

The relationship between maternal age, obesity, and child mortality: A cross-sectional study using 2013-2014 Demographic and Health Survey in Democratic Republic of the Congo

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Key words: Maternal obesity, child health, mortality, Democratic Republic of the Congo

Acknowledgements

The authors thank the DHS Program, the Ghana Health Service and the Ghana Statistical Service for the data used in this study.



This is an Accepted Manuscript for Public Health Nutrition. This peer-reviewed article has been accepted for publication but not yet copyedited or typeset, and so may be subject to change during the production process. The article is considered published and may be cited using its DOI 10.1017/S1368980024002647

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Financial support

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest

The authors have no conflict of interest to declare.

Authorship

Z.T.D conceived and designed the study, interpreted the results, wrote the first draft of the manuscript and contributed to revision of the manuscript. Z.T.D. and S.M.M. analysed the data. Z.T.D., S.M.M. and R.M.N. contributed to study design, data interpretation and critical revision of the manuscript. All authors read and approved the final version, and they take responsibility for any issue that may arise from the publication of this manuscript.

Ethics of human subject participation

Ethical approvals were obtained from the national ethics committees of Democratic Republic of the Congo. Written informed consent was obtained from every participant before she/he was allowed to take part in the survey. Consent was obtained from parents before their children's measurements were taken. The DHS Program in the United States of America, granted the authors permission to use the data. The data were completely anonymous and publicly available at <https://dhsprogram.com/data/available-datasets.cfm>; therefore, the authors did not seek further ethical clearance.

Abstract

Objective: To investigate the relationship between maternal age and nutritional status, and test associations between maternal nutritional status and child mortality with a focus on maternal obesity.

Design: Secondary analysis of data from nationally representative cross-sectional sample of women of reproductive ages (15—49 years) and their children under five years. The outcome variable for maternal nutritional status was Body Mass Index (BMI), classified into underweight ($\text{BMI} < 18.50 \text{ kg/m}^2$), normal weight ($18.50\text{—}24.99 \text{ kg/m}^2$), overweight ($25.0\text{—}29.9 \text{ kg/m}^2$) and obesity ($\geq 30.0 \text{ kg/m}^2$). Child mortality was captured with five binary variables measuring the risk of dying in specific age intervals (neonatal, post-neonatal, infant, childhood, and under-five mortality).

Setting: The most recent Demographic and Health Surveys from Democratic Republic of Congo (DRC).

Participants: The final samples consisted of 7,892 women of reproductive ages (15—49 years) and 19,003 children aged 0—59 months.

Results: The prevalence of obesity was estimated at 3.4%; it increased with maternal age. Furthermore, obesity unevenly affected provinces in the Democratic Republic of the Congo: Kinshasa, South Kivu, North Kivu and Maniema were most affected. Finally, maternal obesity showed mixed effects on child mortality.

Conclusion: The prevalence of obesity is still low; however, provinces are unevenly affected. Therefore, interventions and programs to improve nutrition should incorporate geographical disparities to tackle adverse child outcomes associated with maternal obesity, to limit negative consequences of maternal obesity, including non-communicable diseases (NCD) which might be a strong impediment to reach Sustainable Development Goals (SDG) 2 and 3.

Introduction

Most epidemiologists trace the **origins of obesity** back in the 1970s⁽¹⁾; during that time, it was mostly confined to developed countries^(2,3). Very recently, obesity significantly spanned in developing countries⁽⁴⁻⁶⁾. In the 2000s, the World Health Organization (WHO) recognized obesity as a global epidemic⁽⁷⁾ because of its interlinkages with non-communicable diseases (NCD). Recent estimates indicated that 1.5 billion of adults aged 20 years and above were overweight; among them, over 200 million of men and 300 million of women were obese⁽⁵⁾. Previous studies showed strong variations of obesity across regions and countries, with sub-Saharan Africa being the less affected region⁽⁸⁾.

Research has established a relationship between maternal age and maternal obesity⁽⁹⁾; however, this relationship is not well documented in developing countries. There are plausible reasons to suggest that maternal obesity may increase with age. First, studies consistently showed that women gain weight during pregnancies⁽¹⁰⁻¹²⁾ and weight gain persists after deliveries. Second, parity increases with maternal age, making weight gain more likely. According to 2022 Global Nutrition Report⁽¹³⁾, even though the prevalence of obesity is lower than the regional averages (20.8% for women and 9.2% for men), a sizeable percentage of people aged 18 years and over in Democratic Republic of the Congo (DRC) are living with obesity (11.6% and 4.5% of women and men, respectively). Furthermore, evidence indicated that the prevalence of overweight among adult aged 18 years and over increased from 18.8% to 20.6% between 2010 and 2014, while the prevalence of obesity rose from 3.7% to 4.4% during the same period. These figures however, mask regional and local disparities of obesity⁽¹⁴⁻¹⁶⁾. For instance, a localized study among a mine-based workforce showed that the prevalence of obesity increased from 4.5% to 11.1%⁽¹⁵⁾. Therefore, the first objective of this paper is to estimate the probabilities of maternal nutritional status using **body mass index (BMI)** and adopting a sub-national perspective and emphasizing urban-rural differences and poverty effects.

Although evidence showed that under-five mortality (U5M) rates in DRC has declined from 186 p. 1000 in early 1990s to 81 p. 1000 in 2020^(17,18), there still are provincial disparities in the country⁽¹⁹⁾. In spite of the decline of U5M, DRC accounts for 11% of annual deaths of children under 5 years in sub-Saharan Africa⁽¹⁸⁾. Previous research has identified several factors at

different layers (child, maternal, and community levels) associated with U5M⁽²⁰⁾, including maternal obesity^(11,12,21–25). Consequences of maternal obesity of child health outcomes include preterm births⁽²⁶⁾; fetal deaths, stillbirths, and infant deaths^(12,21,25,27,28). Yet, this relationship is poorly documented in developing countries, including DRC. Since maternal obesity is alarmingly increasing in developing countries, and child health is still poor in these settings, it is crucial to scrutinize the relationship between maternal obesity and pregnancy and child health outcomes. Therefore, the second objective of the paper is to unpack the relationship between maternal obesity and child mortality at national and sub-national levels.

Methods

Data source

The paper utilizes data from the 2013–2014 Demographic and Health Surveys (DHS) conducted in the Democratic Republic of Congo. DHSs are nationally representative surveys, using a two-stage sampling design, which collected information on households, women and men of reproductive ages, anthropometric measures, contraception and family planning, among others. All men and women aged 15–59 and 15–49, respectively, in the selected households were eligible to participate in the survey if they were either usual residents of the household or visitors present in the household on the night before the survey. This paper reports on findings from women of reproductive ages in the individual record files.

Analyses are restricted to women for whom body mass index was collected (See Figure 1). Likewise, analyses for child health outcomes are restricted to children from women with valid information on BMI.

Ethics statement

Ethical approvals were obtained from the national ethics committees of Democratic Republic of the Congo before the surveys were conducted. Written informed consent was obtained from every participant before she/he was allowed to take part in the survey. Consent was obtained from parents before their children's measurements were taken. The DHS Program in the United States of America granted the authors permission to use the data. The data were completely

anonymous; therefore, the authors did not seek further ethical clearance at the university since the data are publicly available at <https://dhsprogram.com/data/available-datasets.cfm>.

Variables Measurement

Outcomes

Maternal nutritional status

To estimate the prevalence of overweight and obesity among women of reproductive ages, original information was obtained from the body mass index (BMI) derived from results of height and weight measurements. Trained field technicians collected the height and weight using standard techniques⁽²⁹⁾. Using electronic Seca scales with a digital screen, women's weight were measured, while height measurements were taken using a stadiometer produced by Shorr Productions. BMI, referred to as Quetelet's Index⁽³⁰⁾ was derived by dividing weight in kilograms by the squared height in meters. Based on the BMI (Kg/m²) estimates, and according to WHO guidelines for sub-Saharan Africa (SSA), the participants were classified as underweight (BMI < 18.50 Kg/m²), normal weight (18.50–24.99 Kg/m²), overweight (25.0–29.9 Kg/m²) and obese (\geq 30.0 Kg/m²). Preliminary analyses showed that obesity was marginal in the DRC. Therefore, and to avoid instability of statistical models, overweight and obesity were grouped in the category overweight/obesity, resulting into three categories. The normal weight (18.50–24.99 Kg/m²) was used as reference category in the analysis.

Child health outcomes

Previous literature has extensively documented the relationship between maternal nutritional status, referred to as **maternal overweight/obesity** and child health outcomes^(11,12,21–24). This paper is interested in the associations between maternal overweight/obesity and (i) neonatal mortality; (ii) post-neonatal mortality; (iii) infant mortality; (iv) childhood mortality; and (v) under-five mortality. All these indicators have been linked to development levels worldwide⁽³¹⁾ with developing countries experiencing higher levels of child mortality compared with developed countries^(32,33).

DHSs collect information about age at death for deceased children. This information was used to classify the *period of child deaths* for deceased children. All these variables are binary, indicating whether a child has deceased in a specific age-interval. These include:

- *Neonatal mortality* (nn): The risk of dying before birth and first month

- *Post-neonatal mortality* (pnn): The risk of dying between first month and 11 months, contingent to surviving the first month.
- *Infant mortality* (IM) : The risk of dying between birth and 11 months
- *Childhood mortality* (n_{1-5}): The risk of dying between first year and before 5 years, for children who survived till the first anniversary.
- *Under-five mortality* (U5M): The risk of dying between birth and the fifth birthday

Key independent variables

In this paper, two set of independent variables, selected from existing literature, were used to estimate the associations between maternal nutritional status and child health outcomes. Given the nature of analyses, the unit of analysis was different for each set of estimations. For maternal nutritional status, *woman* was the unit of analysis while *child* was the unit of analysis to estimate the associations between maternal nutritional status and child mortality.

Maternal overweight/obesity. To estimate maternal nutritional status, the predictors used in the analysis included women's age and education, working status at the time of survey, breastfeeding status, marital status, sex of the head of household, household wealth index (HWI), place of residence, and province of residence. The original variable HWI has five categories (poorest, poor, middle, rich, and richest). In this study, this variable was recorded into two categories: poor (poorest and poor) and non-poor households.

Child health outcomes. The predictors of interest to estimate the risk of dying in a specific age-interval included **maternal nutritional status** as key independent variable, controlling for sex of the child, pregnancy outcome (child is singleton), birth order, women's age and education, parity, working status, sex of head of household, household wealth index (HWI), place of residence, and province of residence.

Analytical strategy

Maternal nutritional status

The paper used multinomial logistic regression (MLR) to estimate the probabilities of women's nutritional status. MLR approach is appropriate since the outcome measure is polychotomous. Further, MLR was considered attractive analytical technique because it does not assume normality, linearity, or homoscedasticity⁽³⁴⁾. In MLR, vectors $Y = (y_1, y_2, \dots, y_{k+1})$ are observed for the dependent variable; $y_i = 0$ for all i , and one j with $y_j = 1$, and corresponding probability p_j . The MLR is given by

$$p_i = \frac{\exp(\pi^{(i)\top})}{1 + \sum_{j=1}^k \exp(\pi^{(j)\top})} \quad \text{for } i = 1, 2, \dots, k \quad (1)$$

and

$$p_{k+1} = \frac{1}{1 + \sum_{j=1}^k \exp(\pi^{(j)\top})} \quad \text{for } i = 1, 2, \dots, k \quad (2)$$

where $x = (x_1, x_2, \dots, x_m)^\top$ is the vector of covariates, and $\pi^{(i)}$ is the parameter vector corresponding to the i -th response category. In Equation (2), the parameters set to zero and allows computing the probability for the base category in the MLR. The MLR model was performed to investigate the relationship between maternal age at the time of survey and nutritional status, controlling for other relevant variables. Using a BMI category of 18.5–24.99 Kg/m^2 (*normal weight*) as the reference category, a set of logistic regressions for underweight, and overweight/obese were estimated. All covariates were simultaneously entered into the model. Results were presented in the form of coefficients with significance levels and 95% Confidence Intervals (95% CI).

Child mortality. In this paper, the indicators pertaining to child health outcomes were all defined as *binary outcomes*. In a previous study, scholars used *linear probability model (LPM)* to estimate the effects of dying before the first anniversary⁽³⁵⁾. Although this statistical technique leads to easy interpretation, it does not account for the non-linearity of the events; yet,

demographic research has clearly pointed out to this issue⁽³⁶⁾. Therefore, *generalized linear models (GLM)* were used in this paper to account for non-linearity of the outcomes. In GLM, outcomes (Y) are assumed to be generated from a distribution belonging to a large family of *exponential distributions*. Under this assumption, the conditional mean μ of the distribution of the outcomes depends on the independent variables X as follows:

$$E(Y|X) = \mu = g^{-1}(X\beta) \quad (3)$$

Compared with the *standard linear model*, GLM have the following advantages: (i) dropping the normality requirements; (ii) relaxing the homoscedasticity assumption; and (iii) allowing for some function of $E(Y)$ to be linear in the parameters as a **link** $g(\cdot)$.

Specifically, estimations in this paper were performed using the family *binomial* and *logit* as the **link function** in STATA 18 SE. Additionally, the number of iterations was increased using the *option iter(100)* to improve the stability of the models.

Results

Descriptive results

Tables 1–3 present descriptive results for samples of women of reproductive ages (Tables 1 and 2), and children under age 5 (Table 3), respectively. Findings indicate that, overall, 16% of women of reproductive ages are overweight or obese (Table 1). A marginal percentage (result not shown) of them are obese (3.4%). There are rationales to pay attention to geographical variations of maternal nutritional status given diet differences across provinces in the country. In this paper, Table 2 highlights the importance of geographical variations in analyzing women's weight. Clearly, women's average weight varies by province, urban residence, and household poverty levels. Indeed, the average weight of women of reproductive ages ranged from 48.5 kgs in Kongo Central to 61.3 kgs in Kinshasa. Findings also showed rural–urban differences (51.1 kgs vs. 58.4 kgs); differences by poverty levels, with women living in better-off households being heavier (on average: 56.2 kgs) compared with their counterparts living in poor households (49.9 kgs).

Regarding height, findings indicate that shortest women live in the provinces of North Kivu (average: 153.2 cm); South Kivu (average: 153.6 cm); and Maniema (average: 154.1 cm). In

contrast, tallest women are found in Kinshasa, the Capital city, with an average of 160.7 cm. Similarly, findings indicate differences between rural and urban areas, as well as between poor and non-poor households. Finally, analyses of BMI showed that skinniest women lived in the province of Kongo Central (on average: 20.1 Kg/m²). Again, women living in the provinces of North Kivu, South Kivu, and Maniema recorded highest BMI, along with Kinshasa.

Table 3 focuses on the associations between women's nutritional status and child mortality. Figures in Table 3 are expressed in terms of **number of deaths per 1000 live births**. Findings indicate a clear gradient between maternal nutritional status and children health outcomes. Indeed, child health outcomes were worst among children born from underweight women compared to those born from overweight/obese women. However, these differences were not statistically significant. Neonatal mortality was higher among children born from underweight women (35.2 p. 1000) compared with those born from overweight/obese women (23.4 p.1000). Postneonatal mortality rates were also higher among children born from underweight women (48.6 p.1000) compared to those from overweight/obese women (40.0 p.1000). Findings also that infant mortality rates were higher among children born from underweight women (82.0 p.1000) compared to those from overweight/obese women (62.5 p.1000). Likewise, childhood mortality rates were higher among children born from underweight women (50.7 p.1000) compared to those from overweight/obese women (49.2 p.1000). Finally, under-five mortality rates were higher among children born from underweight women (128.6 p.1000) compared to those from overweight/obese women (108.6 p.1000).

Multivariate results

Predicting maternal nutritional status

Figures 2 and 3 display the predicted probabilities of the nutritional status of women of reproductive ages in the Democratic Republic of Congo, based on a multinomial logistic regression of women's observed nutritional status on age, while controlling for women's education, working status, breastfeeding status, marital status, parity, sex of household head, household poverty, place of residence, and provinces.

When focusing on overweight/obesity only (Figure 2), the following provinces are the most affected: North Kivu and South Kivu, Orientale, and to some extent, Kinshasa. Marginally, the provinces of Kasai oriental, Bandundu, and Katanga are affected. Figure 3 shows that obesity is primarily concentrated in urban areas, and among better-off households.

Associations between maternal nutritional status and child mortality

Figure 4 and Table 4 present the associations between women's nutritional status (for the entire sample, and by household poverty levels and place of residence) and five child health outcomes, including neonatal mortality, post-neonatal mortality, infant mortality, child mortality, and under-five mortality, controlling for child-level variables (sex of the child, birth order, type of birth), woman-, household-, and community-level variables (age, education, parity, sex of household head, household poverty, place of residence, and province).

Figure 4 confirms the absence of a *clear gradient* between maternal nutritional status and child health outcomes as aforementioned. For instance (See Table 4), underweight is *positively* associated with infant mortality [$\beta = 0.203$; 95%CI: (-0.006; 0.449)], childhood mortality [$\beta = 0.301$; 95%CI: (0.012; 0.591)], and U5-mortality [$\beta = 0.252$; 95%CI: (0.087 – 0.417)]. Overweight/Obesity is *negatively* associated with three child health outcomes, including neonatal mortality [$\beta = -0.358$; 95%CI: (-0.631; -0.084)]; infant mortality [$\beta = -0.279$; 95%CI: (-0.498; -0.059)]; and under-five mortality [$\beta = -0.155$; 95%CI: (-0.303; -0.007)].

When data are disaggregated by household poverty levels (See Table 4; Panel B), findings show that women's nutritional status is not significantly associated with child health outcomes for poor households. In advantaged households, some associations between women's nutritional status and child health outcomes reached statistical significance, mimicking the pattern in the entire sample. Indeed, underweight was *positively* associated with infant mortality [$\beta = 0.258$; 95%CI: (-0.022; 0.538)]; childhood mortality [$\beta = 0.485$; 95%CI: (0.105; 0.864)]; and under-five mortality [$\beta = 0.357$; 95%CI: (0.135; 0.579)]. Likewise, overweight/obesity was marginally *negatively*

associated with neonatal mortality [$\beta = -0.273$; 95%CI: (-0.574; -0.027)] and infant mortality [$\beta = -0.232$; 95%CI: (-0.473; -0.008)].

Looking into the associations between maternal nutritional status and child health outcomes by place of residence (Table 4; Panel C). Among rural women, underweight was *positively* associated, net of controls, with under-five mortality [$\beta = 0.247$; 95%CI: (0.061; 0.432)]; and marginally with infant mortality [$\beta = 0.193$; 95%CI: (0.034; 0.419)] and childhood mortality [$\beta = 0.299$; 95%CI: (-0.025; 0.623)]. In contrast, overweight/obesity was *negatively* associated with neonatal mortality [$\beta = -0.503$; 95%CI: (-0.886; -0.120)]; infant mortality [$\beta = -0.380$; 95%CI: (-0.699; -0.061)]; and under-five mortality [$\beta = -0.210$; 95%CI: (-0.398; -0.022)]. Among urban women, no significant associations are found between maternal nutritional status and child health outcomes.

Geographical variations of the associations between maternal nutritional status and child health outcomes

Table 5 presents the associations between maternal nutritional status and child health outcomes by province of residence. Although Table 5 provides much more details, this section focuses on overweight/obesity. In Bandundu, findings indicated that maternal overweight/obesity was *significantly and negatively* associated with childhood mortality [$\beta = -1.713$; 95%CI: (-3.144; -0.283)]; and under-five mortality [$\beta = -0.822$; 95%CI: (-1.492; -0.151)]. In Equator, being overweight/obese was *significantly and positively* associated with under-five mortality [$\beta = 0.320$; 95%CI: (0.034; 0.606)]. In contrast, being overweight/obese in North Kivu was *significantly and negatively* associated with under-five mortality [$\beta = -0.608$; 95%CI: (-1.202; -0.014)]

Discussion

The objectives of the paper are twofold. First, the study investigated the relationship between maternal age and maternal nutritional status, with a special attention on obesity in the Democratic Republic of Congo. Second, the paper was interested in the relationship between maternal nutritional status and child mortality assuming that children from obese mothers have worse outcomes compared with those born from non-obese mothers.

Main findings

Maternal age and nutritional status among women of reproductive ages

Findings from this paper showed that the likelihood of being obese among women of reproductive ages in the Democratic Republic of the Congo increased with age, after controlling for women's education, working status, breastfeeding status, marital status, parity, sex of household head, household poverty, place of residence, and province. However, the percentage of obese women was marginal (3.4%) and lower than reported in previous studies. For instance, a study reported that 13% of adults aged 18 years and above were obese, and 39% were overweight⁽³⁷⁾. Collapsing overweight and obesity brings up to 16%; this percentage became comparable to figures reported in Uganda around 2011⁽³⁸⁾ and sub-Saharan Africa⁽³⁹⁾. The study in Uganda reported a prevalence of overweight/obesity of 19.4% in 2011. Furthermore, obesity was more prevalent among women living in advantaged households⁽⁴⁰⁾. Explanations include the lifestyles and physical activity. Women from advantaged households have more access to processed foods; therefore, increasing their risks to be obese. Also, they do adopt a much more sedentary lifestyle. They do exercise less compared to women from poor households and rural areas. For instance, they have access to maids and personal drivers which significantly limit their opportunities to exercise. In contrast, women from disadvantaged households and rural areas have more opportunities to exercise due to financial constraints and lifestyle; therefore, decreasing the likelihood of being obese.

The paper highlighted geographical variations of women's nutritional status in the Democratic Republic of Congo. Overall, all the eleven provinces are unevenly affected in terms of the prevalence of obesity. Some provinces (North Kivu, Orientale, South Kivu), and to some extent Kinshasa the Capital City are more affected. These inequalities will significantly impact the Sustainable Development Goals (SDG) related to obesity. SDGs 2 and 3 focus on ending all forms of malnutrition (SDG 2), and non-communicable diseases (NCD) (SDG 3), particularly as the country grapples with inequalities in obesity prevalence. Therefore, the government should devise more effective programs and interventions to tackle these inequalities to ensure that the country could reach SDG goals. Indeed, DRC has made limited progress towards achieving the diet-related non-communicable disease (NCD) targets⁽¹⁸⁾.

Figures reported here on overweight/obesity are lower than those found in more localized studies⁽⁴¹⁾. In a baseline study on obesity, diabetes and hypertension among Tenke Fungurume Mining workforce, findings showed that prevalence of obesity increased from 4.5% to 11.1% between 2010 and 2015. Localized studies could uncover further disparities across provinces, highlighting the need for urgent action to address this pandemic and reduce the prevalence of non-communicable diseases (NCDs) in the country.

Maternal nutritional status and child mortality

Previous studies have consistently reported that maternal obesity is positively and significantly with adverse pregnancy outcomes^(11,24) and health risks during infancy^(26,42–45). This study provided partial support of the associations between maternal obesity and child mortality. In the entire sample, maternal obesity was positively and significantly associated with childhood mortality. When data are disaggregated by province, urban residence and poverty levels, findings are more inconsistent compared to what has been reported in previous studies.

Two empirical explanations can be drawn from previous studies. First, previous have been undertaken in developed countries where obesity prevalence is alarmingly high and could lead to adverse pregnancy and child outcomes. Indeed, the average national prevalence of obesity in developed countries is estimated at 17%⁽⁵⁾. The corresponding figure in developing countries ranges between 6.8% and 8.7%^(46,47). In the current study, the prevalence of obesity among women of reproductive ages was very low. That can explain the poor and unstable relationship observed between maternal obesity and child obesity for the entire sample and disaggregated data. Second, the concentration of obesity among women of reproductive ages can be another plausible explanation. In developing countries and sub-Saharan Africa, previous studies showed that the prevalence of obesity is low and concentrated among advantaged women⁽⁴⁰⁾.

Additionally, previous studies showed that child mortality is higher in poor households. Therefore, it might be a *compensation effect* concerning the associations between maternal obesity and child mortality. While one might expect maternal obesity to be associated with child mortality; being in better-off households provides with a buffer in the sense that those households provide children with good care when they are sick and therefore leads to lower risks

of child mortality. This explanation is not definitive because the relationship between maternal obesity and child mortality is not widely documented in sub-Saharan Africa. Some exceptions do exist^(48–50). However, these studies mostly used pooled data therefore increasing statistical power of the estimates and masking differences within and across countries. The current study dug into geographical disparities in maternal obesity and how this might affect child mortality. With this approach, the paper provided insights to better devise national and local strategies to better tackle the double burden of nutrition in the country.

Study strengths and limitations

The paper used nationally representative data which yielded to robust estimates of the associations between maternal age and obesity on one hand, and on the other hand, of the associations between maternal nutritional status and child mortality. Additionally, women's height and weight data used to compute body mass index (BMI) were objectively measured, reducing possible misclassification. However, all women in the original sample were not included in the analyses because BMI was not collected. This reduced statistical power of modelling, especially at sub-national levels.

Conclusion and policy implications

The paper evidenced the disparities of overweight/obesity prevalence in the Democratic Republic of Congo. The consequences of overweight/obesity on population health are poorly documented developing countries, while it is alarmingly increasing in sub-Saharan Africa. Therefore, more comprehensive and effective national and sub-national interventions to tackle overweight and obesity in the country are of chief importance to reach SDGs 2 and 3. Non-communicable diseases (NCD) have the potential to increase operational costs while decreasing productivity in the country and might bring additional pressure to health facilities.

References

1. Pedersen MM, Ekstrøm CT & Sørensen TIA (2023) Emergence of the obesity epidemic preceding the presumed obesogenic transformation of the society. *Science Advances* **9**, eadg6237.
2. Al-Worafi YM, Ming LC, Dhabali AA, et al. (2023) Obesity in Developing Countries. pp. 1–42 [Al-Worafi YM, editor]. Cham: Springer International Publishing.
3. Boutari C & Mantzoros CS (2022) A 2022 update on the epidemiology of obesity and a call to action: As its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. *Metabolism - Clinical and Experimental* **133**.
4. Friedrich MJ (2002) Epidemic of obesity expands its spread to developing countries. *JAMA* **287**, 1382–1386.
5. Ng M, Fleming T, Robinson M, et al. (2014) Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: A systematic analysis for the global burden of disease study 2013. *The Lancet* **384**, 766–781.
6. Popkin BM, Adair LS & Ng SW (2012) Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews* **70**, 3–21.
7. Caballero B (2007) The global epidemic of obesity: An overview. *Epidemiologic Reviews* **29**, 1–5.
8. Haslam DW & James WPT (2005) Obesity. *The Lancet* **366**, 1197–1209.
9. Dudenhausen JW, Kunze M, Wittwer-Backofen U, et al. (2018) The relationship between maternal age, body mass index, and the rate of preterm birth. *Journal of the Turkish German Gynecological Association* **19**, 182–186.
10. Sun M, Zhang S, Chen L, et al. (2022) Association between paternal pre-pregnancy body mass index with preterm birth and low birth weight. *Frontiers in Pediatrics* **10**.
11. Aviram A, Hod M & Yogev Y (2011) Maternal obesity: Implications for pregnancy outcome and long-term risks a link to maternal nutrition. *International Journal of Gynecology & Obstetrics* **115**, S6–S10.
12. Abu Hamad K, Abed Y & Abu Hamad B (2007) Risk factors associated with preterm birth in the Gaza Strip: hospital-based case-control study. *EMHJ - Eastern Mediterranean Health Journal* **13**, 1132–1141.
13. Global nutrition report (2022) | country nutrition profiles - global nutrition report.

14. Mapatano MA, Muyer M-C, Buntinx F, et al. (2007) Obesity in diabetic patients in Kinshasa, Democratic Republic of Congo. *Acta Clinica Belgica* **62**, 293-297.
15. Mawaw PM, Yav T, Mukuku O, et al. (2019) Increased prevalence of obesity, diabetes mellitus and hypertension with associated risk factors in a mine-based workforce, Democratic Republic of Congo. *The Pan African Medical Journal* **34**, 135.
16. Mbala FK, Mbangi JM, Nkodila AN, et al. (2022) Determinants of Regional Obesity (Visceral and Subcutaneous Obesity) within Cardiovascular Risk Factors in the Cardiology Department of the University Clinics of Kinshasa. *World Journal of Cardiovascular Diseases* **12**, 444–456.
17. You D, Jones G, Hill K, et al. (2010) Levels and trends in child mortality, 1990-2009. *The Lancet* **376**, 931–933.
18. Schedwin M, Furaha AB, Kapend R, et al. (2022) Under-five mortality in the Democratic Republic of the Congo: Secondary analyses of survey and conflict data by province. *Bulletin of the World Health Organization* **100**, 422–435.
19. Kandala N-B, Emina JB, Nzita PDK, et al. (2009) Diarrhoea, acute respiratory infection, and fever among children in the Democratic Republic of Congo. *Social Science & Medicine* **68**, 1728–1736.
20. Bhusal MK & Khanal SP (2022) A Systematic Review of Factors Associated with Under-Five Child Mortality. *BioMed Research International* **2022**, 1181409.
21. Aune D, Saugstad OD, Henriksen T, et al. (2014) Maternal body mass index and the risk of fetal death, stillbirth, and infant death: A systematic review and meta-analysis. *JAMA* **311**, 1536–1546.
22. Bautista-Castaño I, Henriquez-Sanchez P, Alemán-Perez N, et al. (2013) Maternal Obesity in Early Pregnancy and Risk of Adverse Outcomes. *PLOS ONE* **8**, e80410.
23. Bone JN, Joseph KS, Mayer C, et al. (2022) The association between pre-pregnancy body mass index and perinatal death and the role of gestational age at delivery. *PLOS ONE* **17**, e0264565.
24. Briese V, Voigt M, Hermanussen M, et al. (2010) Morbid obesity: Pregnancy risks, birth risks and status of the newborn. *HOMO* **61**, 64–72.
25. Chen A, Feresu SA, Fernandez C, et al. (2009) Maternal obesity and the risk of infant death in the United States. *Epidemiology* **20**, 74.

26. Cnattingius S, Villamor E, Johansson S, et al. (2013) Maternal obesity and risk of preterm delivery. *JAMA* **309**, 2362–2370.
27. Baer RJ, Yang J, Berghella V, et al. (2018) Risk of preterm birth by maternal age at first and second pregnancy and race/ethnicity. *Journal of Perinatal Medicine* **46**, 539–546.
28. Gaillard R, Durmuş B, Hofman A, et al. (2013) Risk factors and outcomes of maternal obesity and excessive weight gain during pregnancy. *Obesity* **21**, 1046–1055.
29. Pullum TW (2008) *An assessment of the quality of data on health and nutrition in the DHS surveys, 1993-2003*. Calverton, Maryland, USA:
30. Eknoyan G (2008) Adolphe Quetelet (1796/1874) the average man and indices of obesity. *Nephrology Dialysis Transplantation* **23**, 47–51.
31. Ezbakhe F & Pérez-Foguet A (2020) Child mortality levels and trends: A new compositional approach. *Demographic Research* **43**, 1263–1296.
32. Hanmer L, Lensink R & White H (2003) Infant and child mortality in developing countries: Analysing the data for robust determinants. *The Journal of Development Studies* **40**, 101–118.
33. O’Hare B, Makuta I, Chiwaula L, et al. (2013) Income and child mortality in developing countries: a systematic review and meta-analysis. *Journal of the Royal Society of Medicine* **106**, 408–414.
34. Starkweather J & Moske AK (2011) *Multinomial logistic regression*. Available at http://bayes.acs.unt.edu:8083/BayesContent/class/Jon/Benchmarks/MLR_JDS_Aug2011.pdf
35. Pongou R, Kuate Defo B & Tsala Dimbuene Z (2017) Excess Male Infant Mortality: The Gene-Institution Interactions. *American Economic Review* **107**, 541–545.
36. Sharrow D, Hug L, You D, et al. (2022) Global, regional, and national trends in under-5 mortality between 1990 and 2019 with scenario-based projections until 2030: A systematic analysis by the UN inter-agency group for child mortality estimation. *The Lancet Global Health* **10**, e195–e206.
37. Lim HJ, Xue H & Wang Y (2020) Global Trends in Obesity. pp. 1217–1235 [Meiselman HL, editor]. Cham: Springer International Publishing.
38. Amegbor PM, Yankey O, Davies M, et al. (2022) Individual and contextual predictors of overweight or obesity among women in Uganda: a spatio-temporal perspective. *GeoJournal* **87**, 3793–3813.

39. Agyemang C, Boatemaa S, Frempong GA, et al. (2015) Obesity in Sub-Saharan Africa. Springer International Publishing Switzerland 2015.
40. Neupane S, K. C. P & Doku DT (2016) Overweight and obesity among women: analysis of demographic and health survey data from 32 Sub-Saharan African Countries. *BMC Public Health* **16**, 30.
41. Mawaw PM, Yav T, Mukuku O, et al. (2019) Increased prevalence of obesity, diabetes mellitus and hypertension with associated risk factors in a mine-based workforce, Democratic Republic of Congo. *The Pan African Medical Journal* **34**, 135.
42. Onubi OJ, Marais D, Aucott L, et al. (2016) Maternal obesity in Africa: A systematic review and meta-analysis. *Journal of Public Health* **38**, e218–e231.
43. Yang Z, Phung H, Freebairn L, et al. (2019) Contribution of maternal overweight and obesity to the occurrence of adverse pregnancy outcomes. *Australian and New Zealand Journal of Obstetrics and Gynaecology* **59**, 367–374.
44. Huo N, Zhang K, Wang L, et al. (2021) Association of maternal body mass index with risk of infant mortality: A dose-response meta-analysis. *Frontiers in Pediatrics* **9**, 650413.
45. Gao L, Peng W, Xue H, et al. (2023) Spatial temporal trends in global childhood overweight and obesity from 1975 to 2030: a weight mean center and projection analysis of 191 countries. *Globalization and Health* **19**, 53.
46. Prentice AM (2006) The emerging epidemic of obesity in developing countries. *International Journal of Epidemiology* **35**, 93–99.
47. Bhurosy T & Jeewon R (2014) Overweight and Obesity Epidemic in Developing Countries: A Problem with Diet, Physical Activity, or Socioeconomic Status? *The Scientific World Journal* **2014**, e964236.
48. Cresswell JA, Campbell OM, Silva MJD, et al. (2012) Effect of maternal obesity on neonatal death in sub-Saharan Africa: Multivariable analysis of 27 national datasets. *The Lancet* **380**, 1325–1330.
49. Ozodiegwu ID, Mamudu HM, Wang L, et al. Country-level analysis of the association between maternal obesity and neonatal mortality in 34 sub-Saharan African countries. *Annals of Global Health* **85**, 139.
50. Nohr EA (2012) Maternal obesity and neonatal mortality in an African setting. *The Lancet* **380**, 1292–1293.

Table 1: Descriptive statistics of the sample of women of reproductive ages.

Dependent variable: Women's nutritional status	N (unweighted)	Weighted %/Mean ± S.D.
Underweight	1,197	14.4
Normal weight	5,587	69.7
Overweight/Obese	1108	16.0
Independent variables		
Women's level variables		
Age	7,892	28.5 ± 9.9
Education (in completed years)	7,892	6.1 ± 4.1
Working status (% working at survey)	5,318	66.5
Breastfeeding (% women breastfeeding at survey)	3,117	38.3
Marital status		
Single	4,545	29.3
Married/Cohabiting	12,448	59.4
Widowed/Divorced/Separated	1,834	11.3
Household- and community-level variables		
Household head is Male	5,798	73.9
Household wealth index		
Poor (40% bottom)	3,353	37.2
Non-poor (60% top)	4,539	62.8
Urban residence (% urban)	2,882	37.7
Province of residence		
Kinshasa	769	12.0
Kongo Central	1,043	16.1
Bandundu	414	4.9
Equator	1,098	12.8

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Kasai Occidental	594	6.4
Kasai Oriental	893	10.2
Katanga	896	8.9
Maniema	362	3.1
North Kivu	510	9.4
Orientale	895	9.5
South Kivu	418	6.7
Total sample size	7,892	100.0

Table 2: Sub-national estimates of maternal nutritional status among women of reproductive ages: Making a case for a geographical inquiry.

Variables	Weight (in kilograms)		Height (in centimeters)		Body Mass Index (in kilograms/m ²)		Mean	95% C.I.	
	Mean	95% C.I.	Mean	95% C.I.	Mean	95% C.I.			
Province of residence									
Kinshasa	61.3	(60.2 - 62.4)	160.7	(159.9 - 161.5)	-	23.7	(23.4 - 24.1)	-	
Kongo Central	48.5	(47.5 - 49.5)	155.1	(153.9 - 156.3)	-	20.1	(19.8 - 20.4)	-	
Bandundu	51.0	(47.9 - 54.1)	155.8	(154.6 - 157.0)	-	20.9	(19.9 - 21.9)	-	
Equator	53.7	(52.4 - 54.9)	158.5	(157.7 - 159.3)	-	21.3	(21.0 - 21.6)	-	
Kasai Occidental	52.4	(51.0 - 53.7)	157.8	(156.9 - 158.8)	-	21.0	(20.6 - 21.3)	-	
Kasai Oriental	53.8	(52.1 - 55.6)	158.5	(157.2 - 159.9)	-	21.3	(20.9 - 21.7)	-	
Katanga	52.5	(50.5 - 54.4)	155.4	(154.4 - 156.4)	-	21.6	(21.1 - 22.1)	-	
Maniema	53.1	(51.6 - 54.7)	154.1	(151.8 - 156.4)	-	22.4	(21.8 - 22.9)	-	
North Kivu	55.7	(54.0 - 57.5)	153.2	(151.9 - 154.4)	-	23.7	(23.2 - 24.2)	-	
Orientale	55.2	(53.6 - 56.7)	155.7	(154.1 - 157.4)	-	22.7	(22.3 - 23.1)	-	
South Kivu	54.9	(51.5 - 58.4)	153.6	(151.7 - 155.5)	-	23.2	(22.3 - 24.0)	-	
Residence									

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Rural	51.1	(50.3 - 51.8)	155.2	(154.7 155.7)	-	21.2	(20.9 21.4)	-
Urban	58.4	(57.7 - 59.2)	158.8	(158.3 159.2)	-	23.1	(22.9 23.4)	-
Household wealth index								
Poor	49.9	(49.4 - 50.4)	155.0	(154.4 155.6)	-	20.8	(20.6 20.9)	-
Non-Poor	56.2	(55.5 - 56.9)	157.4	(157.0 157.9)	-	22.6	(22.3 22.8)	-

Table 3: Maternal nutritional status and child mortality in the Democratic Republic of the Congo

Women's nutritional status	Unweighted N	Neonatal mortality	95% CI
Underweight	2,612	35.2	(25.0 - 49.4)
Normal weight	13,581	30.3	(26.1 - 35.2)
Overweight/Obese	2,810	23.4	(17.4 - 31.4)
Total	19,003	29.7	(26.1 - 33.7)
Women's nutritional status	Unweighted N	Postneonatal mortality	95% CI
Underweight	2,534	48.6	(35.1 - 66.9)
Normal weight	13,184	42.8	(37.4 - 49.0)
Overweight/Obese	2,744	40.0	(29.0 - 54.9)
Total	18,462	43.0	(38.0 - 48.7)
Women's nutritional status	Unweighted N	Infant mortality	95% CI
Underweight	2,612	82.0	(64.4 - 104.0)
Normal weight	13,581	71.9	(64.5 - 80.0)
Overweight/Obese	2,810	62.5	(48.8 - 79.7)
Total	19,003	71.4	(64.4 - 79.1)
Women's nutritional status	Unweighted N	Child mortality	95% CI
Underweight	2,410	50.7	(38.8 - 66.0)
Normal weight	12,615	44.3	(37.9 - 51.8)
Overweight/Obese	2,643	49.2	(38.0 - 63.5)
Total	17,668	46.0	(41.1 - 51.5)
Women's nutritional status	Unweighted N	Under-five mortality	95% CI
Underweight	2,612	128.6	(107.1 - 153.6)
Normal weight	13,581	113.0	(104.2 - 122.5)
Overweight/Obese	2,810	108.6	(88.2 - 133.1)
Total	19,003	114.2	(105.4 - 123.5)

Table 4: Maternal nutritional status and child mortality: Entire Sample, and by household poverty levels and place of residence

Panel A. Entire sample (Children under 5 years)					
	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Women's nutritional status (Ref.: Normal weight)					
Underweight	0.228 (-0.113 0.569)	0.174 - (-0.133 - 0.480)	0.203* (-0.006 0.411)	0.301** - (0.012 - 0.591)	0.252*** (0.087 - 0.417)
Overweight/Obesity	-0.358** (-0.631 0.084)	-0.219 - (-0.488 - 0.049)	-0.279** (-0.498 0.059)	0.040 - (-0.199 - 0.279)	-0.155** (-0.303 - -0.007)
Panel B. Household poverty level					
	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Women's nutritional status (Ref.: Normal weight)					
Underweight	0.0899 (-0.344 0.524)	0.187 - (-0.149 - 0.522)	0.157 (-0.119 0.434)	0.138 - (-0.236 - 0.513)	0.159 (-0.078 - 0.397)
Overweight/Obesity	-0.395	-0.131	-0.24	-0.169	-0.223

	(-1.010 0.221)	- (-0.662 - 0.400)	(-0.700 0.220)	- (-0.502 - 0.164)	(-0.535 - 0.088)
	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Non-Poor households					
Women's nutritional status (Ref.: Normal weight)					
Underweight	0.36 (-0.134 0.853)	0.177 (-0.272 - 0.626)	0.258* (-0.022 0.538)	0.485** (0.105 - 0.864)	0.357*** (0.135 - 0.579)
Overweight/Obesity	-0.273* (-0.574 0.027)	-0.200 (-0.512 - 0.112)	-0.232* (-0.473 0.008)	0.141 (-0.185 - 0.467)	-0.087 (-0.259 - 0.086)
Panel C. Place of residence					
Rural women					
	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Women's nutritional status (Ref.: Normal weight)					
Underweight	0.190 (-0.185 0.565)	0.181 (-0.162 - 0.524)	0.193* (-0.034 0.419)	0.299* (-0.025 - 0.623)	0.247*** (0.061 - 0.432)
Overweight/Obesity	-0.503**	-0.285	-0.380**	0.0613	-0.210**

	(-0.886 - 0.120)	-	-	(-0.699 - 0.0611)	-	-	(-0.279 - 0.402)	(-0.398 - -0.022)
Urban women								
	Neonatal mortality		Postneonatal mortality		Infant mortality		Childhood mortality	Under-five mortality
Women's nutritional status (Ref.: Normal weight)								
Underweight	0.191		0.150		0.169		0.227	0.189
	(-0.403 - 0.786)	-	(-0.313 - 0.613)		(-0.171 - 0.509)	-	(-0.283 - 0.736)	(-0.068 - 0.446)
Overweight/Obesity	-0.207		-0.158		-0.18		0.0619	-0.0876
	(-0.642 - 0.229)	-	(-0.527 - 0.210)		(-0.480 - 0.119)	-	(-0.266 - 0.390)	(-0.330 - 0.155)

Confidence Intervals in parentheses

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Maternal nutritional status and child mortality, sub-national estimates.

Women's nutritional status (Ref.: Normal weight)		Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Kinshasa						
Underweight	(n.a)	1.304***	0.622*	(n.a)	0.0765	
	...	(0.632 - 1.977)	(-0.0539 - 1.298)	-	...	(-0.548 - 0.701)
Overweight/Obesity	-0.658	-0.235	-0.397	-0.0561	-0.261	
	(-1.467 - 0.150)	(-0.894 - 0.424)	(-0.998 - 0.205)	(-0.648 - 0.535)	(-0.736 - 0.214)	
Kongo Central						
Underweight	0.224	-0.546*	-0.187	0.563**	0.112	
	(-0.608 - 1.056)	(-1.162 - 0.069)	(-0.637 - 0.263)	(0.012 - 1.115)	(-0.257 - 0.481)	
Overweight/Obesity	-0.748	-0.241	-0.358	-1.247*	-0.623*	
Bandundu						
Underweight	-0.205	0.497	0.280	0.456	0.378	
	(-1.539 - 1.128)	(-0.632 - 1.627)	(-0.557 - 1.116)	(-0.883 - 1.794)	(-0.298 - 1.054)	
Overweight/Obesity	-0.149	-0.761*	-0.500*	-1.713**	-0.822**	

	(-0.936 - 0.638)	(-1.633 - 0.111)	(-1.087 - 0.0858)	- (-3.144 - -0.283)	(-1.492 - -0.151)
Equator	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Underweight	0.491*	0.216	0.333*	0.713***	0.537***
	(-0.052 - 1.034)	(-0.338 - 0.771)	(-0.036 - 0.702)	(0.206 - 1.220)	(0.207 - 0.867)
Overweight/Obesity	0.456	0.348	0.406*	0.125	0.320**
	(-0.107 - 1.020)	(-0.345 - 1.041)	(-0.057 - 0.869)	(-0.547 - 0.797)	(0.034 - 0.606)
Kasai Occidental	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Underweight	0.571	0.411	0.490	-0.494*	0.0632
	(-0.340 - 1.482)	(-0.518 - 1.341)	(-0.157 - 1.138)	(-1.009 - 0.022)	(-0.387 - 0.513)
Overweight/Obesity	0.048	-0.279	-0.144	-0.012	-0.041
	(-1.212 - 1.307)	(-1.336 - 0.778)	(-1.060 - 0.772)	(-0.348 - 0.325)	(-0.479 - 0.396)
Kasai Oriental	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Underweight	0.257	0.513	0.423	0.277	0.371*
	(-0.609 - 1.124)	(-0.687 - 1.714)	(-0.286 - 1.132)	(-0.697 - 1.251)	(-0.032 - 0.774)
Overweight/Obesity	-0.55	0.139	-0.0635	-0.161	-0.104
	(-1.549 - 0.449)	(-0.712 - 0.990)	(-0.898 - 0.771)	(-0.867 - 0.544)	(-0.726 - 0.519)
Katanga	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality

Underweight	-0.373 (-1.125 - 0.379)	0.247 (-0.404 - 0.898)	-0.0232 (-0.540 - 0.494)	-0.018 (-0.528 - 0.492)	-0.0343 (-0.439 - 0.371)
Overweight/Obesity	-0.916*** (-1.529 - -0.304)	0.194 (-0.491 - 0.878)	-0.274 (-0.789 - 0.242)	0.679* (-0.112 - 1.471)	0.0863 (-0.345 - 0.517)
	Neonatal	Postneonatal	Infant	Childhood	Under-five
Maniema	mortality	mortality	mortality	mortality	mortality
Underweight	0.839 (-0.421 - 2.099)	0.981* (-0.167 - 2.129)	0.903** (0.021 - 1.786)	0.091 (-1.366 - 1.547)	0.744 (-0.284 - 1.771)
Overweight/Obesity	-1.079 (-3.006 - 0.848)	-0.299 (-1.508 - 0.910)	-0.71 (-2.238 - 0.818)	0.676 (-0.274 - 1.625)	-0.0706 (-0.710 - 0.568)
	Neonatal	Postneonatal	Infant	Childhood	Under-five
North Kivu	mortality	mortality	mortality	mortality	mortality
Underweight	(n.a) ...	-0.768 (-2.730 - 1.193)	-1.590* (-3.339 - 0.158)	1.362** (0.252 - 2.472)	0.319 (-0.737 - 1.376)
Overweight/Obesity	-0.300 (-0.994 - 0.393)	-0.854 (-1.911 - 0.203)	-0.558* (-1.193 - 0.076)	-0.685 (-1.589 - 0.220)	-0.608** (-1.202 - -0.014)
	Neonatal	Postneonatal	Infant	Childhood	Under-five
Orientale	mortality	mortality	mortality	mortality	mortality
Underweight	0.091 (-0.839 - 1.020)	0.174 (-0.623 - 0.970)	0.136 (-0.373 - 0.644)	-0.116 (-0.835 - 0.604)	0.039 (-0.438 - 0.518)
Overweight/Obesity	-0.803* (-1.683 - 0.078)	-0.313 (-1.150 - 0.524)	-0.537* (-1.156 - 0.082)	0.361 (-0.135 - 0.858)	-0.124 (-0.634 - 0.386)

South Kivu	Neonatal mortality	Postneonatal mortality	Infant mortality	Childhood mortality	Under-five mortality
Underweight	0.828** (0.193 - 1.462)	0.600 (-0.485 - 1.686)	0.764*** (0.437 - 1.091)	-0.726 (-2.288 - 0.836)	0.556*** (0.245 - 0.867)
Overweight/Obesity	0.0804 (-0.519 - 0.680)	-0.0521 (-1.091 - 0.986)	0.005 (-0.718 - 0.728)	0.303 (-0.992 - 1.599)	0.125 (-0.281 - 0.530)

n.a.: Estimates not available due to small cell sizes

Confidence Intervals in parentheses

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

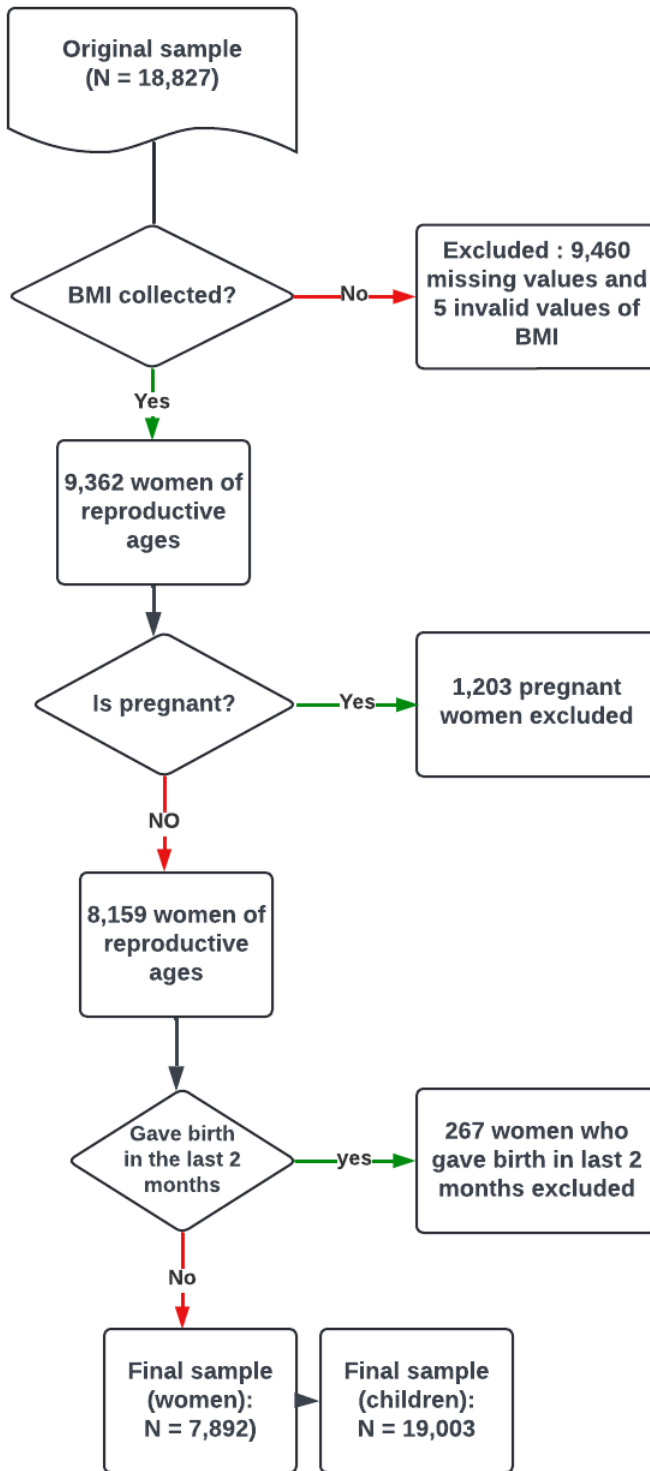


Figure 1: Selection of the final sample

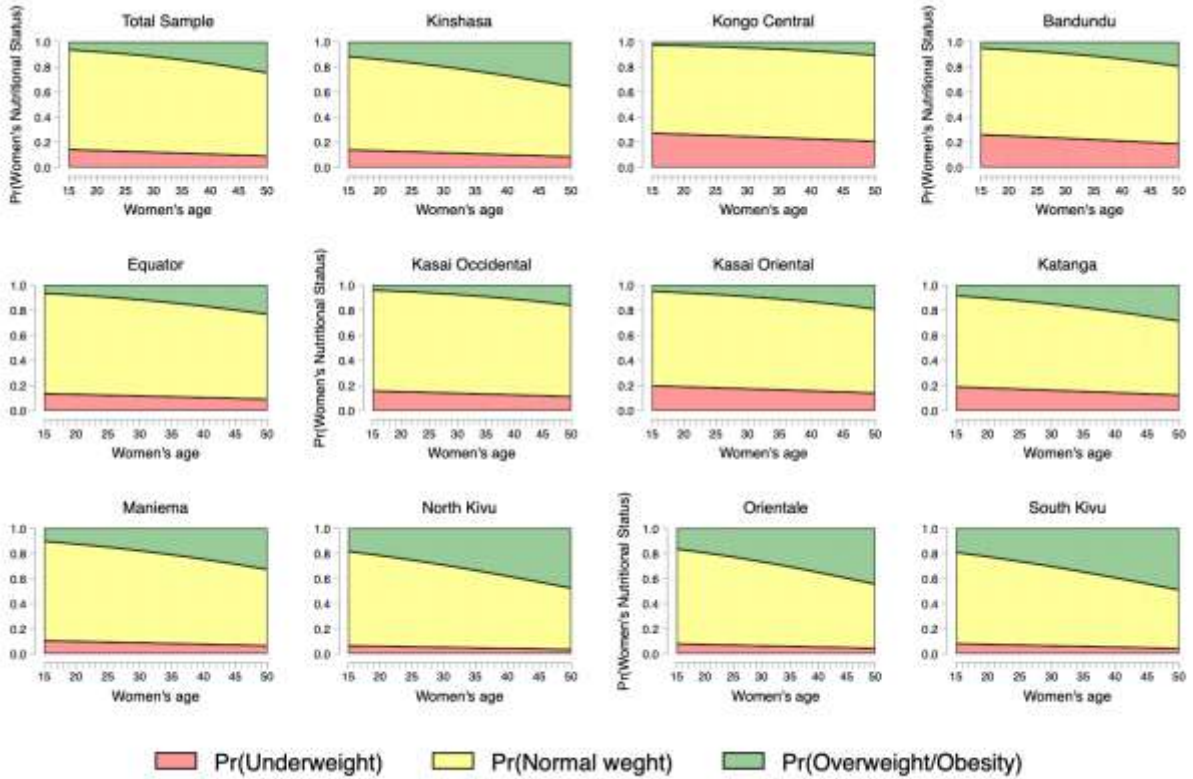


Figure 2: Predicted probabilities of women's nutritional status at national and sub-national levels in the Democratic Republic of Congo

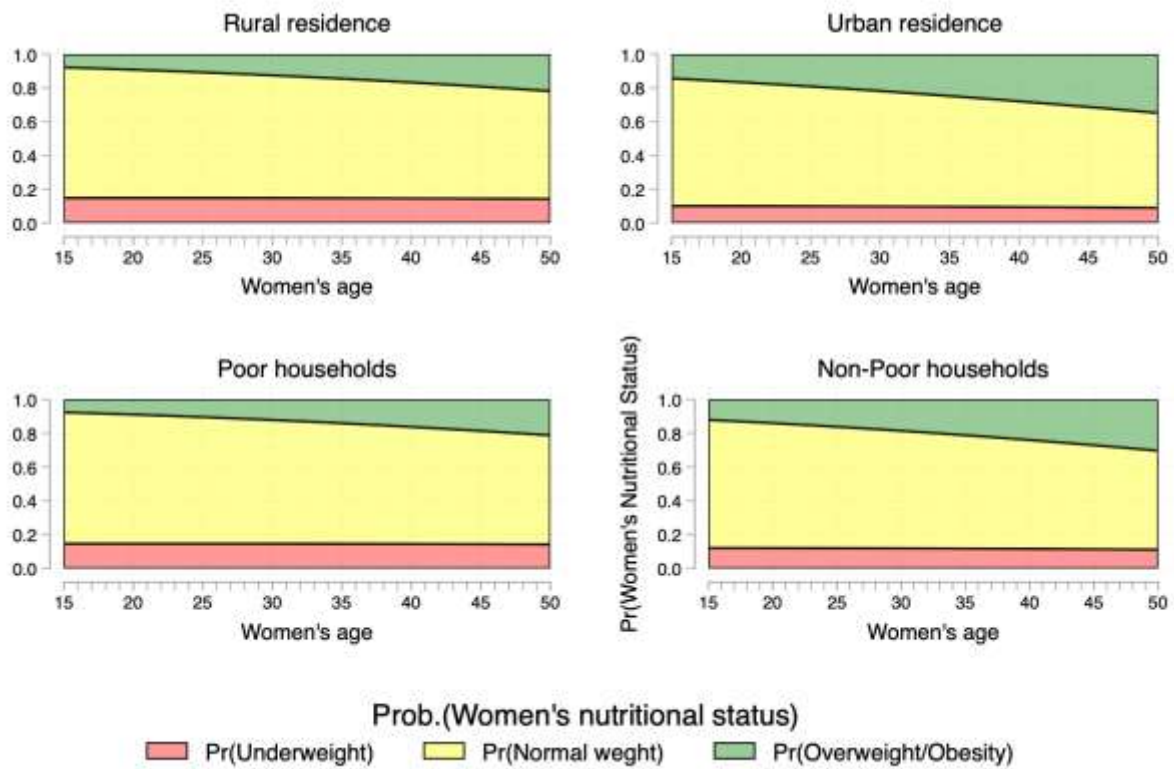


Figure 3: Predicted probabilities of women's nutritional status in the Democratic Republic of Congo, by place of residence and household poverty levels

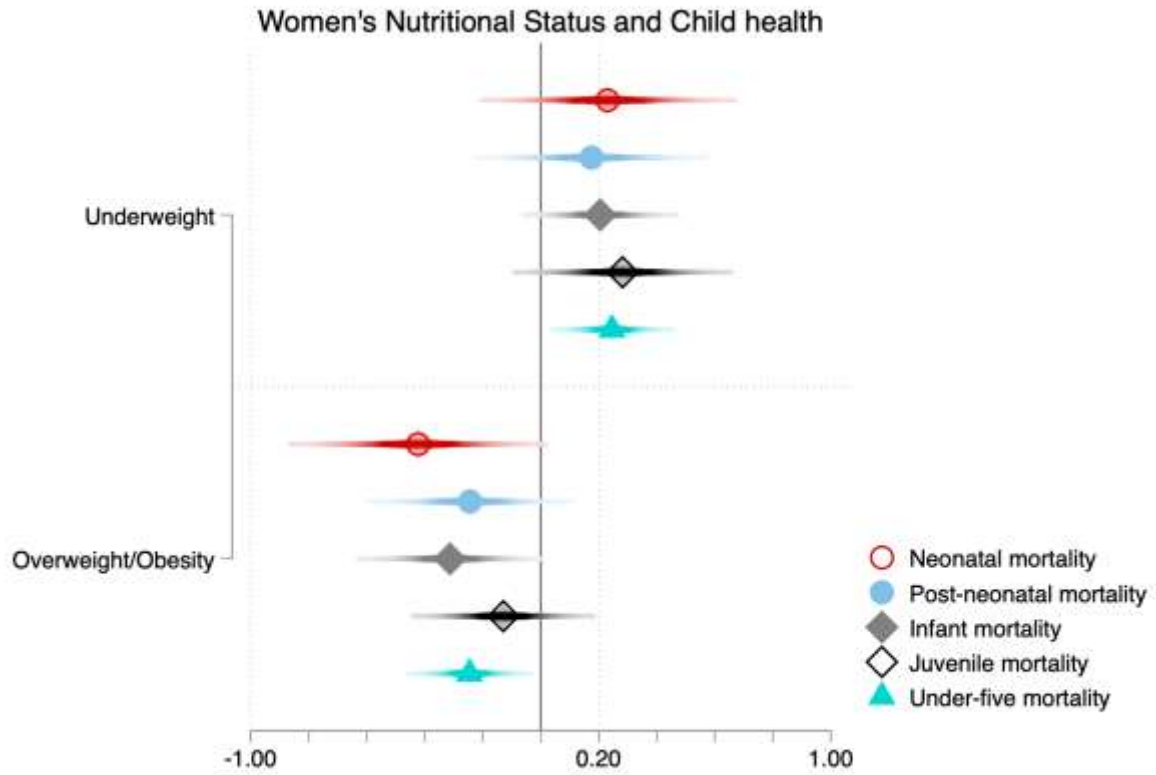


Figure 4: Associations between women’s nutritional status and child mortality in the Democratic Republic of Congo