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Original Article

Paediatrics Section

Prevalence of Double Burden of Malnutrition among Young Children in Rishikesh, Uttarakhand, India: A Cross-sectional Study

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ABSTRACT

Introduction: The Double Burden of Malnutrition (DBM), which refers to the coexistence of obesity and stunting in children, is a newly emerging form of malnutrition and a significant issue in developing countries, including India. Many of these countries are in the third stage of the epidemiological transition and undergoing rapid urbanisation, leading to increased availability of processed food, mechanisation of work, and sedentary lifestyles. These factors present a unique challenge in combating DBM. Due to the lack of evidence on DBM in India, particularly among young children, the current study was conducted.

Aim: The aim of this study was to estimate the prevalence of DBM among children under six years of age and identify its biosocial determinants.

Materials and Methods: A cross-sectional study was conducted in the Urban Anganwadi Centres of Tehsil Rishikesh, Uttarakhand, India. The study spanned six months, from November 2021 to April 2022, and included a total of 310 children from 13 Anganwadi Centres. Data collection was performed using a validated and pretested semi-structured questionnaire through Epicollect 5.0. The collected data were analysed using the Statistical Package for Social Sciences (SPSS) version 23.0. Pearson's Chi-square test was employed to examine the association between various biosocial determinants (sociodemographic factors, Infant and Young Child Feeding practices, and screen time) and DBM.

Results: The study included 310 children under six years of age, among whom 11 (3.5%) exhibited DBM. The prevalence of DBM was higher in females, with 8 (5.2%) affected, compared to males, with 3 (2%) affected. Among the females, DBM was more prevalent in the age group of 2-5 years, with five cases. Six out of the 11 children with DBM belonged to the lower-middle class. Additionally, 7 (4%) of the DBM children were breastfed immediately, while 4 (3.5%) were breastfed after a few hours or days. The prevalence of DBM in urban areas of Rishikesh (3.5%) was higher than the national average of 2.8% reported in the Comprehensive National Nutrition Survey (CNNS) 2016-2018 report.

Conclusion: Although, the present study had a small sample size, it offers valuable insights and fills the data gap regarding the estimation of DBM at the individual level and the association of various factors in this specific age group. DBM was more prevalent in females compared to males, suggesting a gender-related disparity in the occurrence of DBM among young children. However, further research is needed to understand the underlying factors contributing to this difference and to develop targeted interventions.

Keywords: Comprehensive national nutrition survey, Coronavirus disease-2019, Feeding practices, Obesity, Stunting

INTRODUCTION

The DBM faced by the world is a newly emergent form of malnutrition. It can be defined as "the coexistence of undernutrition along with overweight and obesity or diet-related non-communicable diseases within individuals, households, and populations, across the life course" [1,2]. Among these three levels of DBM, individual-level DBM is a more serious problem, which can be multifaceted. However, in most cases, the root cause for it is the intake of energy-dense food with excess calories and inadequate physical activity. DBM poses a serious and negative economic impact on families and populations. It hampers children's growth and development, increases healthcare costs, slows economic growth, and perpetuates the cycle of poverty and ill health. The direct and indirect costs incurred by families significantly impede their ability to thrive economically and socially. The economic cost of malnutrition is also increasing as the burden of disease grows, becoming a significant public health challenge [3].

Many developing countries in the world are in the third stage of epidemiological transition due to rapid urbanisation and industrialisation. This has led to an increasing availability of highly processed, nutritionally deficient food, along with a decreased requirement for physical activity due to improved socioeconomic standards and access to modern gadgets, among other factors. The epidemiological and nutrition transition has resulted in an increased number of children who are obese and overweight, adding to the burden of malnutrition that already exists [4,5]. In 2020, the World Health Organisation (WHO) reported that roughly 39 million children under the age of five were either overweight or obese, while 149 million were stunted [6,7]. This situation has been further exacerbated by the Coronavirus Disease-2019 (COVID-19) pandemic, which has been linked to overnutrition in recent times [8]. According to the United Nations Children's Fund (UNICEF), approximately 6% of children under five are overweight, which equates to approximately 40 million children worldwide [9]. Meanwhile, the prevalence of stunting continues to be high at 22% [10]. Some globally conducted studies have revealed a range of DBM prevalence, ranging from 0.2% to 1.9% in low and middle-income countries [11], and less than 5% in Sub-Saharan Africa at the household level [12].

India bears the burden of DBM, with persistent undernutrition and a significant rise in overnutrition and non-communicable diseases such as hypertension, diabetes, and cardiovascular diseases. The latest National Family Health Survey (NFHS-V) conducted during 2019-2020 reported an increase in overweight among children under five years of age, from 2.1% to 3.4% [13]. Obesity has also

increased at an annual rate of 4.98% from 1990 to 2017 and is estimated to reach 17.5% by 2030 [14]. On the contrary, the prevalence of stunted children has fallen by 2.9% to the current level of 35.5% [13]. However, it is still high and far from reaching the sustainable development goal of reducing stunted children by 50% by 2030 [15]. This situation of rising overweight and obesity coexisting with persistent high levels of stunting is resulting in an increasing prevalence of DBM.

In India, DBM has been reported to be 5.5% in 23 states and union territories [16], 33% in Delhi among mother-child dyads at the household level [17], and 55.6% among adolescent girls at the population level in Barabanki district of Uttar Pradesh [18]. Additionally, India's urban population is steadily increasing, with a current total urban population of 35.39% in 2020-2021 [19]. This growing urban population faces numerous challenges, including overcrowding, lack of basic needs, substandard housing, reduced access to healthcare and clean water, and inadequate sanitation [20]. City dwellers encounter a wide range of health and nutrition problems, and the coexistence of undernutrition and overweight/obesity is becoming a serious, slowly evolving public health issue.

Since very few studies have been conducted on DBM in the country to assess its prevalence at the individual level, and moreover, no data is available from any northern states of the country, the present research was conducted to explore the situation in Uttarakhand and assess the biosocial determinants of DBM.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Urban Anganwadi Centres of Tehsil Rishikesh, Uttarakhand, India. The study duration was six months, from November 2021 to April 2022, and included children under six years of age. Data were collected after obtaining written informed consent from the parents/guardians of the selected children. The research was conducted with the approval of the Institutional Ethics Committee (IEC NO: AIIMS/IEC/21/601).

Inclusion criteria: Children under six years of age whose parents/guardians provided written consent were included in the study.

Sample size calculation: The sample size was calculated based on the primary objective of the research, which was to estimate the prevalence of chronic malnutrition and its correlates in children under six years of age residing in urban areas of Rishikesh. The sample size was calculated using the prevalence of stunting reported by Rehan A et al., (2020) among children in Rishikesh under six years of age, which was 43.3%, with a relative precision of 8% and a design effect of 2 at a 95% confidence level [21]. The calculated sample size was 292.

Formula: $\{DEFF*Np(1-p)\}/\{(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)\}$

Two-stage cluster random sampling was used to select the sample units.

Stage 1: There are 34 Anganwadi Centres in the urban Rishikesh area, and one-third of them, i.e., 11 centres, were planned to be included in the study by random sampling using the lottery method.

Stage 2: From each Anganwadi centre, 27 children were selected by simple random sampling using the lottery method. In a few Anganwadi centres, parents of the remaining children insisted on the inclusion of their children, hence the final sample size increased from the calculated sample size.

However, two randomly selected Anganwadi centres had a shortage of the required number of children, so their nearest AWCs were also included to complete the sample size. Finally, 310 children were included in the study.

Study Procedure

A pretested and validated semi-structured study tool was used, which included information on sociodemographic parameters such as age, socioeconomic status (modified Kuppuswamy Scale) [22], religion, caste, and type of family. It also included feeding methods (breastfeeding, complementary feeding, frequency of feeding, etc.) and parameters to assess the physical activity of the child (playing outdoor games, watching television).

Anthropometric assessments were conducted, including measuring each child's height and weight. Length/height was measured to the nearest 0.1 cm using an IndoSurgicals Infantometer/Krups stadiometer following a standard protocol. Weight was measured using a bar weighing scale for children under two years of age and a calibrated Digital Samso weighing scale for children above two years of age, with measurements taken to the nearest 0.1 kg following a standard protocol.

Operational definitions:

- Stunting: A child was defined as stunted if their height/length-for-age was more than two standard deviations below the WHO child growth standards median [23].
- Overweight: A child up to five years of age was defined as overweight if their weight-for-height was greater than two standard deviations above the WHO child growth standards median. For children above five years, if their weight-for-height was greater than one standard deviation above the WHO child growth standards median [24].
- Obesity: A child up to five years of age was defined as obese if their weight-for-height was greater than three standard deviations above the WHO child growth standards median. For children above five years, if their weight-for-height was greater than two standard deviations above the WHO child growth standards median [24].

Double Burden of Malnutrition (DBM): For this study, DBM was considered as a child having height/length-for-age more than two standard deviations below the WHO child growth standards median and weight-for-height more than three standard deviations above for children below five years, and more than two standard deviations above for children above five years, as per the WHO child growth standards median.

STATISTICAL ANALYSIS

The data were collected using Epicollect 5.0 software and analysed using SPSS version 23.0. Descriptive statistics were calculated, including mean and standard deviation, median (interquartile range), and proportions and percentages for numerical and categorical variables, respectively. To determine the association between DBM and biosocial determinants (sociodemographic, IYCF, screen time), Pearson's chi-square test was employed. In 2×2 tables, Fisher's exact test was used whenever the expected frequency was less than one. A p-value <0.05 was considered significant.

RESULTS

The study included 310 children under six years of age, with more male children (156, 50.3%) than female children (154, 49.7%). The prevalence of DBM was 11 (3.5%), while 71 (22.9%) children were stunted, and almost half of them (32, 10.3%) were overweight and obese. Out of the 11 DBM children, eight were females, and five of them were in the age group of 2-5 years. All 11 DBM children were Hindu by religion. Considering caste, 196 (63.22%) children were from the general category, while 92 (29.7%) were from backward caste, and 22 (7.1%) were Scheduled Castes (SC)/Scheduled Tribes (ST). Out of the 11 DBM children, eight were from the General category, while only three were from Other Backward Classes (OBC)/ST/SC. The present study included 145 (46.8%) children from nuclear families, 86 (27.7%) from joint families, and 79 (25.5%) from third-generation families. Six children from nuclear families were facing DBM (p-value=0.823).

A maximum of 204 (66.4%) participants belonged to the middle class of socioeconomic status in the study, and eight out of the

11 DBM cases were from this class, while three children were from the lower class. However, no cases of DBM were reported from the upper class (p-value >0.999) [Table/Fig-1,2].

Gender n (%)	Normal n (%)	Stunted n (%)	Overweight n (%)	Obese n (%)	Stunted+Obese =Double burden n (%)
Males					
156 (50.3)	114 (73.0)	33 (21)	5 (3.2)	7 (4.5)	3 (2)
Females					
154 (49.7)	105 (68)	38 (24.6)	10 (6.5)	10 (6.5)	8 (5.2)
Total					
310	219 (70.6)	71 (22.9)	15 (4.8)	17 (5.5)	11 (3.5)

[Table/Fig-1]: Nutritional status among children (N=310).
(also included one female child who was both stunted and overweight)

Sociodemographic factors	DBM (11/3.5)			p-value
	N (310)	n	% (95% CI)	
Age (in months)				
0- 6 @	19	1	5.3 (0.1-26)	>0.999*
6-12@	22	1	4.5 (0.1-23)	
12-24@	53	2	3.8 (9.4-32)	
24-60#	183	5	2.8 (0.9-6.3)	
60-72#	33	2	6 (0.7-20)	
Gender				
Male	156	3	2 (0.4-5.5)	0.12*
Female	154	8	5.2 (2.3-10)	
Religion				
Hindu	305	11	3.6 (1.9-6.3)	>0.999*
Muslim@	4	0	0 (0-60.2)	
Sikh@	1	0	0 (0-97.5)	
Caste category				
General	196	8	4 (1.8-8)	0.748*
OBC@	92	2	2.2 (0.3-7.6)	
SC/ST@	22	1	4.5 (0.1-23)	
Types of family				
Nuclear	145	6	4.1 (1.5-9)	0.823*
Joint@	86	3	3.5 (0.7- 10)	
Third generation@	79	2	2.5 (0.3-9)	
Socioeconomic status (Modified Kuppuswamy Scale)				
Lower	0	0	100 (0-100)	>0.999&
Upper lower	97	3	3.1 (0.7-8.8)	
Lower middle	138	6	4.3 (1.8-8.9)	
Upper middle	66	2	3 (0.4-11)	
Upper	9	0	100 (0-100)	

[Table/Fig-2]: Association of sociodemographic factors with Double Burden of Malnutrition (DBM).
#,@rows are merged for computation purpose
*Fisher's-exact test
&Pearson's Chi-square test

Association of young child feeding practices with Double Burden of Malnutrition (DBM): The study analysed different IYCF practices like ever breastfed, initiation of breastfeeding, any prelacteal feeds, colostrum, exclusive breastfeeding for six months, frequency of breastfeeding, top feeding given, age of start of complimentary feeding/weaning, food eating frequency, and explored their association with DBM. Strikingly, DBM was more common among children who were ever breastfed (11, 3.8%), had immediate initiation of breastfeeding (7, 4.1%), were not given any prelacteal feeds (7, 4%), had colostrum at birth (9, 4.2%), exclusively breastfed for six months (8, 3.7%), and were breastfed on demand (5, 7%). DBM was also more common among children who were given top feed (4, 4%) and among those who started complementary feeding/weaning after the age of one year (1, 8.3%). However, DBM was not significantly associated with any of these feeding practices [Table/Fig-3].

Infant and Young Child Feeding (IYCF) practices	DBM (11/3.5)			p-value
	N (310)	n	% (95% CI)	
Ever breastfed				
Yes	291	11	3.8 (2- 6.7)	1.000*
No	19	0	0 (0-17.6)	
Initiation of breastfeeding				
Immediately$	177	7	4 (1.6-8)	1.000*
Delayed hours/days	114	4	3.5 (1-8.8)	
Any prelacteal feeds				
Yes	139	4	3 (0.8-7.2)	0.760*
No	171	7	4 (1.7- 8.2)	
Colostrum				
Yes	212	9	4.2 (2- 8)	0.512*
No	98	2	2 (0.2- 7)	
Exclusively breastfeed for 6 months				
Yes	217	8	3.7 (1.6- 7.1)	1.000*
No	93	3	3.2 (0.7-9.1)	
Frequency of breastfeeding				
On demand@	68	5	7.3 (2.4-16.3)	>0.999*
Two hourly	166	6	3.7 (1.3- 8)	
Four hourly@	4	0	0 (0-60)	
Anytime@	53	0	0 (0- 6.7)	
Top feeding given				
Yes	102	4	4 (1-9.8)	0.755*
No	208	7	3.4 (1.4-6.8)	
Top feeding was given via				
Bottle	76	4	5.3 (1.5-13)	0.570*
Kattori-Chammach	26	0	0 (0 -13.2)	
Age of start of complimentary feeding/weaning&				
<6 months@	14	1	7.1 (0.2-34)	>0.999*
6 months	236	8	3.4 (1.5-6.6)	
> 6 months and <1 year@	27	0	0 (0-12.8)	
>1 year@	12	1	8.3 (0.2- 38.5)	
Food eating frequency				
Child is on breastfeed/bottle feed only	26	0	0 (013.2)	0.750*
< 2 times a day@	34	3	8.9 (1.9-23.6)	
2-3 times a day@	201	8	4 (1.7-7.7)	
4-5 times a day@	49	0	0 (0 -7.3)	

[Table/Fig-3]: Association of young child feeding practices with Double Burden of Malnutrition (DBM).
#,@rows are merged for computation purpose
*Fisher's-exact test
$Within one hour for normal delivery and within four hours of caesarean delivery
&Two children even after crossing the age of one year had not started complimentary feeding

Association of Screen Time with Double Burden of Malnutrition (DBM): The study examined the association between several screen variables and DBM. The results showed that DBM was more common among children who played video games on mobile (8, 3.8%) and children who played games or watched videos for less than one hour per day (6, 4.1%). DBM was also more common among children who often watched television (9, 5%) and those who watched television or used mobile devices while eating (7, 4.8%). However, DBM was not significantly associated with any factors of screen time [Table/Fig-4].

Physical activity and technology use	DBM (11/3.5)			p-value
	N (310)	n	% (95% CI)	
Playing games/videos on mobile				
Yes	209	8	3.8 (1.7-7.4)	1.000*
No	101	3	3 (0.6-8.4)	
Average number of hours per day (mobile)				
≤1 hour	144	6	4.1 (1.5-8.8)	>0.999*
>1 hour	65	2	3.1 (0.4-11)	
Often watch mobile/TV while munching				
Yes	146	7	4.8 (2-10.)	0.263*
No	164	4	2.4 (0.7-6.1)	
Watching television				
Yes	181	9	5 (2.3-9.2)	0.130*
No	129	2	1.5 (0.2-5.5)	
Average number of hours per day (television)				
≤1 hour	122	8	6.6 (2.9-12.5)	0.325*
>1 hour	59	1	1.7 (0.04-9.1)	

[Table/Fig-4]: Association of screen time with Double Burden of Malnutrition (DBM).
#,@rows are merged for computation purpose
*Fischer's-exact test

DISCUSSION

Prevalence of DBM in this study was 3.5%, which is higher than the 2.8% reported in the CNNS 2016-2018 report [25]. This variation may be attributed to sociodemographic differences among different geographical locations in India. As there is limited literature available providing evidence of DBM at the individual level for children under six years of age, an attempt was made to discuss the findings to obtain approximations for comparison. The prevalence of DBM was reported as 5.5% among preschool children in a study by Kukka A across 23 states and union territories [16]. In a study by Lerm BR et al., the prevalence ranged from 0.2% to 10.9% at the individual level in 90 low- and middle-income countries, while Adeomi A et al., reported a prevalence of 4% at the individual level in two Nigerian states. Bates K et al., reported a prevalence ranging from 0.3% to 11.7% in 79 low- and middle-income countries [11,12,26,27]. In contrast to the current study, Shukla M et al., conducted a study among school-going adolescent girls in Uttar Pradesh and reported that 55.6% of girls had DBM [18]. Another study conducted among 6-17 year-old school-going children in three districts of South India observed a population double burden prevalence of 39.7% [28]. The variations in the study findings can be attributed to different study designs, settings, and interstate variations in geographical, sociodemographic, and sociocultural traits.

The child's age was not significantly associated with DBM (p-value >0.999). A similar finding was reported by Adeomi A et al., where the double burden at the individual level was not significantly associated with age (p-value=0.309) [26]. However, a study conducted by Oddo VM et al., reported that an age of more than 24 months was found to be significantly associated with DBM at the household level (p-value <0.001) [29]. The variation in outcome findings is attributed to the study population and study type.

Religion and caste category were not found to be significantly associated with DBM. However, DBM was reported more in the General Caste category (8, 4%). A similar finding was reported by Panda BK et al., who reported a high risk of overnutrition among the General category. This may be attributed to inadequate IYCF practices, easy availability of packed food, and poor access to nutritious food [30].

In the present study, DBM cases were reported in the Hindu religion, which was contrary to a study conducted by Panda BK et al., where a higher risk of overnutrition was found among Muslims [30]. The variation in the study findings may be attributed to cultural and dietary practices, rapid urbanisation, changing lifestyles, the study area, and sample size. Socioeconomic status was found not to be associated with DBM. A similar finding was reported in a study conducted by Adeomi A et al., in two Nigerian states [26]. In contrast, a study of mothers and children in Cambodia reported that DBM at the household level was significantly associated with socioeconomic status (p-value <0.001) [30]. The variation in the study findings may be due to the current study assessing DBM at the individual level, whereas the latter study assessed it at the household level. Child ever breastfed was not significantly associated with DBM, which was consistent with the findings of a study conducted by Oddo VM et al., which reported that breastfeeding was protective against mother-child DBM [29]. This is one of the first research studies of its kind in the state of Uttarakhand and one of the few in the country that has analysed DBM in a community-based setting.

Limitation(s)

The study had a small sample size, and recall bias could have occurred for some of the questions regarding IYCF practices, such as the age of starting weaning/complementary feeding.

CONCLUSION(S)

The prevalence of DBM in the study was 3.5%, which is higher compared to the national average of 2.8%, as reported in the CNNS 2016-2018 report. Further research is needed to assess DBM at the individual level, along with its risk factors, and to understand the underlying factors contributing to DBM, particularly in females. These efforts will help develop targeted interventions.

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