, economic security, male involvement in housework, and nonfamily group domains, is associated with women and their children nutritional status in Kalalé district of northern Benin.

Methods: Data were obtained from the 2014 Solar Market Garden baseline study: 767 paired reproductive-age women aged 15 to 49 years and children 6 to 59 months old. Exploratory principal component (cross-validate with confirmatory) factor analysis was first conducted to identify the structure of empowerment. Then, using a new survey-based index, regression analysis was conducted to examine associations between WE measures and maternal dietary diversity score (DDS) and body mass index (BMI), as well as their child's DDS, height-for-age z score (HAZ), weight-for-height z score (WHZ), and weight-for-age z score (WAZ).

Results: Positive associations were observed between women's composite empowerment, leadership, maternal DDS and BMI, and female child's DDS. However, opposite signs were found between economic security and child's DDS. Mobility was positively associated with female children's WHZ and male children's HAZ and WAZ, while decision-making was correlated with male child's WHZ and female children's WAZ.

Conclusions: Women's empowerment can be associated with undernutrition. Efforts to improve nutrition may benefit from empowerment initiatives that promote women's self-confidence and

¹ Health Promotion Sciences Department, University of Arizona, Tucson, AZ, USA

² Epidemiology and Biostatistics Department, University of Arizona, Tucson, AZ, USA

³ School of Global Policy and Strategy, University of California, San Diego, San Diego, CA, USA

⁴ School of Earth, Energy & Environmental Sciences, Stanford University, Stanford, CA, USA

Corresponding Author:

Halimatou Alaofè, Mel and Enid Zuckerman College of Public Health, University of Arizona, 1295 N. Martin Avenue, Campus PO Box: 245163, Tucson, AZ 85724, USA.

Email: halaofe@email.arizona.edu

decision-making in Benin. However, additional qualitative and longitudinal research may enhance understanding of WE in the present area.

Keywords

women's empowerment, dietary diversity score, maternal nutrition, child nutrition, Kalalé district, northern Benin

Introduction

Women empowerment (WE) is increasingly viewed as an important strategy to reduce maternal and child undernutrition,¹⁻³ which continues to be a major health burden in low- and middle-income countries causing 3.5 million preventable maternal and child deaths, 35% of the disease burden in children younger than 5 years, and 11% of total global disability-adjusted life years.^{4,5} Global data show that one of the worst affected regions is sub-Saharan Africa (SSA), where about 20% of children are malnourished.^{6,7} Benin is no exception, as the prevalence of stunting, wasting, and underweight was 37%, 5%, and 17%, respectively, among children aged 6 to 59 months in the 2006 Benin Demographic and Health Survey (DHS),⁸ while 9% of women had chronic energy deficiency in the 2012 DHS.⁹ Greater rates were observed in rural areas where stunting was found in 40% of children, underweight in 19%, and wasting in 5%, while 10% of women had chronic energy deficiency.^{8,9} Additionally, Beninese women and children have a limited dietary diversity score (DDS), with diets predominately composed of starchy staples with little or no animal products and few fresh fruits and vegetables.^{10,11} Government, United Nation agencies, and nongovernmental organizations in Benin recognize that the state of maternal and child undernutrition requires multiple types of interventions.¹²

However, women's low empowerment status in Benin can hinder the improvement in women's and children's undernutrition. Indeed, although females accounted for 47% of the economically active population in 2014,¹³ social and civil legislation is strongly influenced by tradition and customs, as women continue to be required to seek their husband's authorization in certain areas such as family planning or health services.¹⁴

Rural women provided labor to the families' commercial plots, were responsible for household food production and processing, and also had to work in the cooperative structures set up by the state in addition to their household tasks.¹⁴ In a more recent study of productivity differences by gender in central Benin, researchers noted that female rice farmers are particularly discriminated against with regard to access to land and equipment, resulting in significant negative impacts on their productivity and income.¹⁵ As in other areas of West Africa, women also have the responsibility of caring for children and preparing food for the household,¹⁶ but they may be vulnerable to food insecurity owing to unequal intrahousehold food distribution and their willingness to forego meals in favor of children during times of scarcity.¹⁷ Finally, no study to date has examined links between women's empowerment and nutrition in Benin.

In addition, the evidence backing the effect of women's empowerment on maternal and child undernutrition is inconsistent.¹⁸ Using the Women's Empowerment in Agriculture Index (WEAI), Malapit et al¹⁹ reported positive and significant association between women's group (WG) membership, control over income, overall empowerment, and women's health (as measured by body mass index [BMI] and DDS) in Nepal. However, in Ghana, women's aggregate empowerment and participation in credit decisions were positively correlated with women's DDS, but not BMI.²⁰ Mixed findings were also observed between women's empowerment and child anthropometry. Moestue et al²¹ found a positive association between maternal involvement in social groups and length-for-age *z* score of 1-year-old children, but De Silva and Harpham²² showed a negative association in 6- to 18-month-old children. Shroff et al²³ found positive

association between decision-making and child weight-for-age *z* score (WAZ), but Begum and Sen's²⁴ analysis of Bangladesh DHS data did not reveal any significant associations. Therefore, information about which domains of WE are associated with nutritional status is limited,²⁰ and this lack of knowledge constrains the set of policy options that can be used to empower women and improve nutrition.

In addition to a limited set of studies in SSA, examinations of the effects of WE on nutrition outcomes are constrained due to interstudy differences in population characteristics, settings, or methods/conceptualizations of WE.²⁵⁻²⁷ For example, despite recognition of the complex, multidimensional, and culturally defined nature and influence of empowerment on nutrition,^{20,26,28,29} only a few studies considered the multidimensional structure of empowerment domains in Africa or examined the varied relationships between each measure of WE and maternal and child nutrition status.^{30,31} Furthermore, in 2012, the International Food Policy Research Institute developed WEAI constructed from 5 prespecified domains of empowerment,³² which may not be equally relevant in all areas. In contrast, in 2015, the United Nations adopted the Sustainable Development Goals (SDG), but the specific indicators for the SDG empowerment targets are largely equality metrics.³³ To address the need for multidimensional and contextual examinations of WE and its influence on maternal and child health outcomes, we draw from the concepts put forward in the WEAI and the SDGs but took an approach more along the lines of the World Bank which gathers indicators, both equity and empowerment related, that can be used in contextually appropriate ways.³⁴ The aims of this study were therefore to first explore the structure and domains of WE in Kalalé district of northern Benin and then to examine the effects of these constructs on nutritional status of women and their children in the region.

Materials and Methods

Data Sources

Data for this study were obtained from a baseline survey to evaluate the multidimensional impact

of the Solar Market Garden (SMG) project in the Kalalé district of northern Benin.³⁵⁻³⁷ The SMG is a community-scale, solar-powered irrigation system used by women's agricultural groups that had previously been engaged in very small-scale hand-watered horticulture. The broader evaluation aims to quantify the impact of the technology on a range of indicators, including socioeconomic well-being, food security, and WE. The baseline study was conducted between January and March 2014 and was carried out in 16 villages (8 intervention villages and 8 matched-pair comparison villages). Details relevant to the design and conduct of the survey are described in detail elsewhere.³⁸

Briefly, in each village, all households represented in the WGs were surveyed along with a random sample of a maximum of 30 nonmember households (NWGs) in the same village. Participants included a woman-child pair from each household where the woman was not pregnant but of childbearing age (15-49 years) with her youngest child aged between 6 and 59 months. Overall, 767 households were successfully recruited and assessed. Qualitative 24-hour dietary recalls were analyzed for 765 mothers and 647 children. Anthropometric measurements were collected from 585 mothers, while weight and height were collected from 682 and 609 children, respectively, due to missing or incomplete anthropometric measurements. The study was approved by the National Ethics Committee for Health Research of Benin. Ethical clearance was obtained from the institutional review boards (IRBs) charged with the protection of human research subjects of the University of Arizona. The analysis portion of the project was additionally approved by the IRB of the University of California, San Diego. All women were informed verbally about the aims and procedures of the study, and informed consent was obtained from all women and children, via their mother or guardian approval for these latter, before enrollment.

Dependent Variables

Dietary diversity and anthropometry for women and children were the primary outcomes of the

analysis. Information about infant and young child-feeding practices was based on responses of mothers or caretakers of children. Child DDS was defined as the number of food groups consumed in the last 24 hours of 7 food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables.³⁹ The minimum diet diversity for children aged 6 to 23 months was defined as consuming at least 4 food groups of the 7 food groups if breastfed and of 6 food groups (excluding dairy products) if not breastfed in the last 24-hour period. The child nutrition outcomes were based on anthropometric *z* scores for children younger than 5 years calculated using the 2006 World Health Organization Child Growth Standards.⁴⁰ Underweight was defined as WAZ <−2 standard deviation (SD), stunting as height-for-age *z* scores (HAZ) <−2 SD, and wasting as weight-for-height *z* scores (WHZ) <−2 SD. For women, the DDS was defined as the number of food groups consumed based on 24-hour recall, namely (1) starchy staples, (2) beans and peas, (3) nuts and seeds, (4) dairy, (5) flesh foods, (6) eggs, (7) vitamin A-rich dark green leafy vegetables, (8) other vitamin A-rich vegetables and fruits, (9) other vegetables, and (10) other fruits.⁴¹ The minimum diet diversity for women was defined as consuming at least 5 food groups of 10. Body mass index was defined as the ratio of weight (in kg) to the square of height (in meters). A woman is considered underweight if her BMI <18.50 kg/m².⁴²

Independent Variables

Women's empowerment measures were derived from a factor analysis conducted with 32 questions about WE (Supplementary Table S1). Specifically, the WE questions were based on work from the World Bank.⁴³⁻⁴⁷ The work by Malhotra and Schuler⁴⁴ emphasized that the main domains for these measures at the household, community, and broader arenas were classified as (1) economic, (2) social and cultural, (3) legal, (4) political, and (5) psychological. Domestic decision-making has focused on (1) finances, (2) social and domestic matters and child-related

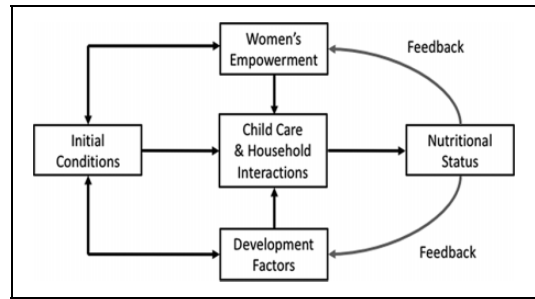


Figure 1. Framework for role of women's empowerment on nutritional status. Adapted from Petesch et al.⁴⁸

issues, (3) access or control over resources, and (4) mobility and freedom of movement along with family support including couple interactions.⁴³ These domains have also been combined to determine the role of development as part of community-level development projects⁴⁷ and to set the framework for the United Nations Development Program Global Inequality Index as a measure for WE that includes their role in community decision-making as determined by the proportion of parliamentary seats occupied by females, measures of education, and economic status including their participation to the labor force.³³

Our focus on WE was partially based on the models developed by Petesch et al⁴⁸ in which empowerment directly affects health. However, due to the reality that multiple factors affect how empowerment is obtained and used to effect health, our framework utilized the interactions between empowerment, policy, and initial conditions which occur in villages (Figure 1). Since this was a new study, an exploratory principal component factor analysis (EFA) was used to uncover the underlying factor structure of the individual responses and to establish a subset of questions suitable for confirmatory factor analysis (CFA).^{49,50} In order to perform EFA and cross-validate with CFA, the baseline data were split into 2 samples using a random uniform distribution, with one used as the training set for EFA and the other used for CFA. Before running the factor analysis, the correlation matrix among the 32 questions was examined to justify undertaking the factor analysis. The χ^2 for the Bartlett

test of sphericity was significant at $P < .01$, and the Kaiser-Meyer-Olkin test showed a score of 0.74, indicating that the correlation among the variables was sufficiently strong for a factor analysis.

The number of factors retained was based on 3 criteria: (1) the Kaiser criterion (eigenvalues >1), (2) inflection point of the screen plot, and (3) interpretability of factors.^{51,52} The factors were rotated using a Varimax rotation. Factor loadings indicated the strength and direction of the association between the domains and individual indicator. The derived domains of WE were labeled based on individual indicators having a rotated factor loading >0.6 (Supplementary Table S2 and Figure S1). After reducing the number of questions ($n = 22$) and establishing our domains using EFA, CFA was performed to determine whether the indicators chosen conformed to the theoretical model. The CFA provided fit indices about the appropriateness of the model based on the covariance structure of the observed data such as root mean square error of approximation (RMSEA), standardized root mean square (SRMS), Bentler comparative fit index (CFI), and Tucker-Lewis index (TLI).⁵³ These modification indices were used to examine how the model might be adjusted to improve its fit. When error terms of 2 individual indicators were correlated in the same domain, the lower factor loading item was removed, resulting in the final set ($n = 16$) of included questions (Supplementary Table S3).

Results from the factor analyses identified and confirmed 6 underlying domains from the remaining 16 questions (indicators), and these domains accounted for 74.8% of total variance explained. The goodness of fit of the modified model is superior to that of the proposed model. The RMSEA value was 0.04, the CFI value was 0.98, and the TLI value was 0.97, while the SRMS value was 0.03, suggesting that the fit of the model to the data is acceptable (Supplementary Table S3). Overall, the empowerment domains and their respective indicators were conceptualized as follows: *Leadership* domain referred to assertiveness and actions indicating a sense of self-security. The domain was examined using 2 questions concerning woman's sense of self—whether woman feels important or her opinion was respected (1 = yes, always; 0 = no

or sometimes) and one question relating to woman's self-confidence—whether she feels confident to resolve a problem on her own (1 = yes, always; 0 = no or sometimes). *Decision-making* domain was measured by the woman's participation in decisions regarding household matters. Three questions were included relating to the number of children, kids' schooling, and health care (1 = woman alone or joint decision, 0 = other).

Mobility domain was characterized as women's freedom to leave the home. The 3 mobility scenarios included: goes to local market for purchases, goes to health center or traditional doctor, and goes to visit friends (1 = yes, woman alone, 0 = no or accompanied woman). *Economic security* domain was examined using 3 questions relating to their capability to afford fruits and vegetables, own clothes, and own beauty (1 = yes; 0 = no). *Male involvement in housework* domain represents women's familial and marital roles, including household status in contexts of negotiation. Two questions measured this domain when respondents were asked if they get help from adult males of their household to prepare meals or for the laundry (1 = yes; 0 = no). *Non-family groups' domain* included participating in an environment for creating a sense of solidarity with other women. This domain was examined using 2 questions relating to participation in labor or political organization groups (1 = yes; 0 = no). Table 1 summarizes the aggregation rules used to code the more empowered response of each question. Most of our binary coding are conservative ("sometimes" and other intermediate answers are coded as zeros or not empowered in that particular domain) as analysis with the alternative coding ("sometimes" and other intermediate answers coded as "empowered") did not show significant differences.

Control Variables

The potential confounding variables included maternal characteristics (maternal age in years, level of education completed, occupation, and type of group), child characteristics (age in months and sex), and household characteristics (socioeconomic status [SES], self-reported food

Table 1. Women Empowerment Domains, Indicators, and Aggregate Codes.

Dimension	Indicator Label	Questions	Response Categories	Aggregate Recodes Used in Analysis ^a
1. Leadership	1.1. Sense of self	Do you feel like an important member of your household? Do you think the members of your household listen to you and respect your opinion?	0 = No 1 = Sometimes 2 = Always	Code = 1 if Q1 = 2 Code = 0 if Q1 = 0 or 1
	1.2. Self-confidence	If you have a problem at home, do you feel confident enough to resolve it on your own?		
2. Decision making	2.1. Decision on health care	Who has the last word regarding what to do if a member of household is sick?	1 = Partner 2 = Respondent 4 = Respondent and partner	Code = 1 if Q2 = 2, 4, or 5 ^a Code = 0 if Q2 = 1, 3, or 6-8
	2.2. Decision on education	Who has the last word regarding decisions on kids' schooling?	5 = Respondent and other members of household	
	2.3. Decision on children	Who has the last word regarding whether to have another child or not?		
3. Mobility	3.1. Permission to market	Are you habitually authorized to go to local market for purchases?	1: Alone 2: Only if I'm accompanied	Code = 1 if Q3 = 1 Code = 0 if Q3 = 2 or 3
	3.2. Permission to health center	Are you habitually authorized to go to health center or traditional doctor?	3: Not at all	
	3.3. Permission to visit friends	Are you habitually authorized to go to friends in village?		
4. Economic security	4.1. Afford fruits and vegetables purchase	Can you afford the finances needed to buy fruits and vegetables?	0: No 1: Yes	Code = 1 if Q4 = 1 Code = 0 if Q4 = 0
	4.2. Afford own clothes purchase	Can you afford the finances needed to buy clothes of yourself?		
	4.2. Afford own beauty purchase	Can you afford the finances needed to buy beauty of yourself?		
5. Male involvement	5.1. Help from adult male	Do the adult male members of your household help you prepare meals? Do the adult male members of your household help you for the laundry?	0: Not at all 1 Very rarely 2: From time to time 3 regularly 4: Always	Code = 1 if Q5 = 2-4 Code = 0 if Q5 = 0, 1 ^b
6. Nonfamily groups	6.1. Group member	Are you a member of a labor organization? Are you a member of a political organization?	0: No 1: Yes	Code = 1 if Q6 = 1 Code = 0 if Q6 = 0

^aCodes not shown: 3 = another member of the household; 6 = a group of household members; 7 = others out of household; 8 = do not know.

^bCodes not shown: 5 Not applicable (If no adult male in the household).

insecurity in the last 12 months, self-reported access to health care in the last 12 months, production diversity, family size, ethnicity, safe water, electricity connection, village, and frequency of radio listening). Age, family size, and frequency of radio listening were included as continuous variables. Maternal level of education was assessed as categorical—no formal education, primary or less, secondary, university, and more. Maternal occupation was a categorical variable (eg, agricultural/other labor, service/business, and others). Gender of children was examined as a binary variable—male, female. Socioeconomic status was examined using household asset data, such as ownership of consumer items and home attributes.⁵⁴ Factor scores derived from the first factor (which explained 27.8% of the variance) were then used to characterize the SES of each household. Households were categorized into SES quartiles based on their individual SES index score. Self-reported food insecurity and access to health care were binary measures defined as a household that was food insecure or health insecure in the last 12 months or not. Ethnicity was a categorical measure (eg, Gando, Boo, Peulh, Boko, Bariba, and others). The production diversity index was based on the household production of 9 food groups: (1) starchy staples; (2) beans, legumes, and nuts; (3) dark green leafy vegetables; (4) vitamin A-rich fruits, vegetables, and tubers; (5) other fruits and vegetables; (6) milk and milk products; (7) eggs; (8) fish; and (10) meat.¹⁹ Type of groups indicated whether the principal female was a member of WG or not.

Data Analysis

Data analysis was conducted in 3 main steps using STATA version 13.1 (Stata Corporation, College Station, Texas). First, descriptive analyses were conducted, and categorical variables were expressed as percentages, while continuous variables were expressed as arithmetic means (standard deviation [SD]). Differences between groups were determined using *t* test or χ^2 test. Second, a composite score of WE was calculated based on the sum of the 16 empowerment indicators with a total possible score ranging from 0 to

16. All domains have a possible score range from 0 to 3, except for male involvement and group membership domains (0-2). Women's empowerment was categorized into 2 groups: the proportion of women with total scores above the population mean versus those with scores at or below the population mean. These steps were repeated for each of the 6 domains. Third, sequential regression analyses were conducted. The univariate analysis was first conducted to identify the control variables that reached a statistically significant association with maternal and child nutrition outcomes. Next, multiple regression was conducted and included all variables found to be significant at $P \leq .20$. The models were estimated in 2 specifications. In the first specification, the total empowerment score was included to isolate the effect of WE. In the second specification, the aggregate WE was decomposed into 6 domains to investigate how each of these domains was associated with maternal and child nutritional status. The variance inflation factor to assess multicollinearity of variables in the models was shown to be below cutoff point of 10. Model fit was assessed through likelihood ratio χ^2 test and Wald χ^2 test. Significance of standardized coefficients is reported at the 10%, 5%, and 1% probability levels.

Results

Sociodemographic, Dietary, and Anthropometric Characteristics of Participants

Among the children, mean age was 21.6 months (SD 12.5) with a range of 6 to 59 months; 48.9% were male, while 65.4% received vitamin A supplements within the past 6 months (Table 2). The mean child DDS was 3.1 food groups, and 30.8% of children (6-23 months) satisfied the minimum diversity criterion. Overall, 39.8% of children were stunted, 23.6% underweight, and 10.9% of them were wasted. The majority of mothers had no formal education, and half of them were primarily engaged in farming. The mean maternal DDS was 4.5, and 44.7% consumed at least 5 food groups (of 10). About 9% of women had chronic energy deficiency (BMI < 18.5 kg/m²).

Table 2. Sociodemographic, Dietary, and Anthropometric Characteristics of the Study Population.

Characteristic	Total	
	n	Mean (SD)/%
Child outcomes and characteristics		
Age, months	764	21.59 (12.53)
6-11		17.93
12-23		33.38
24-59		48.69
Sex, male	764	48.95
Vitamin A supplements	748	65.37
Dietary diversity score	647	3.10 (2.16)
Minimum diet diversity (6-23 months)	338	30.77
Weight-for-height z score (WHZ)	585	-0.09 (1.86)
Wasting (WHZ < -2 SD)		10.94
Weight-for-age z score (WAZ)	639	-0.75 (1.81)
Underweight (WAZ < -2SD)		23.63
Height-for-age z score (HAZ)	593	-1.22 (2.43)
Stunting (HAZ < -2SD)		39.80
Women outcomes and characteristics		
Age, years	764	29.86 (6.71)
15-29		57.85
30-39		32.98
40-49		9.16
Mother education	755	
No formal Education		90.33
Primary or less		4.37
Secondary		5.03
University and more		0.26
Mother occupation ^a	759	
Agricultural/other labor		50.07
Service/business		16.86
Others		33.06
Dietary diversity score	762	4.63 (1.43)
Minimum diet diversity		44.75
BMI, kg/m ²	585	22.19 (3.27)
BMI <18.5		9.06
Households characteristics		
Household size	764	7.74 (3.76)
Religion, %	767	
Muslim		92.12
Others		7.88
Ethnicity	762	
Gando		34.51
Boo		23.88
Peulh		15.49
Boko		11.81
Bariba		10.37
Others		3.94

(continued)

Table 2. (continued)

Characteristic	Total	
	n	Mean (SD)/%
Food insecurity	754	21.09
Health-care insecurity	740	32.97
Latrines	742	13.21
Safe source of water ^b	757	65.13
Electricity connection	747	8.17
Production diversity	767	3.02 (1.52)
Socioeconomic status	673	
Low		25.11
Middle		49.93
High		24.96
Radio frequency listening, d/wk	752	3.37 (3.10)

Abbreviations: BMI, body mass index; SD, standard deviation.

^aAgricultural/other labor: farming, livestock, and hunting; services/business: small commerce, services, other commerce, and salaried employee; Artisans/others: domestic work, student, unemployed/retired, and manual worker.^bSafe source of water included water from tap and other sources that had been treated.

Analyses of household characteristics revealed an average household size of 7.7 members, with the majority of them as Muslim (92.1%). About 21% of households self-reported food insecurity and 33% self-reported having limited access to health care in the past 12 months. Only 13.2% and 8.2% had access to hygienic latrines and an electricity connection, respectively. The agricultural production diversity was 3.02 (SD 1.5) food groups, and the frequency of listening to a radio was 3.4 (SD 3.1) d/wk.

Women's Empowerment

Table 3 shows the descriptive statistics for the 16 WE indicators. By domain, mobility was the domain in which most of women were empowered (72%), followed by economic security (55.5%) and leadership (54%). However, only 17.1% of women reported having a say in decisions about number of children, their education, or health care; 17.2% were also labor and political groups' members, while 10.6% of them received adult male assistance. Overall, 55.8% of women were empowered.

Table 3. Distribution of Women's Empowerment Indicators and Domains by Groups.^a

Women's Empowerment Indicators	Total (N = 745), Mean (SD)/%
Leadership	
Sense of self as member of household	55.60
Sense of self as respected member of household	56.21
Self-confidence	44.43
Mean leadership subscore (out of 3 total points)	1.52 (1.33)
% women > mean	53.96
Decision-making	
Decision on health care	12.48
Decision on education	14.00
Decision on children	14.82
Mean decision-making power sub-score (out of 3 total points)	0.40 (0.94)
% women > mean	17.12
Mobility	
Permission to market	93.84
Permission to health center	77.70
Permission to visit friends	90.08
Mean mobility subscore (out of 3 total points)	2.53 (0.88)
% women > mean	71.98
Economic security	
Afford fruits and vegetables purchase	67.38
Afford own clothes purchase	68.27
Afford own beauty	80.21
Mean economic security subscore (out of 3 total points)	2.10 (1.16)
% women > mean	55.51
Male involvement in housework	
Help from adult male on cooking meal	6.02
Help from adult male on laundry	9.84
Mean male involvement subscore (out of 2 total points)	0.15 (0.47)
% women > mean	10.64
Nonfamily groups	
Labor group member	16.29
Political group member	10.01
Mean nonfamily group subscore (out of 2 total points)	0.25 (0.59)
% women > mean	17.25
Total empowerment score (16 total points)	6.94 (2.64)
% women > mean	55.77

Abbreviation: SD, standard deviation.

^aCategorical variables were expressed as percentages, while continuous variables were expressed as arithmetic means (SD).

Women's Empowerment and Maternal and Child Outcomes

Table 4 presents associations between the composite empowerment status and each domain with maternal DDS and BMI. The results revealed a significant and positive association between the women's composite empowerment score with their DDS ($P = .01$) and their BMI ($P = .09$). Additionally, the leadership domain was associated with maternal DDS ($P = .008$) and BMI ($P = .06$).

As for children diet quality outcomes, the adjusted models indicated that none of the 5 empowerment indicators (leadership, decision-making power, mobility, male involvement in housework, and nonfamily groups) were significantly associated with male child's DDS (Table 5). However, the composite empowerment score ($P = 0.09$) and leadership domain ($P \leq .001$) were significantly associated with the female child's DDS. Surprisingly, the economic security

Table 4. Associations Between Women Empowerment Measures and Women's Dietary Diversity Score and Body Mass Index.

Structural Model	Diet Diversity Score ^a	Body Mass Index ^b
	Coefficient (Robust Standard Error)	Coefficient (Robust Standard Error)
Specification I		
Total empowerment score	0.047^c(0.024)	0.105^d(0.057)
n	636	533
R ²	.047	.051
Specification II		
Leadership	0.123^e(0.046)	0.216^d(0.116)
Decision-making power	−0.030 (0.068)	0.038 (0.161)
Mobility	0.092 (0.076)	0.033 (0.203)
Economic security	−0.038 (0.054)	0.0078 (0.129)
Male involvement	0.157 (0.146)	−0.029 (0.337)
Nonfamily groups	−0.027 (0.115)	0.076 (0.280)
n	636	533
R ²	.058	.053

Note. Boldface values are statistically significant.

^aAdjusted for maternal age, group, and education; village; ethnicity; productivity diversity; food insecurity; socioeconomic status; electricity connection; and information through radio.

^bAdjusted for maternal age, group, and education; family size; ethnicity; productivity diversity; socioeconomic status; safe water; and information through radio.

^c $P < .05$.

^d $P < 0.1$.

^e $P < .01$.

domain was negatively correlated with male ($P = .07$) and female ($P = .05$) children's DDS.

Overall, women's empowerment was only weakly associated with children's nutrition status. Mobility was positively associated with male children's HAZ and WAZ scores, while decision-making power was positively correlated with male children's WHZ. For female children, mobility was associated with WHZ, while decision-making power was correlated with WHZ and WAZ. Leadership was also positively and significantly associated with HAZ; however, significant negative association was observed between leadership and WHZ. Finally, no significant associations were found between the composite empowerment score, economic security, male involvement in housework, and participation in labor and political groups and the anthropometric measurements for male and female children (Table 5).

Discussion

This study is one of the few studies that have examined a multidimensional investigation of

WE on children's and women's nutrition outcomes in SSA. We built upon prior analyses by including a composite empowerment measure in addition to examining the direct contribution of 6 domains (leadership, decision making, mobility, economic security, male involvement in housework, and nonfamily groups), using analytical methods that accounted for differences in individual, partner, and household characteristics. Key findings indicate that low dietary diversity and undernutrition were common, confirming the urgent need for interventions.¹² In the present study, children had a DDS of 3.09, and only 31% satisfied the minimum diversity criterion of eating 4 of 7 food groups. These results are only slightly lower than those reported (33%) for urban households,⁹ reflecting the higher rates of poverty and less diverse production portfolios observed in our study. The prevalence of child wasting (11%) was also greater than the rest of the country (5%).¹⁰ Similar to the child indicators, the prevalence of women's undernutrition in our study was also greater than reported for Benin (9% vs. 6%).⁹

Table 5. Associations Between Women Empowerment Measures and Children's Dietary Diversity Score and Anthropometric z Scores.

Structural Model	Diet Diversity Score ^a	Height for Age ^b	Weight for Height ^c	Weight for Age ^d
	Coefficient (Robust Standard Error)	Coefficient (Robust Standard Error)	Coefficient (Robust Standard Error)	Coefficient (Robust Standard Error)
Male children				
Specification I				
Total empowerment score	-0.076 (0.060)	0.025 (0.061)	0.021 (0.053)	0.033 (0.050)
n	268	242	241	264
R ²	.146	.044	.049	.033
Specification II				
Leadership	0.067 (0.104)	0.032 (0.122)	-0.038 (0.099)	0.025 (0.095)
Decision-making	0.117 (0.145)	0.086 (0.172)	0.240^e (0.123)	0.106 (0.131)
Mobility	-0.018 (0.166)	0.288^e (0.171)	0.001 (0.168)	0.240^e (0.142)
Economic security	-0.395^e (0.217)	0.015 (0.137)	-0.043 (0.102)	-0.039 (0.092)
Male involvement	-0.257 (0.250)	-0.480 (0.280)	-0.128 (0.268)	-0.159 (0.248)
Nonfamily groups	-0.177 (0.112)	-0.087 (0.194)	-0.042 (0.206)	0.057 (0.190)
n	271	242	241	264
R ²	.223	.072	.072	.094
Female children				
Specification I				
Total empowerment score	0.066^e (0.039)	0.067 (0.063)	0.009 (0.047)	0.037 (0.047)
n	264	248	275	301
R ²	.194	.047	.045	.053
Specification II				
Leadership	0.359^f (0.086)	0.359^f (0.130)	-0.187^e (0.101)	0.066 (0.082)
Decision-making	0.047 (0.129)	-0.099 (0.182)	0.316^e (0.160)	0.234^e (0.127)
Mobility	-0.481 (0.182)	-0.245 (0.242)	0.141^e (0.102)	-0.221 (0.142)
Economic security	-0.205^g (0.099)	0.018 (0.141)	-0.035 (0.132)	0.022 (0.084)
Male involvement	-0.274 (0.231)	-0.535 (0.421)	0.287 (0.262)	0.198 (0.267)
Nonfamily groups	0.209 (0.247)	-0.041 (0.308)	-0.112 (0.266)	-0.255 (0.210)
n	264	248	275	301
R ²	.312	.078	.112	.085

Note. Boldface values are statistically significant.

^aAdjusted for maternal age, group and education; child age; village; ethnicity; productivity diversity; socioeconomic status; food insecurity; health insecurity; safe source of water; and information through radio.

^bAdjusted for maternal age, group, activity and education; child age; village; ethnicity; productivity diversity; socio-economic status; safe source of water; and information through radio.

^cAdjusted for maternal age, group, activity and education; ethnicity; productivity diversity; food insecurity; socio-economic status; and safe source of water.

^dAdjusted for maternal age, group and education; village; family size; ethnicity; safe source of water; productivity diversity; socio-economic status; safe water; and information through radio.

^e*p* < .1.

^f*p* < .01.

^g*p* < .05.

However, mixed results were observed between WE and maternal and children nutrition outcomes and suggest that various domains of WE

may have different impacts on nutritional status, consistent with the empowerment literature.^{19,55,56}

The significant positive association of women's overall empowerment and maternal leadership with women's diet diversity in our study is encouraging, as it suggests that increasing women's empowerment, predominantly in the leadership domain, could work synergistically with food-based approaches meant to improve the diet quality and diversity.⁵⁷ A similar pattern was observed by Ross et al³¹ in Ghana, where leadership empowerment was significantly associated with increased women's DDS and BMI. Smith et al⁵⁸ even found that women's lower self-esteem was closely tied to women's own nutritional status and suggested that women with low status may face difficulty in perceiving the need for their own health care, much less garnering the confidence to act on that need. For this reason, several studies have pointed out the need to strengthen women's role and self-confidence within their families.^{59,60} Additionally, the positive associations found between women's overall empowerment, leadership domain, and women's BMI in our study suggest that empowered women in households receive a larger share of family's nutritious food, which can translate to improved nutrition status. By contrast, women's empowerment was not significantly associated with women's BMI in the study of Malapit and Quisumbing.²⁰ The difference in findings may be explained by the fact that, in our study, women regression models included control variables, such as food security, access to health services, ethnicity, and productivity diversity that could potentially negate the impact of higher diet diversity on nutritional status.^{19,61-65}

The current study also suggests that the constellation of factors associated with women's composite empowerment as well as leadership empowerment was associated with a greater DDS among female children, implying that WE may have a differential impact on male and female child's DDS. The positive impact of leadership on female children's diet quality outcomes are in line with earlier findings by Ross et al³¹ who reported that increased women's self-confidence can make better health-enhancing decisions and thus have a positive impact on their families' nutrition. However, Malapit and Quisumbing²⁰ observed in Ghana that only credit decision-

making was associated with a higher DDS, while the empowerment score was negatively correlated with female child's DDS. Interstudy differences in population characteristics, settings or methods of women's empowerment, and the specific domains studied likely contributed to these inconsistencies. Finally, the negative association between economic domain empowerment and child's DDS in the present study imply that children in households where the principal female can meet affordable needs consumed less diverse diets, contrary to our expectations. The qualitative study by Davis et al⁶⁶ in Ghana may provide a possible explanation, since malnourished children were fed a wider variety of food, while well-nourished children typically received fewer types of food. However, in our sample, underweight children consumed fewer food groups (2.6 vs 3.3) and a lower proportion met the minimum DDS (11% vs 17%) compared to well-nourished children. This unexpected finding may point out the need for behavior changes communication that diverse diets are important for a child's general health.

The third implication relates to the significant positive relationship between 3 of the empowerment measures (leadership, decision-making power, and mobility) and children's nutrition outcomes. Greater decision-making power was associated with child's WHZ, suggesting that households where women make decisions may result in supporting greater food consumption and better child care, which could minimize the incidence of acute food shortages or severe disease that results in a deficit weight. Similarly, Dancer and Rammohan⁶⁷ found in Nepal that maternal involvement in decision-making regarding the purchase of daily household purchases was associated with child's WHZ. These estimated associations suggest that an additional decision-making made by the primary female decision maker increases child's WHZ by 0.23 (male) and 0.32 (female) in the present study compared to 0.087 in the latter study. Additionally, mobility was positively correlated with male children's HAZ and WAZ as well as female children's WHZ. According to Shroff et al,^{23,68} access to markets to purchase food, medicines, and other essentials can improve knowledge about nutrition

and health, whereas women with limited mobility are likely to have fewer social exchanges.^{58,59} Furthermore, Mainuddin et al⁶⁹ found that women empowered in deciding major household purchases were significant with women's mobility in visiting hospital. However, opposite signs were observed between maternal leadership and girls' WHZ, suggesting possible trade-offs within the household.

Two of the 6 WE measures (male involvement in housework and participation in labor and political groups) were not linked to maternal and child nutrition outcomes. By contrast, Ross et al³¹ found that membership in social and economic groups played a significant role in improving women's BMI and DDS, whereas male involvement was associated with improved child and maternal health outcomes.⁷⁰⁻⁷² It is possible that maternal and child nutrition outcomes did not involve interactions with this aspect of male involvement^{73,74} or these types (political and labor) of groups in the area of study. Indeed, only 11% of women received adult male assistance for housework, whereas women's participation in labor and political groups was limited (17%). However, WG had significantly greater overall empowerment and economic security scores as well as more children (31.5% vs 30.3%) and mothers (47.6% vs 42.9%) consuming the minimum DDS and lower prevalence of underweight (21.7% vs 25.1%) and wasted (10.7% vs 11.1%) children compared to NWG (data not shown). A final implication relates to the lack of association between composite WE and child nutritional outcomes, despite the association of specific domains of empowerment with child nutrition. This implies that improved nutrition is not necessarily correlated with being empowered across all empowerment domains. Another possible explanation may be that the effects of some of the domains on nutritional status are nullified by others in the composite index because of the low R^2 of most models and the lack of significant associations at $P = .05$.

Additional qualitative research may provide more in-depth understanding of the contexts driving the different associations between WE measures and maternal and child nutrition outcomes. Specifically, qualitative methods could also assist to understand the specific context surrounding

women's participation in labor and political groups and male involvement in housework to identify appropriate indicator for these measures as suggested by Schatz and Williams.⁷⁵ Supplemental qualitative methods could inform whether there is indeed no association between decision-making power and economic security and maternal nutrition outcomes or whether women's empowerment aspects that are linked to maternal outcomes were unmeasured in this study. Measuring a latent construct such as empowerment is inherently challenging, and it is possible that different meanings and manifestations of empowerment were unable to be captured by the current index.

Our study did entail some limitations despite addressing several research gaps. This study employed cross-sectional survey data sets, thus any causal inference is tentative. It is also equally conceivable that women's interpretation and response to the empowerment questions varied across villages, and some aspects of WE may not have been captured by the indicators assessed in the present study.⁷⁶ Ultimately, this may have decreased the predictive value of the construct. Finally, although the use of a summative index has been challenged by some researchers for discounting item-level distinctions, we considered the summative index a more appropriate approach in examining the broader role of WE, particularly given the concerns regarding the adequacy of any single item in an African context. Despite these limitations, the study's strengths are the use of multiple empowerment indicators and domains, use of geographically diverse and large sample, and inclusion of measures compatible with the existing literature. The methodology is both transparent and transportable as it traced from the initial questionnaire through construction of indicators and appropriate treatment of uncertainty in the analysis—such that these methods can be both applied in other, different, contexts and compared to the results presented.

Conclusion

This study is one of only a few studies that examined and incorporated a multidimensional investigation of women's status and empowerment on

maternal and child undernutrition in SSA. Our findings contribute to the existing literature by providing positive and negative empirical evidence on the relationship of potentially synergistic and opposing WE measures and maternal and child undernutrition, specifically in Kalalé district of Northern Benin. In addition, our results suggest that efforts to reduce malnutrition in Benin may benefit from empowerment initiatives that promote women's self-confidence and decision-making power, particularly when informing policies and programs that seek to empower women for improving nutrition. However, the mixed and null findings suggest that additional qualitative and longitudinal research is needed to provide more in-depth understanding of the contexts driving the different associations between WE and maternal and child nutrition status in the region

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Supplemental Material

Supplementary material for this article is available online.

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