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Dynamics of the double burden of malnutrition in Guatemala: a secondary data analysis of the demographic and health surveys from 1998–2015

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ABSTRACT

Objective: We estimated the prevalence and time trends of the double burden of malnutrition (DBM) in Guatemala and explored its occurrence based on socio-demographic factors.
Study design: This was a secondary data analysis using information from four Demographic and Health Surveys covering the period 1998–2015.
Methods: The unit of analysis was the household within which information was gathered from women 18–49 years and their children, 6–59 months. The main outcome was the prevalence of any DBM in the household (co-existence of undernutrition and overnutrition in a woman, her children or both). We estimated the prevalence of any DBM by survey and analysed time trends. Stepwise logistic regression was used to explore the occurrence of DBM and socio-demographic factors.
Results: We analysed 39,749 households across all surveys. The prevalence of any DBM was 25.3% (95% CI: 22.1–28.7) in 1998–99, 23.8% (22.0–25.8) in 2002, 25.9% (24.3–27.5) in 2008–09 and 24.2% (22.9–25.5) in 2014–15, with no significant change over time ($P = 0.782$). Characteristics associated with lower odds of any DBM were rural residence, female-headed household, wealth and women's secondary education. Higher odds were seen for households with electricity, women >25y, indigenous and with >2 children.
Conclusion: Our findings revealed that a quarter of Guatemala's households suffer from DBM, which has remained unchanged for 17 years. Interventions should prioritise urban areas, households of lower socio-economic status and those less educated. To increase awareness of policymakers of this pressing public health concern, further research on DBM could be strengthened by prospective study designs, integrating all household members and expanding the types of malnutrition.

Introduction

Malnutrition affects populations worldwide. Undernutrition remains a global challenge, with an estimated 462 million adults underweight, 264 million women with anaemia[1] and children under 5 years old still bearing a disproportionate prevalence for stunting (22.3%) and for wasting (6.8%).[2] Conversely, the prevalence of overnutrition among children under 5 years is concerning, with overweight cases reaching 5.6% in 2022.[2] This figure mirrors the adult population, where overweight affects 39% (1.9 billion) of adults, with 13% (650 million) classified as having obesity in 2016.[3]

The United Nations has noted all forms of malnutrition as a major public health concern in low- and middle-income countries (LMICs).[4] Addressing under- and overnutrition has been added to the 2030 agenda for Sustainable Development Goals,[5] as all types of malnutrition increase the population's health risks and jeopardise countries' economic development.[6] In Latin America, progress has

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been made in decreasing child stunting and wasting.[7] Simultaneously, obesity and related non-communicable diseases (NCDs) have increased steadily over the last decades.[8] Such overlapping forms of malnutrition, also known as the double burden of malnutrition (DBM), are defined by the World Health Organization (WHO) as 'the co-existence of undernutrition, along with overweight, obesity or diet-related NCDs within individuals, households, populations and across the life course'.[1]

Guatemala is located in Central America, with more than 17 million inhabitants,[9] of which ~40% are self-considered indigenous,[10] and extreme diversity in demographic and socio-economic characteristics, lifestyles and cultures. Guatemala's Civil War, resulting from the transition of military rule to democracy lasted 36 years, from 1960 to 1996.[11] The geography of Guatemala is divided into eight regions and 22 departments (sub-divisions of regions), with large variations in socio-economic and ethnic features, among others, across the regions.[12] For example, while in the Metropolitan region, the majority of the population is from higher socio-economic status and considered non-indigenous, in regions like the North or Northwest the population is more frequently of a lower socio-economic status and indigenous.[13] Historically, Guatemala had a high prevalence of stunting, particularly among those below 5 years,[7,14] and with the recent increase in the prevalence of obesity, DBM has emerged.[15–17] Although DBM has been studied in this setting, no evidence has provided a comprehensive overview of its status, trends across time and space and an in-depth characterisation of associated factors. This information is crucial for informing and developing contextually appropriate strategies to address DBM in Guatemala.

Using woman-child data derived from the Demographic and Health Survey (DHS), this study aimed to estimate the prevalence and trends across time and space of DBM at the household level from 1998 to 2015 in Guatemala and, using the most recent data only, explore the occurrence of DBM based on socio-demographic factors available from DHS.

Methods

This study was guided by the REporting of studies Conducted using the Observational Routinely-collected health Data (RECORD) Statement.[18]

Study design and data source

This secondary data analysis used information derived from four DHS carried out in Guatemala in 1998–1999, 2002, 2008–2009 and 2014–2015.[13,19–21] The surveys are nationally representative and produce regional and urban-rural estimates. A detailed description of the methodologies of each survey can be found elsewhere.[13,19–21]

Study population

The unit of analysis was the household, defined by DHS as 'a group of people who normally live and eat their meals together'. We included households with at least one woman aged 18–49 years, independent of whether she had children living in the household. If the household had multiple eligible women, we selected one randomly due to data consistency and availability across surveys. Households where the only eligible woman was pregnant or up to six months postpartum were excluded to avoid misclassification of nutritional status. If eligible women had children living in the household, children between 6 and 59 months were included, up to a maximum of 3 children (if more than 3 eligible children were present in the household, 3 were selected randomly).

Variables of interest

DBM at the household level was defined as the co-existence of an indicator of undernutrition and overnutrition in a single woman, in a single child or both. These scenarios were derived from seven typologies, or combinations, of undernutrition and overnutrition (Table 1). Households were classified as having any DBM if at least one typology was present. The primary outcome was the prevalence, at each survey, of any (typology) DBM at the household level. Secondary outcomes entailed the prevalence, at each survey, of the seven DBM typologies specifically.

Undernutrition and overnutrition were limited to anthropometric nutritional profiles. Details concerning the data collection for anthropometric measurements are available in the survey reports.[13,19–21] Women's weight (kg) and height (cm) were measured and further classified using WHO standards.[22–24] Short stature was defined as height <145 cm (cut-off used in other Guatemalan studies),[16] underweight as body mass index (BMI) <18.5 kg/m^2 and overweight as BMI >25 kg/m^2. In children, weight (kg) and length/height (cm) were assessed and compared to the WHO's growth reference standards.[25] Stunting was defined as length/height-for-age Z scores < -2 standard deviations (SD), wasting as weight-for-height Z scores < -2 SD, underweight as weight-for-age Z scores < -2 SD and overweight as weight-for-height Z scores >+2 SD. Implausible values, either for women or children (BMI <12 or >60 kg/m^2 or Z scores -6 SD, respectively), were dropped from the analysis.

Other household variables of interest included residence, region, department, number of household members, sex of the household head, age group of the household head wealth index quintile,

Table 1
The double burden of malnutrition typologies and definitions.

			Undernutrition				
			Children [6–59 months]			Women/mother [18–49 years]	
			Stunting *Length/height-for-age Z scores < -2 SD*	Wasting *Weight-for-height Z scores < -2 SD*	Underweight Weight-for-age Z scores < -2 SD	Short stature *Stature < 145 cm*	Underweight *Body mass index < 18.5 kg/m^2*
Overnutrition	**Children [6–59 months]**	Overweight/obesity *Weight-for-height Z scores >+2 SD*	X	–	–	X	X
	Women/mother [18–49 years]	Overweight/obesity *Body mass index >* 25 kg/m^2	X	X	X	X	–

Standard deviation (SD); Women of reproductive age (WRA).

ownership of dwelling, availability of electricity, number of sleeping rooms, availability of a cooking room and a proxy for household food security. Additional variables for women included age, marital status, education level, type of occupation, ethnic group, language, autonomy regarding household expenses, parity, number of own children <5 years living in the household and alcohol and tobacco consumption in the last 30 days. Other variables on children entailed age in months, sex and being breastfed. Specifications of each variable are presented in Supplemental Material Section 1. Most of the variables were available across all four surveys. The exceptions are presented in the. Supplemental Material Section 1.

Statistical analysis

Household and study population characteristics by survey year were summarised using measures of central tendency for continuous variables and frequency distribution and 95% confidence intervals (95%CI) for categorical variables. For non-normally distributed values, medians and interquartile ranges [IQR] were provided, otherwise means and 95%CI were used. The prevalence, with its corresponding 95%CI, of the individual anthropometric profiles of women and children was calculated per survey year. Time trends of the individual anthropometric profiles were produced using logistic regression models, where the survey year was translated into time and included in the model as a continuous variable, therefore, providing the percent of annual rate change in the prevalence. Similarly, the national prevalence of any DBM and the seven typologies of DBM at the household were also estimated by survey year and tested for time trends using the same methodology as the individual anthropometric profiles. For space trends, all DBM prevalences were calculated for each region and the prevalence for any DBM and the three most prevalent typologies for each department.

To explore the occurrence of DBM (for any DBM and the three most prevalent typologies) based on the socio-demographic factor available from DHS, we used data from the most recent survey and applied backward stepwise logistic regression models. The variables were selected based on current literature and relevance to the setting and included variables at the household-, woman- and child-level (Supplementary Material Section 2). The child-level variables were limited to mother-child typologies. The backward selection was set to remove variables with a *P*-value $\geq$0.1 in all models. All analyses were conducted with available data only. Analyses were adjusted for clustering, stratification and sampling weights, except for the stepwise logistic regressions, which could not be adjusted for clustering as a limitation of the statistical package. Stata (Release 16/SE. College Station, TX: StataCorp LP) was used to conduct all analyses and Microsoft® Excel® (Version 2208) for maps.

Results

The analysis sample included 3481 (1998–99), 7316 (2002), 13,728 (2008–09) and 15,224 (2014–15) households (Fig. 1). Supplementary Table S1 depicts the characteristics of the 39,749 households. The residence of households remained similar over time, with 45–48% located in urban areas. The number of household members decreased slightly, from a mean of 5.8 in 1998 to 5.3 in 2015. The frequency of women being reported as household heads increased from 19% to 26% between 1998 and 2015. In the same period, the availability of electricity increased from 73% to 89% and the median number of sleeping rooms increased from 1 to 2. In 2014–15, based on the proxy for food security, 4% of the households were considered insecure.

Women had a median age of 31–32 years across the surveys (Supplementary Table S2). In 1998, most of them were married/

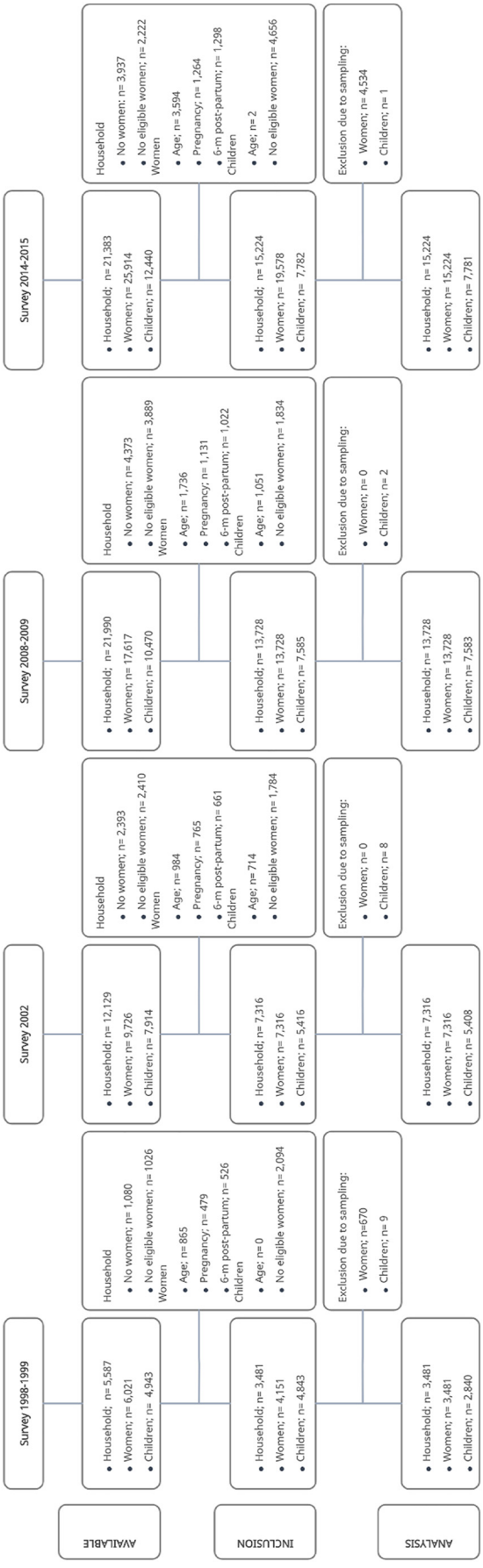

Fig. 1. Flow chart of the data selection process of households across the four DHS surveys available in Guatemala. Data was obtained under request to the DHS program and included DHS data sets from Guatemala of the years 1998–99, 2002, 2008–09 and 2014–15. The data presented in this figure was generated by data analyses conducted by the authors, using the statistical software Stata. This figure was created by the authors using the online tool Creately (https://creately.com/).

Table 2
National prevalence and trend of any DBM and DBM typologies (Prevalence and 95%CI).

Any DBM at the household level	1998–1999	2002	2008–2009	2014–2015	Time trend 1998–2014	
					OR (95%CI)	*P*-value
n/N[a]	591/2269	1148/4524	1852/7221	1788/7371	21,385	
Prevalence % (95%CI)	25.3 (22.1; 28.7)	23.8 (22.0; 25.8)	25.9 (24.3; 27.5)	24.2 (22.9; 25.5)	1.00 (0.99; 1.01)	0.782
Typologies of DBM						
I. Women with overweight + short stature						
n/N[a]	214/1676	825/5922	1876/12,535	2054/15,013	35,146	
Prevalence % (95%CI)	12.3 (10.3; 14.6)	12.1 (11.1; 13.2)	15.2 (14.4; 16.1)	14.2 (13.5; 15.1)	1.01 (1.00; 1.02)	**0.016**
II. Child with overweight + stunting						
n/N[a]	43/2295	61/4569	44/7250	24/7386	21,500	
Prevalence % (95%CI)	1.4 (0.9; 2.2)	1.1 (0.8; 1.4)	0.6 (0.4; 0.8)	0.3 (0.2; 0.5)	0.90 (0.87; 0.94)	**<0.001**
III. Child with stunting + mother with overweight						
n/N[a]	472/2269	878/4536	1344/7228	1287/7371	21,404	0.326
Prevalence % (95%CI)	19.2 (16.4; 22.3)	17.8 (16.3; 19.4)	18.4 (17.1; 19.8)	17.5 (16.4; 18.6)	0.99 (0.98; 1.00)	
IV. Child with wasting + mother with overweight						
n/N[a]	19/2269	37/4549	26/7231	29/7371	21,420	
Prevalence % (95%CI)	1.0 (0.6; 1.9)	1.0 (0.7; 1.5)	0.3 (0.2; 0.5)	0.4 (0.3; 0.6)	0.93 (0.88; 0.97)	**0.001**
V. Child with underweight + mother with overweight						
n/N[a]	124/2269	370/4558	516/7261	535/7371	21,459	
Prevalence % (95%CI)	5.6 (4.2; 7.5)	7.5 (6.5; 8.6)	7.1 (6.3; 7.9)	7.0 (6.3; 7.8)	1.00 (0.99; 1.02)	0.521
VI. Child with overweight + mother with short stature						
n/N[a]	22/2278	40/4552	40/7231	24/7371	21,432	
Prevalence % (95%CI)	0.7 (0.4; 1.1)	0.6 (0.4; 0.9)	0.5 (0.4; 0.7)	0.3 (0.2; 0.5)	0.95 (0.92; 0.99)	**0.008**
VII. Child with overweight + mother with underweight						
n/N[a]	1/2269	0/4549	3/7231	1/7371	21,420	0.427
Prevalence % (95%CI)	0.1 (0.0; 0.5)	–	0.0 (0.0; 0.2)	0.0 (0.0; 0.1)	0.94 (0.81; 1.09)	

Odds ratio (OR); 95% confidence interval (95%CI).
[a] Unweighted number of observations. Prevalence % and ORs with their corresponding 95%CI are weighted based on survey design. OR and *P*-value were obtained using logistic regression models. Bold values indicate statistical significance, $P < 0.05$. Data was obtained under request to the DHS program and included DHS data sets from Guatemala of the years 1998–99, 2002, 2008–09 and 2014–15. The data presented in this table was generated by data analyses conducted by the authors, using the statistical software Stata.

cohabiting (74%) and in 2015, 69% reported being married. There was a reduction of women with no education from 28% in 1998 to 17% in 2015. Across the same period, women who reported being indigenous ranged from 29% to 38%, women's sole autonomy on household expenses decreased from 72% to 52% and parity decreased from a mean of 3.4 to 2.7. Supplementary Table S3 presents the characteristics of 23,612 including children 6–59 months. The median age varied between 32 and 33 months while the number of boys and girls was equally distributed over time. Breastfeeding practices remained stable across the surveys.

The individual anthropometric profile of included women and children across surveys is shown in Supplementary Fig. S1. For women, between the period 1998 and 2015, a significant decrease in underweight and an increase in overweight and obesity was observed. For children, stunting, wasting, underweight and overweight decreased significantly from 1998 to 2015. A description of the anthropometric values of excluded subjects is presented in Supplementary Table S4.

Table 2 presents the prevalence and time trend of any DBM and the seven DBM typologies at the household level. The prevalence of any DBM was 25.3% (95%CI: 22.1–28.7) in 1998–99, 23.8% (22.0–25.8) in 2002, 25.9% (24.3–27.5) in 2008–09 and 24.2% (22.9–25.5) in 2014–15, with no statistically significant annual change over the 1998–2015 time period (OR: 1.0, 95%CI: 0.99–1.01). The typology of 'women with overweight + short stature' increased from 12.3% in 1998 to 14.2% in 2015; an annual increase of 1%. Contrastingly, the prevalence of 'child with overweight + stunting' decreased over time from a prevalence of 1.4% in 1998 to 0.3% in 2015, a 10% annual reduction. The prevalence of the most common typology - 'child with stunting + mother with overweight' was 19.2% in 1998 and 17.5% in 2015, however, did not significantly decrease annually. The prevalence of the other mother-child pair typologies of 'child with wasting + mother with overweight' and 'child with overweight + mother with short stature' decreased between 1998 and 2015, the former from 1.0% to 0.4% indicating an annual reduction of 7% and the latter from 0.7% to 0.3% reflecting a 5% annual reduction.

For the space trends, the regional prevalence of any DBM and by typology across the surveys are provided in Supplementary Table S5. Briefly, between 1998 and 2015, the prevalence of any DBM decreased in the Metropolitan, Northeast and Central regions and increased in the North, Southwest, Northwest and Petén regions. Fig. 2 illustrates the space evolution from 1998 to 2015, by departments of the prevalence of any DBM and of the three most prevalent typologies. It shows that in the Department of Guatemala, the prevalence of any DBM decreased from 25% in 1998 to 14% in 2015. Contrastingly, it showed increases in Huehuetenango (2%–10%), Quiché (4%–9%), San Marcos (5%–7%) and Alta Verapaz (6%–9%).

Table 3 shows the results of the multivariable logistic regressions for any DBM in 2014–2015. Households in rural areas had 28% lower odds of any DBM when compared to urban households. Female-headed households had 22% lower odds of any DBM compared to male-headed. Wealthier households reported lower odds of any DBM when compared to the poorest. Households with electricity had 67% higher odds of any DBM. Households with older women, 25-34y and >35y, had 29% and 67%, respectively, higher odds of any DBM than households with women <25y. Households where women were considered indigenous, had 38% higher odds of any DBM compared to non-indigenous. Households where women attended secondary school, compared to those without education, had 33% lower odds of any DBM and households where women had more than two children had 40% higher odds of any DBM, compared to those that had ≤2 children.

Discussion

Using repeated cross-sectional survey data from 39,749 households collected between 1998 and 2015 in Guatemala, this study estimated the prevalence and time-space trends of DBM at the

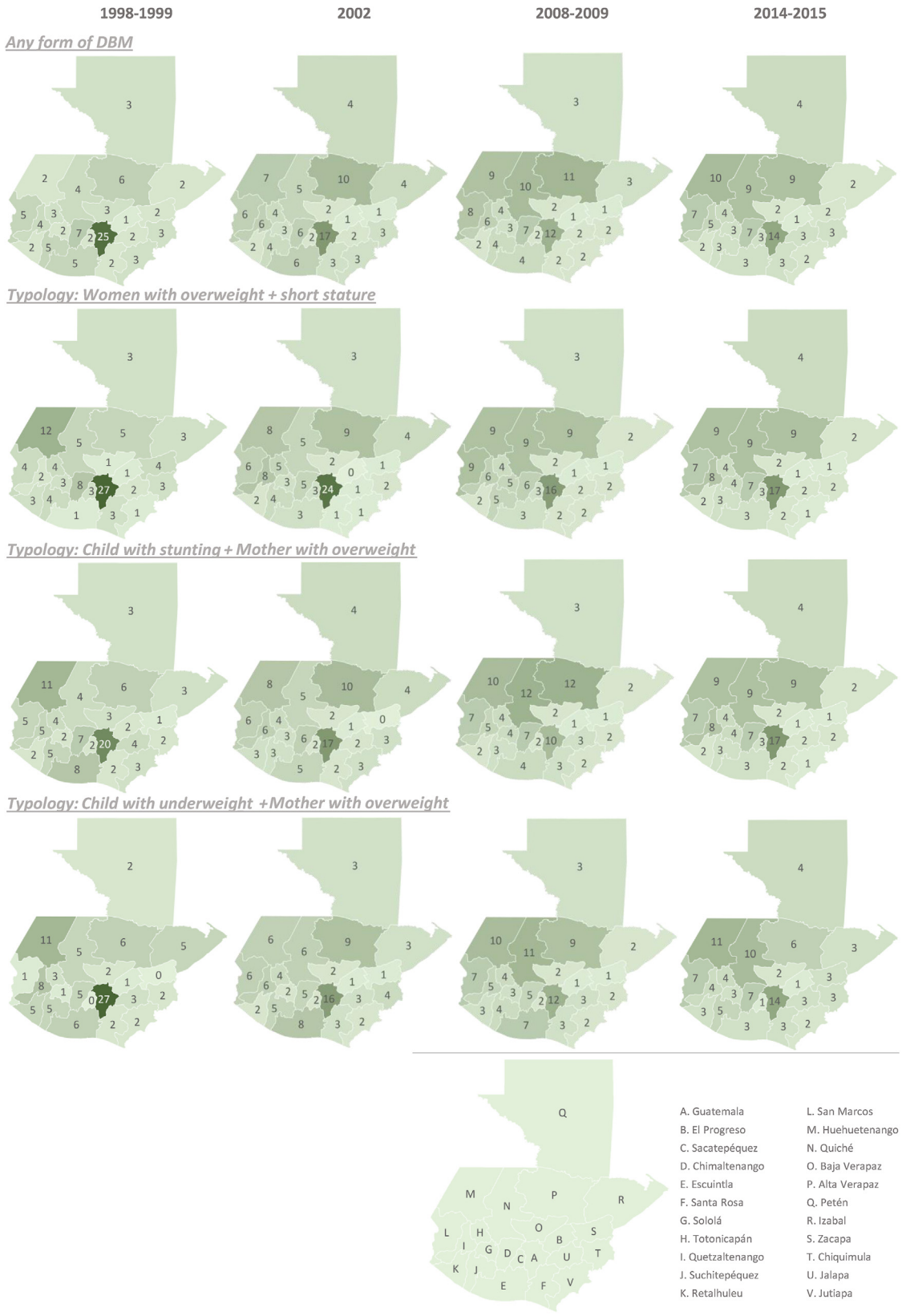

Fig. 2. Departmental prevalence and space trend of any DBM and the most prevalent typologies (Prevalence %). The figure illustrates the space evolution of the prevalence of any DBM and the most frequent typologies at the time points of 1998–99, 2002, 2008–09 and 2014-15 by the Guatemalan department (sub-divisions of Guatemalan regions). The map at the bottom of the figure provides the names of the departments. Data was obtained under request to the DHS program and included DHS data sets from Guatemala of the years 1998–99, 2002, 2008–09 and 2014–15. The data presented in this figure was generated by data analyses conducted by the authors, using the statistical software Stata. This figure was created by the authors using Microsoft Excel.

Table 3
Adjusted logistic regression models predicting any DBM and typologies associated with characteristics related to the household, women of reproductive and children.

		aOR (95% CI) *Any DBM*	*P*-value	aOR (95%CI) *Women with overweight + short stature*	*P*-value	aOR (95%CI) *Child with stunting + mother with overweight*	*P*-value	aOR (95%CI) *Child with underweight + mother with overweight*	*P*-value
	N	7370		15,011		7242		7242	
Household characteristics									
Residence	Urban	ref.		ref.		ref.		ref.	
	Rural	0.72 (0.61; 0.86)	<0.001	0.77 (0.67; 0.88)	<0.001	0.75 (0.62; 0.91)	0.003	0.79 (0.61; 1.02)	0.075
Region	Metropolitan	NA		ref		ref.		ref.	
	North	NA		NA		NA		0.59 (0.37; 0.96)	0.034
	Northeast	NA		0.75 (0.60; 0.92)	0.007	NA		NA	
	Southeast	NA		0.63 (0.51; 0.77)	<0.001	NA		0.69 (0.50; 0.94)	0.023
	Northwest	NA		NA		1.29 (1.01; 1.65)	0.039	NA	
Sex of household head	Men	ref.		NA		ref.		NA	
	Women	0.78 (0.65; 0.94)	0.010	NA		0.80 (0.66; 0.97)	0.022	NA	
Availability of electricity	No	ref.		ref.		ref.		NA	
	Yes	1.67 (1.36; 2.04)	<0.001	1.28 (1.06; 1.55)	0.009	1.62 (1.30; 2.02)	<0.001	NA	
Wealth index	Quintile 1	ref.		ref.		ref.		ref.	
	Quintile 4	0.74 (0.60; 0.91)	0.004	NA		0.65 (0.51; 0.84)	0.001	0.66 (0.48; 0.90)	0.009
	Quintile 5	0.52 (0.39; 0.70)	<0.001	0.63 (0.52; 0.76)	<0.001	0.42 (0.30; 0.60)	<0.001	0.38 (0.24; 0.59)	<0.001
Women characteristics									
Age category	18-24y	ref.		ref.		ref.		ref.	
	25-34y	1.29 (1.04; 1.60)	0.020	1.49 (1.26; 1.75)	<0.001	1.32 (1.04; 1.67)	0.021	1.53 (1.13; 2.07)	0.006
	>35y	1.67 (1.28; 2.16)	<0.001	1.89 (1.61; 2.22)	<0.001	1.67 (1.25; 2.21)	<0.001	2.27 (1.61; 3.19)	<0.001
Education level	No education	ref.		ref.		ref.		NA	
	Primary education	NA		0.82 (0.72; 0.94)	0.004	NA		NA	
	Secondary education	0.67 (0.55; 0.80)	<0.001	0.46 (0.36; 0.57)	<0.001	0.72 (0.57; 0.90)	0.005	NA	
	University education	NA		0.26 (0.17; 0.40)	<0.001	NA		NA	
Ethnicity	Non-indigenous	ref.		ref.		ref.		NA	
	Indigenous	1.38 (1.18; 1.61)	<0.001	1.90 (1.73; 2.21)	<0.001	1.43 (1.19; 1.72)	<0.001	NA	
Parity	<2 children	ref.		NA		ref.		NA	
	>2 children	1.40 (1.14; 1.71)	0.001	NA		1.49 (1.19; 1.86)	<0.001	NA	
Children characteristics									
Age category	<18 months	NA		NA		ref.		ref.	
	>36 months	NA	NA	NA		1.19 (1.04; 1.36)	0.011	0.72 (0.59; 0.89)	0.002

Adjusted odds ratios (aOR), not applicable (NA) 95% confidence interval (95%CI). This table presents the variables selected by the backward stepwise logistic regression models retaining those with a *P*-value <0.1. Models were adjusted for stratification and sampling weight. The selection of variables was based on current literature and relevance to the setting, including the following: 1) household-level: residence, region, number of household members, sex of household head, availability of electricity and wealth index; 2) woman-level: age category, education level, ethnicity and parity; and 3) child-level: age category, sex and breastfeeding status. The child-level characteristics were limited to mother-child typologies only. Data was obtained under request to the DHS program and included DHS data sets from Guatemala of the years 1998–99, 2002, 2008–09 and 2014–15. The data presented in this table was generated by data analyses conducted by the authors, using the statistical software Stata.

household level and explored its occurrence based on socio-demographic factors. Our main findings, derived from the primary outcome, revealed a high prevalence of any DBM at the household level ranging between 24 and 26%, which remained constant from 1998 to 2015. When considering DBM typologies (based on secondary outcomes), the prevalence of 'women with overweight + short stature' increased, while 'child with overweight + stunting' decreased from 1998 to 2015. Most 'mother-and-child' DBM typologies also decreased over time or remained constant. Based on our findings, women with overweight appear to be a common denominator across the increasing and unchanging DBM typologies, possibly driving the high burden of DBM at the household level in Guatemala.

As observed in our primary findings, the high and unchanging prevalence of any DBM over the last decades could be partially explained by the rapid development, economic growth and urbanisation that Guatemala has been undergoing lately, like other Latin American countries, which are characteristic of an advanced stage of demographic and epidemiological transitions.[26] These accelerated shifts are intertwined with sociocultural changes such as a reduction in parity, improvement in female education and higher participation in work outside the household. Our findings derived from the secondary outcomes, DBM typologies independently, can be attributed particularly to the situation of obesity increasing at a faster rate than the undernutrition burden is decreasing, also a feature of the nutrition transition.[27] Such a situation can be further understood by zooming in on the findings of the individual anthropometric profiles. We observed that among children 6–59 months, progress has been made in tackling all forms of malnutrition between 1998 and 2015, wasting and overweight declined dramatically and stunting and underweight decreased modestly. These findings coincide with published literature.[2,16] However, this is happening at the same time as overweight is growing alarmingly among children and adolescents aged 5–18 years; from 2000 to 2016 (population segment not included in our study), overweight increased from 18% to 29%.[28] In women, improvements in underweight and short stature were noted in our study, but this overlaps with a steep increase in the prevalence of overweight and obesity. It is important to note that the adult women population with a high prevalence of obesity in 2015 was the children (<5 years) population with a high prevalence of stunting back in 1998, thus exemplifying the known life-course link between childhood stunting and increased risk of adulthood obesity.[29,30]

Evidence on the time trends of DBM (any DBM or DBM typologies) at the household level in Guatemala is scarce. The only study that estimated a fairly comparable prevalence of any DBM at the household level in Guatemala reported an increase from 25% to 26% in the prevalence of total DBM from 1995 to 2015.[6] It also highlighted that Guatemala had the highest prevalence of total household-level DBM in Latin America and ranked in fourth place worldwide.[6] Other studies focused on estimating DBM typologies cross-sectionally and using the same data sources as this study or convenience samples.[16,31,32] No relevant discrepancies were found other. Further research on DBM in this setting could benefit from the use of prospective designs including understudied populations (e.g., school-aged children adolescents and men) and types of malnutrition (e.g., micronutrient deficiencies, NCDs and infections/co-morbidities).

We found large differences in the regional and departmental trends of DBM between 1998 and 2015. In the Metropolitan region, the prevalence of DBM has decreased over the last 17 years, while in the Northwest and North regions, it has increased considerably. These latter regions have been known for decades for their high prevalence of stunting among children under 5 years,[13] and worryingly, our findings suggest that overweight and obesity are also becoming of concern in these regions. Moreover, although factors associated with DBM have been studied in LMICs,[33] in Guatemala evidence is limited.[16,17,34,35] Socio-demographic factors that seemed associated with DBM at the household level were living in urban areas, being less educated, self-considered as indigenous and having lower socio-economic status. These findings, mainly the education level, indigenous populations and socio-economic status, can be potentially interlinked with our findings on the geographical areas. Those regions (Northwest and North) where DBM has increased the most over the last decades are those reported as having the lower socio-economic status and education level and larger proportions of indigenous populations in Guatemala.[13] Our study identified areas and populations where DBM may require more attention. We encourage further research to understand the causes of shifts in the trends of DBM among the mentioned regions and to evaluate environmental, sociocultural and behavioural drivers of DBM. This knowledge can inform the changes required in the current or future strategies to enhance their effectiveness.

This study reflects the efforts taken to curb undernutrition among vulnerable populations in Guatemala. Several policies and programmes have taken place to address undernutrition primarily among children <5 years and women of reproductive age. These programmes include stimulating breastfeeding, food fortification, food security efforts and nutritional education, among others.[36–40] Contrastingly, insufficient attention has been paid to addressing obesity until 2015, when a national policy for the prevention of NCDs was launched. This policy envisages addressing obesity in all populations by, but not only, promoting healthy lifestyles, developing regulations for food reformulation and placing marketing strategies to encourage consumption of nutritious foods.[41] Our findings call for urgent development and implementation of additional strategies to address the upward trend of obesity in the general population while continuing to address the persistent burden of stunting and underweight in younger populations.

To our knowledge, this is the first study to provide a comprehensive analysis of the DBM history and status at the household level in Guatemala, including a thorough description of the population, DBM trends across time and space and factors associated with DBM. Other strengths of this study include the large sample size and the use of national representative data. Limitations include that our results might differ from current levels, as the latest available DHS survey was conducted in 2015. DBM was estimated based on anthropometric data only due to the unreliability or scarcity of information related to other types of malnutrition such as micronutrient deficiencies. DBM at the household level could be under or over-estimated as data on other household members were not available. Information bias is inevitable as most characteristics related to the household, women and children, except for anthropometrics, were self-reported. Although using all relevant information available in the surveys to inform our models, residual confounding cannot be ruled out as a result of unmeasured factors.

Conclusion

Our findings revealed a prevalence of 24–26% of DBM at the household level in Guatemala which has remained unchanged between 1998 and 2015. Women with overweight seem to be a main contributor to the high burden of household DBM. To reduce this burden, it is crucial to prioritise preventive measures aimed at addressing obesity in the general population. We call for further research on DBM to use longitudinal designs, integrate all household members independently of their age and sex and expand the

types of malnutrition included in the research. This will provide accurate estimates of the burden of household DBM and identify its main drivers, which is key information to enhance awareness among policymakers of the public health impact of DBM on the Guatemalan population.

Author statements

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None.

Ethical approval

The DHS received government permission and followed ethical practices including obtaining informed consent. Permission to use these data for a secondary data analysis was requested and granted by the DHS programme. The institutional review board (IRB) from the Institute of Tropical Medicine Antwerp, a leading institution, does not require a separate ethical approval to analyse these data as it uses publicly available data from the DHS program.

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Competing interests

None declared.

Authors' contribution

DS and LB designed and conducted the research; JLP provided methodological advice; DS analysed the data; DS and LB drafted the manuscript; JLP, MRZ and KP reviewed the manuscript. DS had primary responsibility for the final content. All authors have read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2024.01.035.

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