Original Article

A Structural Equation Modeling Analysis of Women's Empowerment Influence on Birth Weight of Infants in West Shewa Zone, Ethiopia

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Abstract

Background: Infant birth weight is one of the major determinants of morbidity and mortality in children and adults. The proportion of low birth weight is 13% in Ethiopia, while macrosomia is rising over time. The importance of empowering women to achieve maternal and child health outcomes is highly acknowledged. Nevertheless, this aspect has not been sufficiently documented in Ethiopia.

Objective: Th is study aimed to assess the effect of women's empowerment on the birth weight of infants in West Shewa Zone, Ethiopia.

Methods: A health facility-based prospective follow-up study was conducted from January to December 2021. Multistage sampling was applied to enroll pregnant women in the study who were followed up until delivery. Women's empowerment data were collected using an interviewer-administered questionnaire. Analysis was performed among 1,165 mother-newborn pairs, where birth weight was abstracted from the mother's medical chart. A confirmatory factor analysis was conducted to validate the women's empowerment measuring tool. Structural equation modeling was employed to investigate the direct effect of women's empowerment dimensions on birth weight.

Results: From the four latent dimensions of women's empowerment, a positive association was found between pregnant women's household decision-making power and the birth weight of the infants they delivered (β= 0.091, p=0.040), whereas higher economic empowerment of the women was related to delivering lower birth weight infants (β= -0.444, p < 0.001). Pregnant women's psychological and time empowerment were not significantly associated with newborn birth weight.

Conclusions: The findings of this study illustrated the substantial correlation between women's agency in decision-making realms and their economic independence with the birth weight of their offspring. Augmenting the influence wielded by women in decision-making processes may prove instrumental in augmenting infant birth weights. Nevertheless, the variegated results of this research underscore the imperative for a more comprehensive exploration of the mechanisms underlying the impact of diverse dimensions of women's empowerment on birth weight to optimize the efficacy of empowerment initiatives in safeguarding optimal infant birth weight outcomes. [*Ethiop. J. Health Dev.* 2023; 37(4)]

Keywords: birth weight, women's empowerment, structural equation modeling, Ethiopia

Introduction

Birth weight is an important predictor of morbidity and mortality in childhood and adulthood (1, 2). Based on birth weight, newborns are classified as having low birth weight (LBW) (<2,500g), normal birth weight (2,500g to 3,999g), and macrosomia (≥4,000g) (1, 3). Both LBW and macrosomia have been associated with higher short- and long-term risks for newborns. LBW increases the risks of infant mortality (4), poor cognitive development (5), and chronic diseases in adult life (6). On the other hand, macrosomia increases the risks of perinatal asphyxia (7) and neonatal hypoglycemia (8). The macrosomic infant has higher long-term risks of type 2 diabetes (9) and cancer (10). Globally, an estimated 19.80 million newborns weighed low at birth in 2020 (1). Recognizing it as a global public health problem, the World Health Organization (WHO) has aimed to reduce LBW by 30% by 2025 (11). Evidence shows that abnormal birth weight is prevalent in Ethiopia. Although a national survey of Ethiopia showed that 13% of births were low in weight (12), a range of 8.8% (13) to 23.3% (14) LBW have been reported in different regions of the country. The prevalence of macrosomia in Ethiopia has increased over time. Recent studies have indicated the prevalence of macrosomia ranges from 7.5% (15) to 19.1% (16) in the country.

The concept of women's empowerment involves enhancing the chances and possibilities available to women, giving them the freedom to make their own set of choices which they value (17). Women's empowerment can be observed in the process of decision-making, psychological wellbeing and capacity to access and manage resources as well as their own and family lives (17-20). In fact, empowering women and ensuring healthy lives and promoting wellbeing for all at all ages are among the sustainable development goals (21). Moreover, women's empowerment has been recognized as one of the significant factors for achieving better maternal and child health and nutrition outcomes (22, 23).

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Empowered women have control over resources and decisions (17, 18) regarding their own health and household resource allocation, including food purchase and preparation (24). Consequently, women's empowerment can result in better maternal healthcare utilization (25, 26) and improved maternal nutrition (27). Maternal nutrition and antenatal care visits during pregnancy are significant determinants of the health of the expectant mother and birth weight (28, 29). Economic empowerment ensures women's access to and control over financial resources (30). Women's economic empowerment enhances household food security (31). Economically empowered women are more likely to allocate more resources to food (32). Thus, they are more likely to eat diverse diets (33) and have better nutritional status (34). Women who are more empowered are less likely to experience stress (35). Stress during pregnancy is known to affect birth weight (36, 37). Psychologically empowered women have higher self-confidence and esteem (38). They are determined to practice their rights and use available resources around them, which are linked to their better nutritional status (39) and less stress (35). In turn, these factors are implicated in birth weight. The long working hours of women have been linked to their poor nutritional status due to high energy expenditure and time constraints for self-care (34, 40). It has also been reported that working long hours during pregnancy increases the risk of delivering LBW (41). Overall, women's empowerment is believed to promote the health and nutritional status of women before and during pregnancy, thereby increasing the chance of delivering normal-weight babies. Based on this, we hypothesized that pregnant women who were empowered would have a higher chance of giving birth to normal-weight babies.

Although women's empowerment is recognized as a significant factor in maternal and child nutrition and health improvement, its impact may vary across countries with different cultures. There has been limited research on the influence of various dimensions of women's empowerment on infant birth weight in Ethiopia. Therefore, this study aimed to fill this gap and provide valuable evidence to improve maternal and child health interventions in the country by examining the direct effects of women's empowerment dimensions on birth weight.

Methods and Materials

Study participants and data source

This study was part of a health facility-based prospective follow-up investigation conducted to evaluate women's empowerment effects on pregnant women's nutritional status and the weight of their newborns. The study was conducted in public health facilities found in West Shewa Zone, Central West Ethiopia. Pregnant women in the second or third trimester who attended antenatal care (ANC) in randomly selected public health facilities in the Zone were enrolled in the study and followed up until delivery. Pregnant women who were less than 18 years and had no partner were not included in this study. A structured questionnaire, which was prepared by the local language, Afan Oromo, was used to collect data on socio-demographic characteristics, obstetric history, women's empowerment, and dietary diversity at enrolment. Dietary diversity measurements were repeated after a month. Women who had completed grade 12 and trained on the data collection tools and techniques were responsible for collecting the data. Data on gestational age, mid-upper arm circumference (MUAC), and hemoglobin level were collected at enrolment by midwives and/or nurses at the ANC provision unit and medical laboratory technologists working at the selected public health centers, respectively. Besides, the midwives and/or nurses were responsible for identifying those who fulfilled the inclusion criteria and linking them to the data collectors. Birth weight was measured immediately after delivery by skilled birth attendants who assisted in delivery at the health facilities. Twins, preterm births, and stillbirths were excluded from the analysis. The data were collected between January and December 2021. Details of the study methods have been described elsewhere (24).

Sample size

Epi-Info version 7.2.2.6 was used to calculate the sample size required to examine the association between women's empowerment and birth weight. Thirty-two percent of LBW among unexposed (women with the lowest decision-making power) (42), a ratio of unexposed to exposed 1:1, 95% confidence level, 80% statistical power, and odds ratio of 0.6 (42) was used, resulting in a sample size of 622. Considering 10% for nonresponse and miss to follow-up and a design effect of 1.5 because of the multistage sampling nature of the study, the required total sample size was 1,026 pregnant women-newborn pairs. This study was a component of a broader investigation that enrolled 1,453 pregnant women; hence, the required sample size for this study was met. Data were collected from 1,453 pregnant women at enrolment. Among these, 70 pregnant women dropped out owing to missing data on second-round dietary diversity measurements and 194 with missing birth weight measurements. Reasons for missing birth weight included miscarriage (n=5), abortion (n=9), stillbirth (n=5), leaving the study area due to workplace change and delivery at relatives outside the study area (n=37), home delivery (n=75) and birth weight not recorded (n=63). Among the 1,189 participants with complete data on birth weight, 15 women with twin births and 9 preterm cases were excluded. Consequently, the final analysis included a size of 1,165 participants.

Sampling procedure

Multistage sampling was employed in this study. Out of 22 districts in the West Shewa Zone, 7 of them were selected by a lottery method. A total of 12 public health centers were proportionally selected using a lottery method based on the number of public health centers in each selected district. The sampling frame was prepared using ANC client registries' list of 2nd and 3rd trimester pregnant women who received ANC service in the selected public health facilities. A total of 2,209 2nd and 3rd trimester pregnant women attended ANC follow-up services in the past 3 months in the health facilities. Then, the total sample size was distributed

proportionally to the health facilities based on the number of those 2nd and 3rd trimester pregnant women who presented to the facilities to receive ANC service in the last 3 months. Finally, a systematic random sampling was used to select every second willing pregnant woman.

Variables and measurements

Dependent variable

Birth weight

Birth weight was the outcome of this study. Full-term newborn babies (infants born between 37 and 42 weeks of gestational age) were weighed naked within 1 hour of delivery by using beam scales to the nearest 10.00g. Birth weight was categorized into low, normal, and macrosomia (1, 2) for descriptive analysis. Birth weight was examined as a continuous variable in the structural equation modeling (SEM) analysis.

Independent variables

Women's empowerment

Resources, agency, and achievements are pillars of women's empowerment (17), which can be expressed in multiple dimensions, including decision-making, economic, psychological, and time dimensions (17-20). These four dimensions were used to operationalize women's empowerment in this study.

Household decision-making power

Four items were used to measure the household decision-making power of pregnant women. Respondents were asked if they participated in decisions on what food to purchase and eat, food prepared every day, household purchases of daily needs, and their healthcare. The responses were dichotomized into 1 if the woman participated in the decision-making either alone or jointly with her husband/partner, and 0 if the decision was made by her partner or someone else.

Economic empowerment

The four items used to measure the economic dimension asked respondents whether they were engaged in activities with cash income, had their cash savings, had direct access to household money in their hands to use, and were involved in decisions on the use of their earnings. Responses to the questions were dichotomized as 1=Yes and 0=No. Respondents were given a score of 1 if they were involved in decision-making, while a 0 score was given if they were not involved in decisions regarding their own earnings use.

Psychological empowerment

The psychological dimension was assessed using three items that asked women whether they felt confident in solving problems by themselves, being an important and respected household member. Scores of 2, 1, and 0 were given for 'always,''sometimes', and 'not at all' responses, respectively.

Time empowerment

For the items used to evaluate the time dimension, values of 0, 1, and 2 were allotted if the indicators' responses to the average time spent on housework daily and the actual time spent on housework the previous day were above 10 hours between 5 and 10 hours and below 5 hours, respectively.

Scores on the items' responses were given such that higher values indicated a higher empowerment status of women. For descriptive analysis purposes, the empowerment status of the women for each dimension was categorized as empowered or not empowered according to the proportion of women with total scores greater than the mean versus those with scores at or lower than the mean.

Covariates

Pregnant women's socio-demographic, household and obstetric characteristics, nutritional status, dietary diversity during pregnancy, and sex of the newborn were identified as control variables because of their potential confounding effects on either or both birth weight and women's empowerment. The age of the respondents, parity, and gestational age in weeks were examined as continuous variables. Gestational age (the number of gestation weeks) at enrolment was assessed based on the last normal menstrual period and physical examination. The educational status (completed grade level) of the respondent and her partner were categorized as having no formal education, primary, secondary, or diploma and above. The occupational status categories of respondents were government employees, private employees, farmers, and housewives.

Similarly, the occupational status of the respondents' partners was categorized as government employees, private employees, and farmers. Binary control variables included place of residence (urban/rural), access to mass media (yes/no), birth order (first/second and above), and sex of the newborn (female/male). The household wealth index was created by applying principal component analysis using standard demographic and health survey (DHS) questions. Drinking, cooking, and washing water sources, toilet facilities, roofs, and floor materials were classified as improved and unimproved, whereas cooking fuel was classified as solid and clean fuels according to the DHS classification (43). Individual household wealth index scores were used to classify households into high, medium, and low quartiles.

The minimum dietary diversity for women (MDD-W) tool was used to measure the dietary diversity during pregnancy. Pregnant women were asked to recall and list the foods they had consumed in the past 24 hours, including snacks. Consumption was determined to be≥ 15g if they had eaten at least one spoonful of the food item throughout the day. The foods consumed were categorized as) grains, white roots and tubers, and plantains; 2) pulses (beans, peas, and lentils); 3) nuts and seeds; 4) dairy; 5) meat, poultry, and fish; 6) eggs; 7) dark green leafy vegetables; 8) other vitamin A-rich fruits and vegetables; 9) other vegetables; and 10) other fruits. A score of 1 was given for a particular food category consumed in the past 24 hours and 0 if not consumed (44). To reduce the inflation or deflation effects of occasions such as holidays or fasting days, dietary diversity was measured twice, and the average

was used during the analysis. In the descriptive analysis, dietary diversity was categorized into adequate and inadequate if $\geq$ 5 and < 5 food groups consumed, respectively (44). It was included as a continuous variable in SEM analysis.

Hemoglobin and MUAC measurements were applied to evaluate the nutritional status of pregnant women. A finger-prick blood sample was obtained from the pregnant woman and analyzed using HemoCue Hb 201 (HemoCue AB, Angelholm, Sweden) to measure the hemoglobin concentration. Altitude adjustment was performed on the values obtained as per the WHO recommendations (45). An adult MUAC non-stretchable measuring tape was used to measure the middle circumference of the left arm. Measurements were performed thrice, and the mean values were used in the analysis. Details of the hemoglobin and MUAC measurements are described elsewhere by the authors (24). Both hemoglobin and MUAC levels were treated as continuous variables in the SEM analysis.

Hypothesized model

Figure 1 shows the hypothesized model of this study. It was developed based on the existing abovementioned literature. The resource and agency aspects of women's empowerment are expected to positively affect achievement, which is depicted as birth weight in this study. The economic and time dimensions represented resources, whereas agency was represented by the decision-making and psychological dimensions. The socio-demographic characteristics of the pregnant women and their households were expected to affect the dimensions of empowerment. In addition to the baseline characteristics, the nutritional status of the pregnant women, obstetric factors, dietary diversity during pregnancy, and sex of the newborn were considered to have a relation with birth weight. Hence, they were controlled for their potential confounding effects.

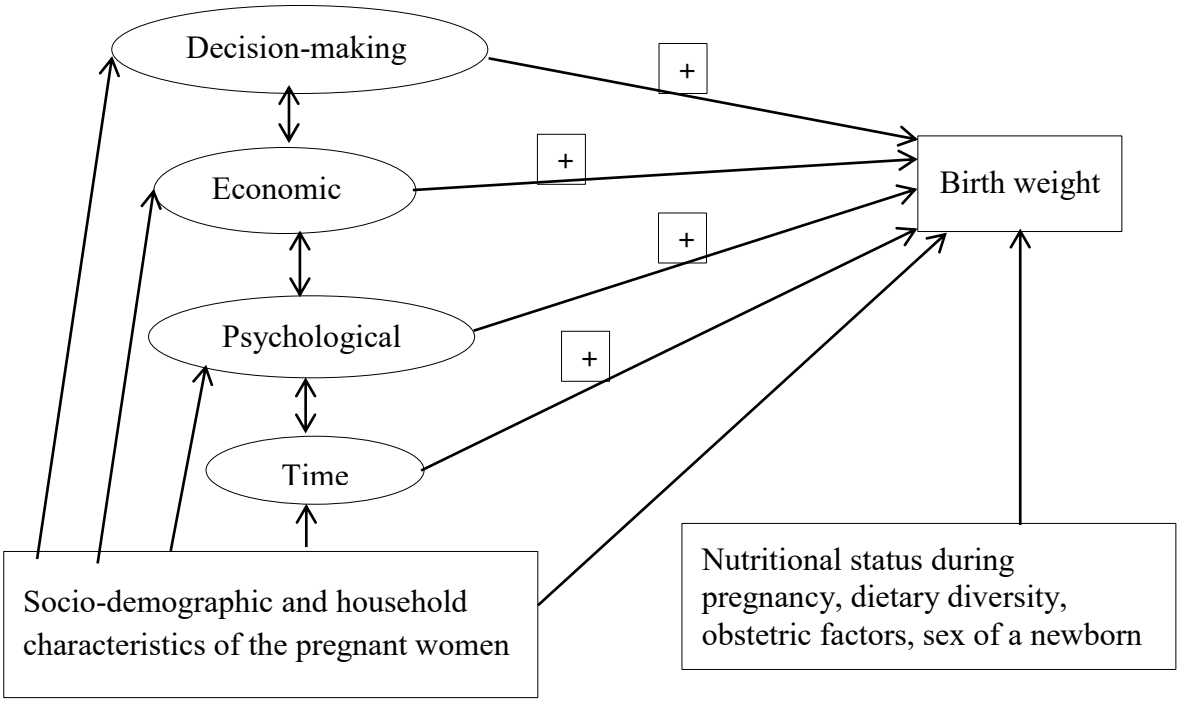

Figure 1: **Hypothesized model on women's empowerment, birth weight and control variables.**

Statistical analyses

Descriptive analyses were conducted utilizing STATA software version 16.0 (Stata Corporation, College Station, Texas). Percentages were used to express categorical variables, whereas means (standard deviation (SD)) were used for continuous variables. To analyze the disparities in socio-demographic characteristics and women's empowerment dimensions between participants who had birth weight measurements and those who did not, an independent t-test for continuous variables and Pearson's chi-square test for categorical variables were employed. The mean birth weight values were compared using t-tests and one-way analyses of variance.

Confirmatory factor analysis (CFA) was performed to validate the latent constructs used to measure women's empowerment using RStudio version 4.2.3. Weighted least squares mean and variance adjusted (WLSMV) estimator was used owing to the categorical nature of the variables (46). The items were tested and used to measure women's empowerment in separate analyses by the authors (24). SEM was applied to examine whether women's empowerment predicts birth weight using RStudio version 4.2.3. SEM is powerful in analyzing the relations between measured and latent variables (46). The four women's empowerment dimensions were used as latent variables. The latent constructs comprised the SEM measurement model, whereas the structural model included the measured variables. The endogenous variables in the SEM were

birth weight and women's empowerment dimensions, whereas the exogenous variables included control variables. The control variables that were significant at p<0.25 in the bivariate analysis were included in the SEM model as potential confounders. Socio-demographic factors related to women and households are fundamental to women's empowerment (47). Besides the characteristics of women and households, obstetric factors, nutritional status, dietary diversity, and the sex of the newborn were related to birth weight in our analysis. The analysis was performed using the WLSMV estimator. Standardized path coefficients for the direct effects of the variables were reported. The model fit for the CFA and SEM models was determined based on the following indices: Bentler comparative fit index (CFI) ≥0.90, Tucker-Lewis index (TLI) ≥ 0.90, root mean square error of approximation (RMSEA) ≤ 0.08, and standardized root mean square residual (SRMR) ≤ 0.1 (48).

Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University (protocol number 107/19/SPH). Permission was granted from the respective public health facilities. Pregnant women were included in the study after providing informed written consent.

Results

Descriptive results

The analysis was based on 1,165 participants with complete data on covariates, women's empowerment, and birth weight. There were no significant differences in background characteristics and main exposure of the study, which was women's empowerment status, between the women enrolled in the large follow-up study and those women excluded from the analysis except for age. Women with missing data on birth weight were slightly older (Table 1).

Table 1**: Socio-demographic and empowerment characteristics of enrolled pregnant women with and without birth weight measurement in West Shewa Zone, Ethiopia, 2021 (n=1,453).**

Characteristics	Birth weight measurement		*p*-value[a]
	Measured n(%)/mean(SD)	Missing n(%)/mean(SD)	
Total	1,165	288	
Socio-demographic characteristics			
Age (years)	27.98(5.39)	29.18(5.43)	0.041
Residence			
Urban	726(62.32)	166(57.64)	0.168
Rural	439(37.68)	122(42.36)	
Education level of respondents			
≤ grade 8	637(54.68)	176(61.11)	0.094
> grade 8	528(45.32)	112(38.89)	
Occupation status of respondents			
Government employee	249(21.37)	51(17.71)	0.225
Private employee	550(47.21)	151(52.43)	
Housewife	366(31.42)	86(29.86)	
Household wealth index			
Low	406(34.85)	103(35.76)	0.189
Middle	372(31.93)	105(36.46)	
High	387(33.22)	80(27.78)	
Women's empowerment dimensions			
Household decision making	3.54(1.05)	3.60(1.01)	0.336
Economic	2.50(1.37)	2.47(1.38)	0.691
Psychological	4.34 (1.53)	4.32(1.39)	0.749
Time	2.99(0.98)	2.91(1.01)	0.057

Note: [a]*p*-values were obtained using independent t-tests and chi-squared tests.

Table 2 summarizes the descriptive statistics of the 1,165 participants included in this study. The mean age of the 1,165 mothers was 27.98 years (SD=5.39), ranging from 18 to 44 years. For 512(43.95%) of them, the current delivery was their first. For the rest, 653(56.02%) of the mothers, the mean birth interval between the current and previous pregnancy was 2.90 years (SD=1.64) with a range of 1 to 13 years. Of 1,165 mothers, 914(78.45%) of them were empowered in the household decision-making dimension, while 600(51.50%) were empowered in the psychological dimension. The majority, 992(85.15%), of them were decision-makers on food bought and consumed by the household. However, only 400(34.33%) of them had cash savings of their own, and 462(39.66%) of them were self-confident in solving problems on their own. About 521(44.72%) of them spent more than six hours on housework daily. The mean maternal MUAC was 25.02 cm (SD=2.17). The mean hemoglobin level during pregnancy was 11.62 g/dL (SD=1.69).

Table 2: **Descriptive characteristics of study participants in West Shewa Zone, Ethiopia (n=1,165).**

Variables	Frequency	Percentage/ Mean (SD)
Demographic characteristics		
Women's education level		
Illiterate	228	19.57
Primary	409	35.10
Secondary and above	528	45.33
Residence		
Rural	726	62.32
Urban	439	37.68
Women's occupation		
Government employee	249	21.37
Private employee	550	47.21
Housewife	366	31.42
Household wealth index		
Low	406	34.85
Middle	372	31.93
High	387	33.22
Women's empowerment dimensions		
Household decision-making power (mean, out of 0-4 total points)		3.54(1.05)
Economic (mean, out of 0-4 total points)		2.50(1.37)
Psychological (mean, out of 0-6 total points)		4.34 (1.53)
Time (mean, out of 0-4 total points)		2.99(0.98)
Dietary diversity		
Adequate	457	39.23
Inadequate	708	60.77

Birth weight

The mean birth weight among 1,165 singleton newborns was 3,168.47g (SD=460.57) (95% CI: 3,142.00, 3,194.95) with a minimum of 2,030g and a maximum of 4,700g (Table 3). About 73 (6.27%) (95% CI: 5.01, 7.81) of the newborns had LBW, whereas 81 (6.95%) (95% CI: 5.63, 8.57) of them were macrosomic.

Table 3: **Mean birth weight of newborns by socio-demographic, obstetric, and nutritional status of their mothers in West Shewa Zone, Ethiopia, 2021.**

Characteristics	n(%)	Mean BW (g)	95% CI	*p*-value[b]
Age (years)				
18-20	122(10.47)	3057.14	2975.54 - 3138.74	0.018
21-30	712(61.12)	3180.43	3146.65 - 3214.21	
≥31	331(28.41)	3183.80	3134.25 - 3233.34	
Residence				
Urban	726(62.32)	3193.55	3160.38 - 3226.71	0.017
Rural	439(37.68)	3127.01	3083.21 - 3170.81	
Education level of respondent				
Illiterate	228(19.57)	3131.08	3071.32 - 3190.83	0.059
Primary	409(35.11)	3144.37	3099.76 - 3189.00	
Secondary and above	528(45.32)	3203.30	3164.03 - 3242.56	
Occupation of respondent				
Government employee	249(21.37)	3256.29	3199.26 - 3313.31	0.003
Private employee	550(47.21)	3149.68	3111.31 - 3188.05	
Housewife	366(31.42)	3136.98	3089.94 - 3184.02	
Household wealth index				
Low	406(34.85)	3136.47	3091.65 - 3181.30	0.213
Middle	372(31.93)	3180.48	3133.65 - 3227.31	
High	387(33.22)	3190.51	3144.59 - 3236.42	
MUAC				
<23 cm	241(20.69)	3029.10	2974.81 - 3083.39	0.000
≥ 23 cm	924(79.31)	3204.83	3174.99 - 3234.66	
Hemoglobin concentration				
< 11 g/dl	361(30.99)	3101.59	3057.41 - 3145.76	0.001

≥ 11 g/dl	804(69.01)	3198.51	3165.82 - 3231.19	
Birth order				
First	512(43.95)	3199.18	3163.93 - 3234.43	0.010
Second and above	653(56.05)	3129.31	3089.34 - 3169.28	
Birth interval between the current and previous pregnancy in years				
<3	305(46.71)	3199.08	3149.54 - 3248.61	0.996
≥3	348(53.29)	3199.27	3149.14 - 3249.41	
Sex of newborn				
Male	501(43.00)	3172.53	3132.96 - 3212.10	0.794
Female	664(57.00)	3165.42	3129.74 - 3201.09	
Dietary diversity				
Adequate	457(39.23)	3333.07	3292.88 - 3373.26	0.000
Inadequate	708(60.77)	3062.23	3029.47 - 3094.99	

Note: [b]*p*-values were obtained from t-test and one-way analysis of variance.

The mean birth weight was significantly higher among newborns of psychologically empowered women than among those not empowered in this dimension (Table 4).

Table 4: **Mean birth weight of newborns by empowerment status of their mothers in West Shewa Zone, Ethiopia, 2021 (n=1,165).**

Empowerment dimensions	n(%)	Mean BW (g)	95% CI	*p*-value[c]
Household decision making power				
Not empowered	251(21.55)	3119.21	3061.77 - 3176.64	0.056
Empowered	914(78.45)	3182.00	3152.16 - 3211.83	
Economic				
Not empowered	468(40.17)	3157.09	3114.22 - 3199.96	0.490
Empowered	697(59.83)	3176.12	3142.43 - 3209.80	
Psychological				
Not empowered	565(48.50)	3126.03	3087.17 - 3164.88	0.002
Empowered	600(51.50)	3208.45	3172.53 - 3244.37	
Time				
Not empowered	464(39.83)	3152.91	3110.70 - 3195.13	0.348
Empowered	701(60.17)	3178.78	3144.73 - 3212.82	

Notes: [c]*p*-value was obtained from the t-test

Confirmatory factor analysis result

The model fit indices for the CFA model (RMSEA=0.049, CFI=0.992, TLI=0.989, and SRMR=0.072) were within the recommended values, suggesting a good fit of the model to the data. The standardized factor loadings of each item and Cronbach's alpha for each dimension are presented in Table 5. Cronbach's alpha results were higher than 0.70 for all the dimensions, suggesting the model had good reliability (49). The correlations among the four dimensions were significant (p=0.000) and less than 0.556.

Table 5: **Standardized factor loadings and reliability results of confirmatory factor analysis.**

Dimensions	Items	Standard loadings	Cronbach's alpha
Household decision-making power	Decision on what food to buy and consume (d1)	0.849	0.959
	Decision on food prepared every day (d2)	0.943	
	Decision on own healthcare (d3)	0.913	
	Decision on daily needs household purchases (d4)	0.953	
Economic	Engagement with cash income activities (ec1)	0.819	0.901
	Cash savings of own (ec2)	0.662	
	Decision on own earning use (ec3)	0.979	
	Direct access to household money for use (ec4)	0.838	
Psychological	Self- confidence in problem solving (p1)	0.982	0.868
	Feeling as an important household member (p2)	0.534	
	Feeling household members respect your opinion (p3)	0.626	
Time	Daily time expenditure on housework (t1)	1.000	0.929
	Time spent on housework the previous day (t2)	0.867	

SEM results

The fit indices results of the SEM indicated a good fit of the hypothesized model: RMSEA=0.042, CFI=0.966, TLI=0.989, and SRMR=0.078. The adjusted SEM results are presented in Figure 2. Household decision-making power and economic dimensions predicted the birth weight of newborns. The household decision-making power of the mothers

(β=0.091, p=0.040) was directly and positively related to the birth weight of newborns. In contrast, the economic empowerment of the mothers (β=-0.444, p=0.000) was negatively correlated to the birth weight of newborns. The psychological (β=0.063, p=0.140) and time (β=0.052, p=0.189) empowerment dimensions were not associated with birth weight.

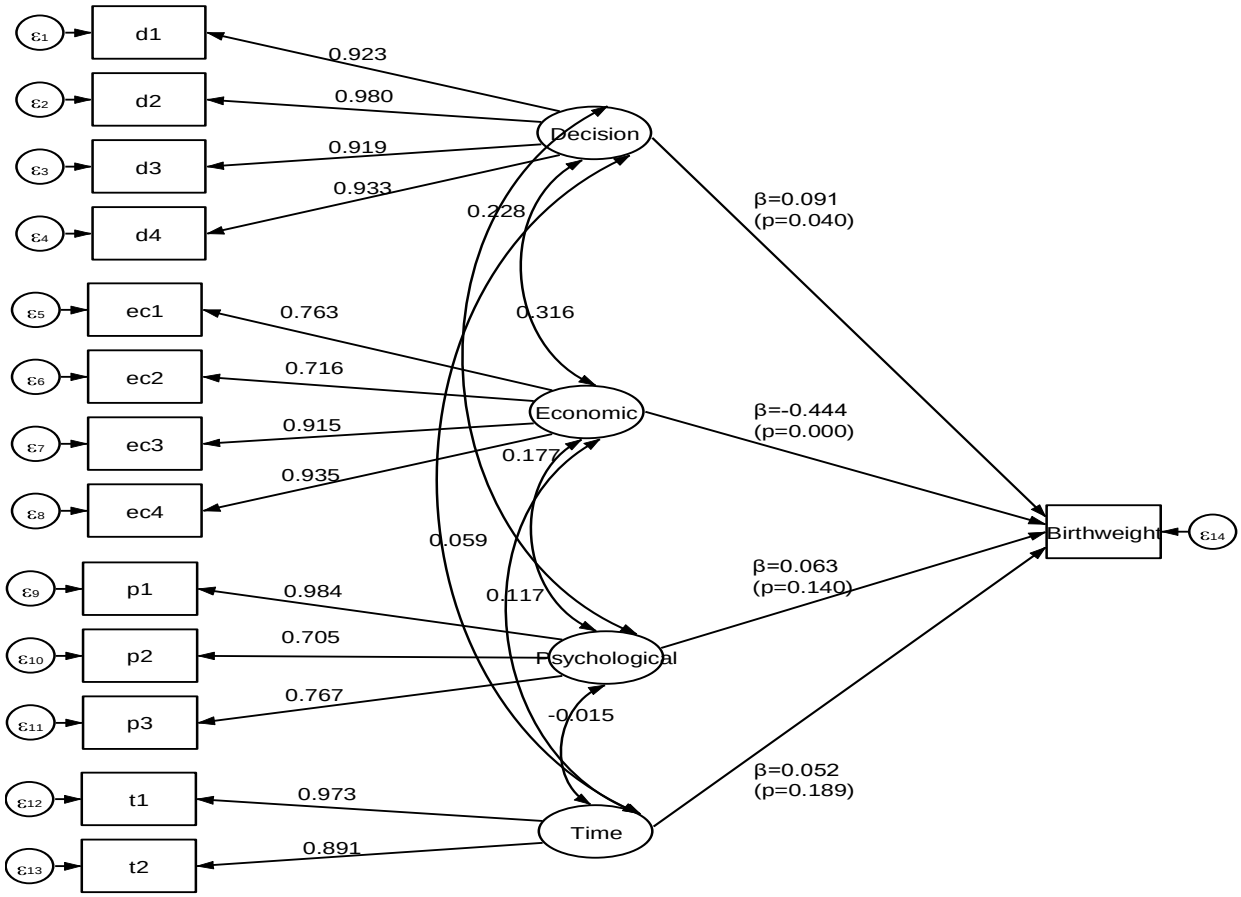

Figure 2: **SEM results of the effects of women's empowerment dimensions on birth weight in West Shewa Zone, Ethiopia, 2021.**

Discussion

This study examined the direct effects of multiple dimensions of women's empowerment on birth weight in Ethiopia using SEM. The finding of this study was consistent with the hypothesis that the household decision-making power of the mothers was positively related to birth weight. Contrary to our hypothesis, the mothers' economic empowerment was negatively related to birth weight. Psychological and time empowerment of the mothers were not associated with birth weight.

The results of this study demonstrated that the prevalence of LBW and macrosomia was comparable, suggesting the need for interventions not only for LBW but also for macrosomia. A significant and positive effect of the mothers' household decision-making power on birth weight was observed in this study. This is consistent with other studies that reported higher decision-making power of women, resulting in higher birth weight (42, 50). The decision-making power of women can affect their health service utilization (25, 26) and nutritional status (24, 27, 51). This may influence fetal growth, which has implications for birth weight. In this study, women who had the freedom to make decisions regarding their healthcare, food purchases, and preparation had higher birth weight babies than those who did not have these privileges. Better health service utilization among women may improve their health knowledge. They are more likely to have adequate antenatal care visits (52), which help them access micronutrients, including iron and folic acid supplements, regulate their nutritional status, and check their health and overall pregnancy status. These factors contribute significantly to averting poor birth outcomes, including poor birth weight. Women with better household decision-making power are more likely to consume adequately diverse diets (53), which reduces micronutrient deficiency (44). Dietary diversity during pregnancy can determine the nutritional status of the mother (44, 54). This, in turn, is known to affect birth weight (28, 55).

Studies have reported that women's economic empowerment is positively associated with better maternal nutrition (34), higher maternal health service utilization (56), and lower parity (57). Besides, women's economic empowerment is known to enhance the household decision-making power of women (58). These evidence suggest that economic empowerment contributes to better birth weight. However, the negative association between mothers' economic empowerment and birth weight was an unexpected finding in this study. This may be owing to the mediating effect of other variables on the relationship between economic empowerment and birth weight. It is

a fact that women have to work to be able to generate income. In addition, the gender role in Ethiopia forces women to accomplish unpaid and tiresome household work (59). These burdens may result in time deprivation to care for themselves. In addition, a heavy workload may increase energy expenditure. Long working hours and heavy workloads have been associated with poor nutritional status (40) and lower birth weight (41, 60). Time use is also reported to impact the agency of women (61). Women who had to work outside for long hours for income generating purposes might not be actively involved in decisions regarding household food purchase and preparation. On the other hand, even if women are involved in income-generating activities, their economic empowerment is sufficient only to allow them to lead subsistence lives. It may not be sufficient to allow them to afford good quality and quantity of food for themselves and their households. This may result in poor nutritional status in women.

Psychologically empowered women are determined to use available resources and services, including maternal health services. They have the strength to cope with stressful situations (35), which contributes to better birth outcomes (36, 37). Some studies have shown that the psychological empowerment of women is positively associated with their nutritional status (24, 39). This has been positively associated with birth weight (28). As pointed out above, time empowerment was linked with better maternal nutritional status (40) and household decision-making power (61). Hence, time empowerment was expected to result in better birth weight. However, neither psychological nor time empowerment was associated with birth weight in this study. These findings imply interconnectedness among the empowerment dimensions. Empowerment in the psychological dimension alone may not significantly affect birth weight unless there is economic empowerment, which enables women to afford good quality and quantity of food and access maternal health services.

Similarly, women's time empowerment may require simultaneous empowerment in other dimensions to result in an expected outcome. Even if a woman is empowered in the time dimension, it does not necessarily imply that she is empowered in the household decision-making, economic, or psychological dimensions. Further investigations are needed to determine whether women who are empowered in the time dimension are financially reliant on their partners and whether this has contributed to less empowerment in household decision-making and psychological dimensions among women.

Birth weight was categorized into LBW or not, as well as macrosomic or not. Separate analyses were conducted to examine the effect of the multiple dimensions of women's empowerment on these categorical variables. None of the dimensions were significantly associated with LBW or macrosomia. This may be because there were relatively few LBW and macrosomic infants, which reduced the statistical power to detect the effects of the empowerment dimensions on the categorized outcomes. Studies in Ethiopia have suggested that macrosomia is rising over time (15, 16). The cases of LBW and macrosomia were similar in this study. Further research may be helpful in determining whether women's empowerment has brought about changes in lifestyle that may be connected to birth weight.

This study is novel in providing empirical evidence of the effects of multiple dimensions of women's empowerment on birth weight in the study area. However, further research is needed to determine how these dimensions impact the outcomes. Investigating the mediating factors between the dimensions of women's empowerment and birth weight is important for developing more effective interventions.

This study has some limitations. The gestational age was not confirmed using ultrasound. This may have affected the accuracy of the estimated gestational age. Birth weight can be affected by several factors, including maternal medical conditions (62), besides the dependent and control variables analyzed in this study. Uncontrolling for these factors may have affected the findings of this study. A tool to measure women's empowerment was developed based on previous studies. There may be unmeasured aspects of women's empowerment that are important to birth weight in the study area. Although the women who were excluded from this study were slightly older, they had no significant difference in the study's main exposure (women's empowerment dimensions) and other background characteristics with the women included in this study. Hence, this is less likely to have affected the results of this study.

Conclusions

Our findings highlight that women's household decision-making power is positively associated with birth weight, while the economic empowerment of women is negatively associated with birth weight. Policies and programs aimed at improving birth weight can benefit from the promotion of women's decision-making power. However, the negative association found in this study signifies the need to pursue further research. Overall, the positive, negative, and insignificant findings of this study suggest the need for pathway analysis and qualitative research to answer the contexts of how and why different associations exist between women's empowerment dimensions and birth weight.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Disclosure

The authors declare that they have no competing interests.

Authors' contributions

TE, AY , and MS contributed to the conception, design of the work, analysis of data, interpretation of data, and

revision of the draft work. TE was responsible for the acquisition of data and drafting the manuscript. All authors read and approved the final manuscript to be published and have agreed on the journal to which the article has been submitted.

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