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Maternal factors promoting normal linear growth of children from impoverished Rwandan households: a cross-sectional study

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Abstract

Background Linear growth faltering remains a pervasive public health concern that affects many children worldwide. This study aimed to investigate possible maternal factors promoting normal linear growth among children aged 6–23 months of age from impoverished Rwandan households.

Methods We used a three-stage cluster sampling procedure. The study population consisted of children aged six to 23 months and their mothers who lived in the study districts. A structured questionnaire helped to collect data from 807 selected mother-child dyads. The primary outcome variable was height-for-age Z scores. The main predictors were maternal income-generating activity, maternal education, maternal depression, household decision making, number of ANC visits, use of family planning method, types of family planning, and mode of delivery. We used univariate analysis to establish median, frequencies, and percentages. Furthermore, we used the Kruskal-Wallis, Mann-Whitney U, and Spearman rank correlation tests for bivariate analysis. We included in the final model of robust linear regression for multivariate analysis the potential confounding variables identified as significantly associated with the outcome (child age, participation in works for both parents, good handwashing practice, owning a vegetable garden, and the total number of livestock) along with maternal factors.

Results Maternal factors that promoted normal linear growth of children were the presence of maternal income generation activity (β= 0.640 [0.0269 1.253], p value = 0.041), the participation of the mother in the decision-making process of the household (β=0.147 [0.080 0.214], p-value < 0.001), and the higher frequency of consultations with ANC (β=0.189 [0.025 0.354], p-value = 0.024). Additionally, a combination of household decision-making with the number of ANC visits predicted an increase in the linear growth of the child (β=0.032 [0.019 0.045], p-value < 0.001).

Conclusion Maternal factors such as maternal income-generating activity, maternal participation in household decision making, and increased number of ANC visits were found to promote normal child linear growth. These results contribute valuable information to the formulation of interventions and policies to improve child nutrition and growth in the community studied.

Keywords Rwanda, Factors, Linear growth, Stunting, Children

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Background

Linear growth faltering continues to be a prevalent public health issue that affects many children worldwide. In 2022, the faltering of linear growth affected approximately 148.1 million children worldwide, which is equivalent to 22.3% of all children under five years of age [1]. Sub-Saharan Africa was among the most affected, with 31.3% constituting a notable concern [2]. Rwanda is among the countries with an alarming rate of linear growth depletion, with approximately 33.1% of children under 5 years of age affected in 2020 [3]. Thus, linear growth faltering is still a substantial health issue that requires further attention in Rwanda.

Linear growth faltering is the finest indicator of the accumulated effect of long-term undernutrition during 1000 days of life [4]. The World Health Organization (WHO) defined it as height-for-age Z scores that fall below minus two standard deviations of the median height of growth standards [5]. The faltering of linear growth is not only an indicator of poor nutrition, it also has short- and long-term consequences such as reduced physical development, cognitive impairment and elevated proneness to infections [4], cardiovascular diseases [6], poor academic performance, reduced physical resilience, and diminished economic productivity [7].

The adverse results of the faltering of linear growth can be devastating and cause irreversible damage, as the first 1,000 days of life are a critical period of the development of the child [8]. Furthermore, the failure of linear growth can also contribute to social and economic inequalities, perpetuating a cycle of poverty and malnutrition [9]. Short stature among mothers also increases the risk of having stunted children and spreads the vicious cycle of faltering intergenerational linear growth [10].

Practical strategies to promote normal linear growth include promoting maternal and child care, encouraging optimal feeding practices, providing early childhood education and stimulation, empowering women, promoting maternal psychosocial factors, and ensuring access to safe water and improved sanitation [11]. Addressing the faltering of linear growth also requires a multisectoral approach that includes collaboration of different sectors, including health, education, water and sanitation, and social protection [12]. With coordinated efforts, it is possible to promote normal linear growth and improve the overall health of millions of children around the world.

The initiatives taken by Rwanda's government and its stakeholders to promote linear growth are evident, such as a cow per family [13] SHISHAKIBONDO distribution, one egg per child, cooking demonstration, monthly growth monitoring and 1000 days campaign [14, 15]. The prevalence of linear growth faltering among children has decreased from 44.2% in 2010 [16] to 33.1 in 2020 [3]. However, this decrease is still far from achieving the target of at least 19% by 2024, as proposed by the fourth strategic plan for Rwanda [17]. This slight decrease testifies to the possibility of normal linear growth in some families. Thus, we need to explore other factors that could be associated with normal linear growth. Therefore, this study investigated the potential maternal factors that contribute to normal linear growth among children of impoverished Rwandan households.

Methods

Study setting, design and population

This study used a cross-sectional design and quantitative approach. We purposively selected districts that exhibited a high prevalence of stunting within their respective provinces. Kayonza from the eastern province with 41%, Nyaruguru from the southern province with 48%, Burera from the northern province with 49%, Rutsiro from the western province with 54%, and Gasabo from Kigali City of Kigali with 14% [18]. We included children aged six to twenty-three months and their mothers who lived in the study districts. The inclusion criteria considered the child from a low-income family (category 1&2 of Ubudehe) [19], being a singleton and being born full-term. We did not consider eligible participants who appeared to be too sick to participate in the study, as they require immediate health care and attention that could be compromised during the investigation or could introduce biases, as their health outcomes may differ significantly from the general population.

We obtained a sample size of 807 participants using the Fischer formula ($\mathrm{n} = \frac{Z^2pq}{d^2}$) [20], considering a design effect of 2, a 20% loss to follow-up and a precision level of 5%. In this formula, n indicates the sample size and Z represents the abscissa of the normal distribution at a confidence level of 95% (Z=1.96), with prevalence p (33.1%), the complement p, q = (1-p) and the desired precision of 5%.

We used a three-stage cluster sampling technique. In the first stage, as the study was about determining factors of stunting, administrative districts with a high prevalence of stunting were purposively selected based on the high prevalence of stunting in their respective provinces. For the following stages, probability sampling was applied to randomly select participants, ensuring representativeness and reducing bias. This combination enabled us to stay focused on specific areas and populations of interest while maintaining generalizability and scientific rigor. In the second stage, the villages within these districts were randomly chosen. In the third stage, households within the selected villages were then selected community health workers identified as eligible participants from each selected village. After compiling all participants from each village, we created an extensive list of all eligible candidates (mothers and children ages 6–23) who

met the inclusion criteria. We divided the total number of eligible households by the sample size to obtain the sampling interval (k). The first dyad was selected randomly from the first interval and after that, every k^{th} household was systematically selected to obtain 807 mother-child dyads.

We selected qualified and experienced enumerators and trained them for a 3-day program. The first day was devoted to theoretical aspects of the purpose of the study, the protocol, and the data collection tool. On The second day involved practical training, including a pre-test, where enumerators practiced administering the survey. The last day was devoted to improving and modifying the data collection instruments in light of the knowledge gathered during the pretest.

During the pretest, we identified eligible households with the help of community health workers from the villages visited. A pretest was conducted in one sector of the Gasabo district, where 20 homes participated. The results of this pretest were used to update and correct the data collection tool. The specific sector within the Gasabo district was selected due to its characteristics similar to the research area, although it was not included in the actual study.

Twenty-five enumerators grouped into five teams collected data from 30 August to 23 September 2021. Each team consisted of six enumerators and one supervisor. The enumerators worked in pairs to help each other during data collection. A team of three pairs was assigned to collect data in one district and coordinate with one supervisor. Data collection was carried out in the households of the participants. Quantitative data was gathered using a data collection tool installed on tablets with an electronic data management system called Kobo Collect to avoid errors and save time for data entry.

We used a portable stadiometer to measure the child's length. We collected the remaining data through a structured questionnaire. The enumerators sent all the collected data to the central system, where the supervisors performed daily checks daily to ensure completeness of the data. The primary investigator and the supervisors oversaw every aspect of the data gathering process.

Study variables

The primary outcome variable of this study was linear growth, presented in the form of height-for-age Z scores as a continuous variable. The main predictors of this study were the mother having income-generating activity, maternal education, maternal depression, household decision making (HHDM), number of visits to the ANC, use of family planning method, types of family planning, and mode of delivery. The potential confounder variables were child age, involvement in work for both parents, good hand washing practice, lack of vegetable gardens, and total number of livestock (including chickens, goats, and cattle).

For variables related to the sociodemographic and economic characteristics of mothers, we used questions similar to those used in the Rwanda Demographic and Health Survey [21]. To assess maternal depression, we used the Edinburgh postnatal depression scale (EPDS), a ten-item tool with a 0–3 Likert scale and a maximum score of 30 [22]. Regarding interpretation, the higher the value, the worse the depressive symptoms. The EPDS tool has been widely used in sub-Saharan Africa [23] and has been validated to examine the extent and potential risks of depression during the perinatal period in numerous countries and languages [23]. It has also been validated as an antenatal depression screening tool in a previous Rwandan study [24]. In the present study, EPDS was reliable, with a Cronbach alpha value of 0.840. Additionally, we use a three-item scale to measure women's household decision-making of women, with a total score between zero and nine [25]. For interpretation, a higher score reflects greater maternal participation in decision making, while decreased scores indicate less participation. The tool was deemed reliable for this study, attaining a Cronbach Alpha value of 0.895. In addition, we included questions related to water, sanitation, and hygiene (WASH). The WASH indicators were grouped and classified into improved and unimproved, following WHO guidelines [26, 27]. We considered participants with good hand washing practices, those who had cut their nails and washed their hands with clean water and soap.

Data analysis

We developed a data dictionary to export the data into Stata 15 for final cleaning and analysis. After data cleaning, we measured inter-rater reliability for socioeconomic factors and anthropometry. For anthropometrics, the Krippendorff's Alpha coefficient is 0.298 (fair agreement of the data), and for socioeconomic status, the Krippendorff's Alpha coefficient is 0.02 (slight agreement of the data). Furthermore, we measured that the Shapiro-Wilk test was used to check the normality of the dependent variable. Given that the outcome variable was not normally distributed, as evidenced by both skewness and kurtosis, we used in univariate analysis, frequencies and percentages for grouped data and median with interquartile range (IQR), to describe and summarize study variables because it offers a more accurate measure of central tendency by being unaffected by extreme values.

The next level involved specifying significant variables considering the primary outcome variable. We opted to use the Kruskal-Wallis test for variables categorized into three or more independent groups, the Mann-Whitney U test for variables grouped into two independent groups, and the Spearman rank correlation test for continuous

variables. In addition, we used Huber's approach for robust linear regression for multivariate analysis. These tests allow for vigorous estimation of model coefficients, accommodating potential outliers, and deviations from normality, which were present in our outcome variable and provide reliable findings in the presence of various types of variable [28]. During that process, we included only significant variables (p-value < 0.05) from the Kruskal-Wallis test the Mann-Whitney U test, and the Spearman rank correlation test.

For the last stage of analysis, we fitted the robust regression analysis models in three steps. In the first step (Model I), significant variables (with p-value < 0.010) from the bivariate analysis were selected one by one. In the second step (Model II), the significant variables (p-value < 0.05) related to maternal factors were entered one by one into the model after controlling for other significant factors from Model I, including child age, good hand washing practices, and number of livestock. In the third stage (Model III), we entered all significant variables with $p < 0.05$ from Model II after controlling the same variables as in Model II. Only significant variables with $p < 0.05$ were considered independent factors of normal linear growth. Results were reported as a beta coefficient (β) with a 95% confidence interval (CI) and p-value.

After finding independently significant variables, we thoroughly analyzed their combined effects. Through this process, we included significant variables based on an exploratory basis to investigate additional potential associations that emerged during the analysis. To be more precise, we created two separate models to look at the relationship between a combination of household decision-making and ANC visit numbers, a combination of household decision-making and the mother having income-generating activity, a combination of the numbers of ANC visits and the mother having income-generating activity, as well as the interaction of all three variables together. The process used to construct these interaction models followed the same exacting guidelines as our earlier analysis.

Results

Linear growth among children

The Z scores for height for age, reflecting the linear growth of the sample, exhibit a median of -1.38 (-2.34--0.43). As shown in Fig. 1, curve A represents a normal distribution, while curve B reflects the growth curve of the study sample. Additionally, curve B shows a left-skewed tendency with a concentration of children aged 6 to 23 months from impoverished Rwandan households that reflect relatively lower height-for-age Z scores. This negative value suggests a tendency towards linear growth faltering. However, even though the present median shows a negative skew, a large number of children still fell within the normal range (above minus two standard deviations), indicating that a significant number of children had a likelihood of improving their height-for-age Z scores despite the unhurried improvement.

Sociodemographic characteristics of the study children and their mothers

As detailed in Table 1, of the mothers who completed the survey, the median EPDS score was 10.84 (6–15) out of a maximum of 30. This median demonstrates a moderate level of depressive syndromes within the study population. Furthermore, the median HHDM score was 7.44

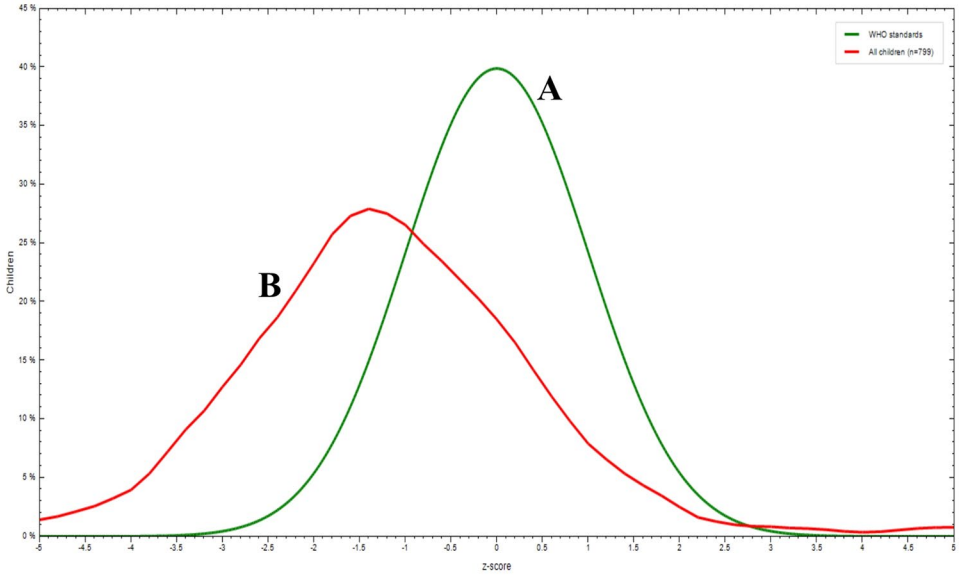


Fig. 1 Height-for-age Z scores (linear growth)

Table 1 Sociodemographic characteristics of children and their mothers (*N* = 807)

Variables	Median (IQR)	Frequency	Per cent	Bivariate analysis	
				ρ/ U/H	*p*-value
EPDS	10.84 (6–15)	-	-	-0.101*	**0.004**
Household decision-making scores	7.44 (6–9)	-	-	0.217*	**< 0.001**
Maternal education					
No formal education	-	89	11.03	10.714***	**0.005**
Primary	-	505	62.58		
Post-primary	-	213	26.39		
The mother has income-generating activities.					
No	-	745	92.3	-2.008**	**0.045**
Yes	-	62	7.7		
Child age					
6–11		279	34.57	35.488***	0.**0001**
12–18		331	41.02		
19–23		197	24.41		
Antenatal care					
Less than four		291	36.06	-2.737**	**0.0062**
Four and more		216	63.94		
Mother works alone					
No	-	30	96.3	-2.351**	**0.019**
Yes	-	777	3.7		
Use of family planning method					
No	-	401	49.7	0.708**	0.479
Yes	-	406	50.3		
Breast discomfort during lactation					
No	-	696	86.2	2.085**	**0.037**
Yes	-	111	13.8		
Family planning types					
No family planning before pregnancy	-	402	49.8	1.508***	0.470
Modern	-	381	47.2		
Traditional	-	24	3.0		
Delivery mode					
Not assisted by health facility	-	15	1.9	11.24***	**0.004**
Vaginal delivery from a health facility	-	703	87.1		
Caesarean	-	89	11.0		
Total number of livestock	1.48 ()	-	-	0.080*	**0.024**
Vegetable garden possession					
No	-	395	48.9	-1.572**	0.116
Yes	-	412	51.1		
Good handwashing practice					
No	-	160	25.9	-6.097**	**< 0.001**
Yes	-	458	74.1		
Both parent working					
No	-	111	13.7	0.175**	0.861
Yes	-	696	86.3		
Minimum dietary diversity for children					
Low DD		250	30.98	-0.800**	0.423
Acceptable DD		557	69.02		
Minimum dietary diversity for women					
Low DD		585	72.49	0.245**	0.807
Acceptable DD		222	27.51		
Child ever breastfed					
No		22	2.73	0.702**	0.482
Yes		785	97.27		

Table 1 (continued)

Variables	Median (IQR)	Frequency	Per cent	Bivariate analysis	
				ρ/ U/H	*p*-value
Child still breastfed					
No		30	3.72	-0.526**	0.598
Yes		777	96.28		

*= **ρ** is the coefficient for Spearman rank correlation,

= **U is the coefficient for the Mann-Whitney U test,

***=**H** is the coefficient for the Kruskal-Wallis test

Table 2 Multivariate analysis: factors that promote normal linear growth in children (*N* = 807)

Variables	Model 1		Model 2		Model 3	
	β [CI]	*p*-value	β [CI]	*p*-value	β [CI]	*p*-value
Child age	-0.466 [-0.637- -0.294]	**< 0.001**				
Maternal education	0.288 [0.087 – 0.489]	**0.005**	0.165 [-0.080 – 0.411]	0.186	-	-
Mother has income-generating activity	0.476 [-0.084 – 1.036]	**0.095**	0.627 [0.009 – 1.246]	**0.047**	0.640 [0.0269 – 1.253]	**0.041**
Edinburgh post-natal depression scale	-0.025 [-0.046– -0.036]	**0.002**	-0.017 [-0.042 – 0.008]	0.181	-	-
Household decision-making scores	0.147 [0.090 – 0.204]	**< 0.001**	0.160 [0.094 – 0.226]	**< 0.001**	0.147 [0.080 – 0.214]	**< 0.001**
ANC visits	0.248 [0.102 – 0.395]	**0.001**	0.224 [0.059 – 0.389]	**0.008**	0.189 [0.025 – 0.354]	**0.024**
Total number of livestock	0.063 [0.020 – 0.107]	**0.004**	-	-	-	-
Mother working alone	-0443 [-1.087 – 0.201]	0.177	-	-	-	-
Breast discomfort during lactation	-0170 [-0.571 – 0.229]	0.404	-	-	-	-
Mode of delivery	0.220 [-0.077 – 0.518]	0.146	-	-	-	-
Good handwashing practice	0.924 [0.587 – 1.261]	**< 0.001**	-	-	-	-

Model I: All significant variables from the bivariate analysis were entered individually.

Model II: Only significant maternal factors from Model I were entered individually after controlling for other significant factors from Model I.

Model III: All significant maternal factors from Model II, after controlling other significant factors from Model I

(6–9) out of a maximum of 10. The median here shows the relatively high level of involvement of mothers in household decision-making among the study population.

About socioeconomic status, the median livestock owned by households was 1.48 domestic animals. Only 7.7% of mothers said that they had income-generating activities, and even fewer 3.7%) claiming to be only those who work in the home, and 11.03% did not receive formal education.

In terms of reproductive health, about half of all women (49.7%) did not use contraception methods before getting pregnant. The percentage of less than four ANC visits was 36.06%. Additionally, most mothers gave birth in a health facility, with only 1.9% reporting giving birth outside of a health facility. After delivery, 13.8% of mothers claimed to experience breast discomfort during lactation. Furthermore, about half of all the households surveyed (51.1%) had a vegetable garden, 74.1% demonstrated good hand washing practices, and 86.3% reported having both parents working.

Using the same table, we examined the relationship between the sociodemographic characteristics of mothers and the normal linear growth of children. The following variables were significant (p-value < 0.05): child age (p-value < 0.001), maternal education (p value = 0.005), EPDS (p value = 0.004) and HHDM (p-value < 0.001), ANC (p value = 0.001), mother has income-generating activities (p-value < 0.001), the mother works alone (p value = 0.019), experience breast discomfort during lactation (p value = 0.037), mode of delivery (p value = 0.004), total number of livestock (p-value = 0.024), and good handwashing practice(p-value < 0.001).

Multivariate analysis: maternal factors that promote normal linear growth of children

Table 2 shows the results of the multivariate analysis in three models, with the final model presented here. The results suggested that maternal participation in income generation, higher scores of maternal involvements in household decision-making, and more ANC visits were positively associated with higher Z scores for height for age. More specifically, mother's involvement in income-generating activities increased by 0.640 in height-for-age of the child (β= 0.640 [0.0269 1.253], p-value = 0.041). Furthermore, with an increase in one unit of household decision making, there was an increase of 0.147 in height-for-age of the child (β= 0.147 [0.080 0.214], p-value < 0.001). Furthermore, in line with the increase in one antenatal care visit for the woman, there was an additional 0.189 units to height-for-age (β=0.189 [0.025 – 0.354], p-value = 0.024).

Table 3 presents the combined effects of all significant variables. The findings showed that a combination of HHDM and ANC visits was significant (β= 0.032 [0.019

Table 3 Combined effect between significant variables that promote linear growth (*N* = 807)

Variables	Model 1		Model 2		Model 3	
	β [CI]	*p*-value	β [CI]	*p*-value	β [CI]	*p*-value
Household Decision Making and number of ANC visits	0.031 [0.020 – 0.042]	**< 0.001**	0.031 [**0.018 – 0.044**]	**< 0.001**	0.032 [0.019 – 0.045]	**< 0.001**
Household Decision Making and the maternal income-generating activity	0.071 [0.001 – 0.1419]	**0.048**	0.084 [0.004 – 0.164]	**0.039**	0.117 [-0.203 – 0.438]	0.473
Number of ANC visits, and the mother has income-generating activity	0.140 [-0.023 – 0.304]	**0.093**	0.206 [0.017 – 0.396]	**0.033**	0.410 [-0.567 – 1.387]	0.410
Household Decision Making, Number of ANC Visits, and the maternal income-generating	0.019 [-0.001 – 0.039]	**0.056**	0.025 [0.001 – 0.049]	**0.043**	-0.060[-0.219 – 0.098]	0.456

Model I: Combined significant variables from multivariate analysis entered individually.

Model II: The significant factors from Model I were combined and entered individually after controlling the same factors.

Model III: All significant maternal factors in Model II were entered individually after controlling for the same factors

0.045], p-value < 0.001). This coefficient indicates an anticipation of a corresponding increase of 0.032 units in linear growth for each unit increase in household decision-making scores and number of ANC visits.

Discussion

Linear growth as expressed by height-for-age Z scores for children in this study was, on average, -1.38 (-2.34; -0.43). This median is relatively lower than the expected average for their age group. The children participating in the present study showed a trend towards a shorter stature for age. This tendence indicates that some children in the studied population experienced mild to moderate growth retardation, but others are less affected or even in normal ranges. A previous study conducted in Rwanda supported these findings, in which the prevalence of stunting changed from 47.4% in 2000 to 38.3% in 2015 [29]. On a more optimistic note, despite this negative tendency, many children still fell in the normal range of linear growth since the median did not fall below minus two.

The present median aligns with a study that indicates the possibility of normal linear growth despite belonging to low socioeconomic families [30]. According to a study conducted in East African countries, all countries examined showed a higher probability of poor linear growth among children under five years compared to Kenya, where the prevalence was 21.9%. The odds of stunting were 4.76 times higher in Burundi, 3.44 times higher in Madagascar, 2.51 times higher in Mozambique, 2.41 times higher in Rwanda, and 2.43 times higher in Zambia [31]. These findings show the necessity of focused interventions in these countries to address and lower the high rates of stunting among children.

The present study explored maternal factors that could promote linear growth. The median of 10.84 (6–15) for the EPDS score indicates an elevated level of depressive syndromes within the studied population. These findings are consistent with other studies conducted in Rwanda, which showed a high prevalence of antenatal depressive symptoms [23, 32]. Despite the elevated prevalence of maternal depressive symptoms, we did not find statistically significant associations with linear growth.

Unlike maternal depression, this study found a positive association between household decision making and linear growth. The median scores of 7.44 (6–9) suggest that mothers in the study population felt relatively empowered with household decision making. This empowerment implies that an empowered decision-making process within households may contribute positively to the linear growth of children [33]. Our findings were consistent with studies conducted in Ethiopia [34, 35] and Nigeria [36], where poor maternal participation in household decision-making decreased Z scores versus height for age for children.

The results of this study revealed a substantial positive correlation between the number of ANC visits for women and the linear growth of the children. This association might explain the increased chances that parents regularly participate in ANC and receive health and nutrition education sessions. In addition, the ANC allowed them to enrol in other government programs that aimed to improve their lives. Unfortunately, we did not explore this. However, some other studies conducted in East Africa [31] and sub-Saharan Africa [30] respectively has also found this association and point to the potential role of maternal healthcare utilization during pregnancy in promoting child growth.

The participation of mothers in income-generating activities increased the Z scores for the height of the child in this study. This relationship may be due to improved access to socioeconomic resources that optimize purchase power, better food, healthcare, and living conditions. Other studies conducted in Ethiopia [37], and in Cambodia [38] found that increased income can improve children's access to health care and better nutrition. Another Bangladeshi survey established a positive relationship between maternal employment and overall economic well-being of the family, which had long-term favourable benefits for child development of the child [39]. Some studies have found the opposite

when a mother is involved in any activity that can generate income [40, 41]. The reason behind this could be the reduced time allocated to children and therefore reduced child care [42].

This analysis explored the combined effects of household decision-making scores and the number of antenatal care (ANC) visits on linear growth. This positive association suggests that the impact of mother participation in household decision making on child linear growth is more pronounced among mothers with a higher number of ANC visits. The findings of this study imply that the joint influence of household decision-making scores and the number of ANC visits significantly strengthens their combined effect on linear growth. In essence, the positive impact of household decision-making scores on linear growth is more pronounced when there are higher levels of ANC consultations. Further interventions should integrate the promotion of these factors within existing initiatives aiming to empower women.

The findings of the present study provide valuable information for global public health, helping to shape strategies, policies, and interventions aimed at reducing malnutrition and improving health outcomes in the community studied or similar settings, particularly in East African countries.

This study has some limitations. First, apart from anthropometric measurements, many of the variables evaluated were self-reported, which may have been subject to social desirability bias. Second, we did not measure other factors, such as nutrition biomarkers, which can also affect linear growth.

In conclusion, the results of this study elaborated on the multifaceted nature of maternal factors that promote linear growth, including maternal participation in household decision making, the increased number of consultations with ANC and the income-generating activity. These results provide valuable information for global public health in formulating strategies, interventions, and policies to improve child nutrition in the studied community and across East Africa, or other similar contexts.

Abbreviations

ANC	Antenatal care
CI	Confidence Interval
CMHS	College of Medicine and Health Sciences
EPDS	Edinburgh Postnatal Depression Scale
HHDM	Household Decision Making
IRB	Institutional Review Board

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Author contributions

H.J.D.D., the principal investigator, conceptualized and designed the study, analyzed and interpreted the data, drafted the initial manuscript, and addressed all feedback; K.N. revised the methodology and edited the manuscript; S.J. conceptualized and edited the manuscript; E.M. provided inputs in analysis, and edited the manuscript; M.U., L.R. and C.M.: conceptualized and supervised the study and edited the manuscript. All authors reviewed the manuscript.

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Data availability

The data will be available to anyone wishing to access it for scientific purposes. Requests should be directed to the corresponding author at jhabimana@cartafrica.org.

Declarations

Ethics approval and consent to participate

The ethical approval was issued by the Institutional Review Board of the College of Medicine and Health Sciences, University of Rwanda (N^{o} 335/CMHS IRB 2021, amended in 2022 N^{o} 178/CMHS IRB). In addition, we obtained a research permit and visa from the Rwanda Ministry of Local Governance and the National Institute of Statistics of Rwanda. Before starting any interview, mothers signed the informed consent form to participate voluntarily after receiving detailed explanations of the purpose of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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