Risk Factors and Predictors of Severe Acute Malnutrition Among 6-59 Months Children in Lumbini Province, Nepal: A Facility-Based Cross-Sectional Study

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Abstract

Background

Adversity over malnutrition results in the most extreme and visible form of undernutrition, ultimately leading to Severe Acute Malnutrition (SAM). Globally, undernutrition among children is observed as a significant contributor to the global burden of disease and a leading cause of child mortality.

Aim

Owing to the limitation of evidence on SAM, this study aimed to bridge the existing knowledge gap by investigating the predictors of severe acute malnutrition among children visiting Out-Patient Therapeutic Centers (OTCs) and Nutrition Rehabilitation Home (NRH) in Lumbini Province.

Methods

A facility-based descriptive cross-sectional study design was adopted in OTCs and NRHs of Lumbini Province, Nepal, among 278 children aged 6-59 months and their mothers. Face-to-face interviews were conducted among mothers of eligible children by trained enumerators using a paper-based structured questionnaire, and the Shakir tape was used to measure Mid-Upper Arm Circumference (MUAC). Written consent from the participants was sought prior to the survey. Ethical approval was obtained from the Ethical Review Board (ERB) of Nepal Health Research Council (NHRC). Data obtained were systematically coded and entered into Epi Data 3.1 and subsequently exported to Statistical Package for Social Sciences (SPSS) Version 20 for analysis. Descriptive statistics (frequency, mean, and standard deviation) were presented in a frequency table, whereas inferential statistics such as the chi-square test were applied to test the significance of the association between independent and dependent variables.

Results

Socio-demographic characteristics of the participants showed that slightly more than fifty percent (55.8%) resided in rural municipalities, and less than fifty percent (44.2%) resided in urban municipalities. Approximately three-fifths had a household income of less than NRs. 30,000. More than four-fifths had a toilet facility, whereas two-thirds had their own kitchen garden. Agriculture was found to be the major source of income for the population interviewed. Nearly two-thirds of the participants were Madhesi/terai, with more than half (53.2%) of the children involved in this study being male, while 46.8% were female.

Risk factors of SAM identified during cORs include place of residence, household income, toilet facility, land ownership, household having service/business as an occupation, households of relatively advantaged ethnic group, household having kitchen garden, food secure household, wealth index of the age of the child, mother's age at childbirth, mother's education, early initiation of breastfeeding, and exclusive breastfeeding. Analysis of aORs highlighted age of the child with aORs [6-11 months; 0.21(0.09-0.52), 12-23 months; 0.20(0.10-0.45)], and mother's age at childbirth with aOR 2.77(1.33-5.77) as significant predictors of SAM.

Conclusion

This study concluded that the prevalence of SAM in Lumbini Province was found to be 34.9%. As observed from our study, household income, toilet facility, occupation, ethnicity, kitchen garden, sex of the child, mother's age at childbirth, food security access, and wealth index of the family were significant determining factors of severe acute malnutrition, whereas only the child's age and mother's age at childbirth were observed as significant predictors of SAM.

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Introduction

The World Health Organization (WHO) defines proper nutrition as “The intake of food, in relation to the body’s dietary needs” [1], and it has always been considered a key determinant of human health[2][3][4]. Undernutrition among children has been observed as a significant contributor to the global disease burden and a leading cause of child mortality [5][6]. An adversity such as malnutrition, incorporating both over and undernutrition, occurs whenever dietary intake is not in accordance with the body’s dietary requirements [7]. Longer exposure to dietary inadequacy develops and subsequently results in the most extreme and visible form of undernutrition known as Severe Acute Malnutrition (SAM) [8]. SAM generally refers to the condition identified by a very low weight for height (below -3z scores of the median WHO growth standards), visible severe wasting, or the presence of nutritional edema [8][9].

Globally, malnutrition remains an important public health concern, with 21.3% of the world’s children experiencing stunting, 6.9% wasting, and 5.6% overweight in 2019 [9]. Despite consistent efforts to enhance child nutrition worldwide, SAM and its associated morbidities are still considered one of the major public health issues, primarily in developing countries [4][10][11][12], with large disparities persisting between developed and developing countries[13]. South Asia reported the highest prevalence of stunting (31.7%) and wasting (14.3%) in 2019 [9], making it home to the largest number of children under 5 years of age with SAM. This situation is further tormented by pre-existing chronic poverty, household food insecurity, lack of education [14], and the most recent emergence of the pandemic[15].

Despite these pre-existing scenarios, recent data from Nepal shows the incredible progress this country has made to address childhood undernutrition. Over the past two decades, Nepal significantly reduced stunting from 57.2% to 35.8% during 2001-2016 [16], which currently is the fastest recorded reduction in stunting in the world[17]. Based on the WHO estimates, all forms of malnutrition account for more than 50% of child mortality in Nepal, with critical wasting prevalence [18]. As per the Nepal Demographic and Health Survey (NDHS) 2022, 25% of children under age 5 years are stunted, 8% are wasted, and 19% are underweight [19]. A study conducted in Bara district of Nepal showed the prevalence of SAM in under 5 children to be 4.14%, and a similar study done in Nepal at a different setting found SAM

prevalence of 5.8% [5][12]. As observed, household size, food access, and the child's age were also major predictors of severe acute malnutrition [20]. Low economic status as well as frequency of breastfeeding less than 8 times/day were other determinants of SAM among children under 5 years of age [21].

Fundamentally, children's right to have access to a safe diet and adequate nutrition to attain the highest standard of growth, development, and health is undeniable [22]. However, poverty, as well as pre-existing inequalities in developing nations, impact people from progressing into better nutrition for themselves [23]. These factors prevailing in such societies are observed as key factors to plague severe acute malnutrition. Despite several government evidences on the prevalence of severe acute malnutrition throughout the nation, its determinants remain questionable as it varies due to the pre-existing social, cultural, and geographical differences. Therefore, this study bridges the existing knowledge gap by investigating the factors and predictors of SAM among children under 5 years of age attending Outpatient Therapeutic Centers (OTCs) and Nutritional Rehabilitation Home (NRH) in Lumbini province of Nepal. Inclusive of both OTCs as well as NRHs providing services within the province improves the outreach of our study population, resulting in province representative findings and policy recommendations.

Methodology

Study design, site, and participants

A facility-based descriptive cross-sectional study was conducted in OTCs and NRHs of Lumbini province, Nepal. The children aged 6-59 months who were admitted in the OTCs and NRHs, and their mothers were our study participants. Anthropometric measurements were obtained from the children admitted, whereas answers to the questionnaire including socio-economic status, household food security access, wealth index, and details on childcare, maternal factors were obtained from the mothers of the respective child. The sample size was determined as 278 by using a single proportional formula using the prevalence rate of severe acute malnutrition at 12% from the Nepal Multiple Indicator Cluster Survey (NMICS) [24], with a 95% confidence interval (CI), 4% margin of error (d), and assuming a non-response rate of 10%.

Data collection

The questionnaire was adopted from a similar study conducted recently[20] and was modified in our context as required. The questionnaire was developed into local languages and explained in detail to obtain high-quality data with minimum or no bias at all. Field team members were oriented on various aspects of the study, including the data collection tools, sampling process, household and individual selection, use of different kinds of forms in the survey, and carrying out the required physical measurements. Face-to-face interviews were conducted among mothers of eligible children by the trained research assistants using a paper-based structured questionnaire. The required sample size for this study was met by proportionately collecting data from randomly selected NRHs and OTCs of our targeted study site.

Socio-economic characteristics

The socio-economic variables used to assess the factors and predictors of SAM were age, gender, place, ecological zone of residence, ethnicity, level of education, occupation, monthly income, family members, kitchen garden, access to toilet facility, number of children in the family, occupation, and land ownership.

Household characteristics were also recorded during the data collection to measure the socio-economic status of our study participants. Overall, the socio-economic status of our study participants was categorized into five broad socio-economic categories including poor, lower middle, middle, upper middle, and rich. Following this, ethnicity was classified into three groups; participants from Chhetri and Brahmin community were classed as a relatively advantaged ethnic group, participants of households from dalit, janajatis, and others were grouped as a relatively disadvantaged ethnic community, including terai or madhesi. Household income was also classified as low-income households with earnings below NPR 30,000 and high-income households with earnings above NPR 30,000.

Household Food Security Access

Our study implied FAO-FANTA guideline's Household Food Insecurity Access Scale (HFIAS) tool to access household food insecurity access, which was then illustrated using the indicator of Household Food Insecurity Access Prevalence (HFIAP) Status. Further down the line, household food insecurity access was assessed into three categories, including food security, mild-to-moderate food insecurity, and severe food insecurity using the HFIAS indicator guide [25][26].

Information on child and maternal level

Age of child, birth order, birth interval, mother's age at childbirth, initiation of breastfeeding, exclusive breastfeeding, Mid-Upper Arm Circumference (MUAC) Ratio, and practices of formula feeding were assessed as the factors inflicting SAM on those participating children.

Anthropometric Measurements

Shakir tape was used to measure MUAC from the child's left arm to the nearest 0.1 cm (1 mm) margin. Our study used WHO standards for MUAC cut-off of below 115 mm to identify SAM among children aged 6 to 59 months. The MUAC measurement was used over weight-for-height below -3 SD of the WHO standards because both of these measures give almost similar prevalence of SAM. All the measurements were taken during daytime following the recommendation of WHO growth standards, 2006 [27].

Research ethics

Ethical approval was taken from the Ethical Review Board (ERB) of Nepal Health Research Council (NHRC; Ref: 1092). Written consent from the eligible mother participants was taken before conducting the survey. The project followed the ethical guidelines of the Voluntary informed participation, and freedom of refusal at any time during the study was applied

in the study. Privacy and confidentiality of the collected information were ensured at all levels. The anonymity of the participants was maintained by not sharing the information at all stages of the study.

Data analysis and management

Data compilation, checking, editing, and coding were carried out following data collection. Data were systematically coded and entered into Epi Data 3.1. The entered data was exported to Statistical Package for Social Sciences (SPSS) Version 20 where consistency was checked and editing of data was done. All analysis was finally performed using SPSS version 20. Inferential statistics such as chi-square test were applied to test the significance of association between independent and dependent variables. Bivariate chi-square test was used to show the association between the dependent and independent variable. To prevent statistical bias in the multivariable logistic regression model, we examined multicollinearity among the independent variables using variation inflation factors (VIF). We used “10” as a cut-off value for the maximum level of VIF [28].

Results

Socio-demographic characteristics of the participants

Socio-demographic characteristics of the participants showed that slightly more than fifty percent (55.8%) were residents of a rural municipality, and less than fifty percent (44.2%) were residents of an urban municipality. More than three-fifths of the families were joint families (64.7%). Approximately three-fifths had a household income of less than NRs. 30,000. More than four-fifths had their toilet facility, whereas two-thirds had their own kitchen garden. Agriculture was found to be the major source of income for almost four-fifths of the population. More than two-thirds of the respondent mothers were over 20 years of age, with slightly more than fifty percent (58.3%) of the participants having more than primary education. Two-fifths of the interviewed mothers were housewives/laborers/others, nearly two-fifths of them were involved in business/services, and more than one-fifth were engaged in agricultural activities as their main source of income. Similarly, nearly fifty percent (45.7%) of the participating mothers had a birth interval of more than two years before the birth of their second child. Nearly two-thirds of the participants were Madhesi/Terai, one-third of them were from advantaged ethnic groups, and 29.9% were from relatively disadvantaged ethnic groups. More than half (53.2%) of the children involved in this study were male, while 46.8% were female.

Table 1. Socio-demographic Characteristics of the Participants

Characteristics	Total		Children with SAM		P-value[1]
	N	%	No (%)	Yes (%)	
	278	100%	65.1	34.9	
Household Factors					
Place of Residence					

Place of Residence					
Urban Municipality	123	44.2	74.0	26.0	0.006*
Rural Municipality	155	55.8	58.1	41.9	
Family Type					
Nuclear	98	35.3	66.3	33.7	0.753
Joint	180	64.7	64.4	35.6	
Number of Children					
Single	116	41.7	61.2	38.8	0.248
More than 1	162	58.3	67.9	32.1	
Household Income					
≤30,000	167	60.1	54.5	45.5	0.000*
˃30,000	111	39.9	81.9	18.9	
Toilet Facility					
Yes	238	85.6	30.7	69.3	0.000*
No	40	14.4	40	60	
Land Ownership					
≤0.5 he	66	23.7	77.3	22.7	0.018*
˃0.5 he	212	76.3	61.3	38.7	
Occupation					
Agriculture	64	23	45.3	54.7	0.000*
Service/Business	102	36.7	18.6	81.4	
Labor/housewife/others	112	40.3	43.8	56.3	
Ethnicity					
Relatively advantaged	87	33.3	85.1	14.9	0.000*
Relatively Disadvantaged	83	29.9	55.4	44.6	
Terai/Madhesi	108	38.8	56.5	43.5	
Kitchen Garden					
Yes	214	77	59.8	40.2	0.001*
No	64	23	53	11	
Food Insecurity					
Food Secure	163	58.63	76.7	23.3	0.000*
Mildly Food Insecure	46	16.5	50	50	
Moderate Food Insecure	45	16.18	46.7	53.3	
Severely Food Insecure	24	8.6	47.8	52.2	
Wealth Quantile					
Poor	55	19.8	43.6	53.4	0.000*
Lower Middle	56	20.1	50	50	
Middle	56	20.1	69.6	30.4	
Upper Middle	55	19.8	74.5	25.5	
Rich	56	20.1	87.5	12.5	
Child Factor					
Sex of Child					

Sex of Child					
Male	148	53.2	66.2	33.8	0.679
Female	130	46.8	63.8	36.2	
Age of child (months)					
6-11	66	23.7	53	47	0.000*
12-23	114	41.0	53.5	46.5	
24-59	98	35.3	86.7	13.3	
Birth Interval (n=162)					
Less than 2 years	35	12.6	65.7	34.3	0.651
More than 2 years	127	45.7	67.7	32.3	
Maternal level factor					
Mothers age at child birth					
≤20 years	59	21.2	40.7	59.3	0.000*
˃20 years	219	78.8	71.7	28.3	
Mothers education					
≤ Primary level	116	41.7	54.3	45.7	0.001*
˃ Primary	162	58.3	72.8	27.2	
Early initiation of breast feeding					
Within an hour	232	83.5	68.1	31.9	0.019*
Delayed	46	16.5	50	50	
Exclusive Breastfeeding					
Yes	232	83.5	68.1	31.9	0.019*
Less than 6 months	46	16.5	50	50	
Formula feeding					
Yes	127	45.7	60.6	39.4	0.151
No	151	54.3	68.9	31.1	

[1] *Chi square test or Fischer exact test; *statistically significant at p<0.05*

Risk factors of SAM identified include place of residence with cOR 0.49 (0.29-0.81), household income 0.28 (0.16-0.49), toilet facility 3.39 (1.70-6.76), land ownership 0.47 (0.25-0.88), household having service/business as an occupation 3.40 (1.82-6.33), households of relatively advantaged ethnic group 4.39 (2.18-8.85), household having a kitchen garden 0.31 (0.15-0.63), food-secure household 3.59 (1.47-8.78), wealth index of the households [poor; 0.11 (0.04-0.29), lower middle; 0.14 (0.06-0.37), middle; 0.33 (0.12-0.87), upper middle; 0.42 (0.15-1.14)], age of child [6-11 months; 0.17 (0.08-0.38), 12-23 months; 0.18 (0.08-0.35)], mother's age at childbirth 0.27 (0.15-0.49), mother's education 2.26 (1.36-3.73), early initiation of breastfeeding 2.13 (1.13-4.05), and exclusive breastfeeding 2.13 (1.12-4.05). Subsequent analysis of adjusted odds ratio highlighted the age of the child with aORs [6-11 months; 0.21 (0.09-0.52), 12-23 months; 0.20 (0.10-0.45)], and mother's age at childbirth with aOR 2.77 (1.33-5.77) as significant predictors of SAM. Logistic regression performed in this study showed that the age of the child and mother's age at childbirth were found to have a significant

association with severe acute malnutrition. No multicollinearity was observed between independent variables. Results are presented as crude odds ratio (cOR) and adjusted odds ratio (aOR) with 95% confidence intervals (CIs).

Table 2. Factors Associated with Severe Acute Malnutrition

Variables	cOR (95% CI)	*P* value	aOR (95% CI)	*P* value
Place of Residence				
Rural	0.49(0.29-0.81)**	0.006	0.74(0.39-1.43)	0.377
Urban (Ref)	1		1	
Household Income				
≤ 30,000	0.28(0.16-0.49)***	0.000	0.98(0.35-2.75)	0.976
˃ 30,000 (Ref)	1		1	
Toilet Facility				
Yes	3.39(1.70-6.76)***	0.001	1.26(0.47-3.37)	0.641
No(Ref)	1		1	
Land Ownership				
˃ 0.5 he	0.47(0.25-0.88) *	0.019	1.04(0.4-2.73)	0.925
≤ 0.5 he(Ref)	1		1	
Occupation				
Agriculture	0.94(0.51-1.74)	0.841	1.58(0.70-3.56)	0.273
Service/Business	3.40(1.82-6.33) **	0.000	2.47(0.94-6.50)	0.066
Labor/housewife/others(Ref)	1		1	
Ethnicity				
Relatively Advantaged	4.39(2.18-8.85)***	0.000	1.96(0.79-4.86)	0.144
Relatively Disadvantaged	0.96(0.54-1.70)	0.881	1.01(0.50-2.07)	0.976
Terai/Madhesi(Ref)	1		1	

Kitchen Garden				
Yes	0.31(0.15-0.63)***	0.001	0.38(0.13-1.09)	0.071
No(Ref)	1		1	
Food Security				
Food Secure	3.59(1.47-8.78) **	0.005	1(0.29-3.47)	1.0
Mildly Food Insecure	1.09(0.40-2.97)	0.865	0.93(0.27-3.15)	0.902
Moderately Food Insecure	0.96(0.35-2.62)	0.928	0.85(0.26-2.73)	0.783
Severely Food Insecure(Ref)	1		1	
Wealth Index				
Poor	0.11(0.04-0.29)***	0.000	0.66(0.14-3.17)	0.604
Lower middle	0.14(0.06-0.37)***	0.000	0.56(0.14-2.30)	0.424
Middle	0.33(0.12-0.87) *	0.25	1.48(0.41-5.37)	0.547
Upper middle	0.42(0.15-1.14) *	0.87	0.89(0.28-2.80)	0.84
Rich(Ref)	1		1	
Age of a child (months)				
6-11	0.17(0.08-0.38)***	0.000	0.21(0.09-0.52) **	0.01
12-23	0.18(0.08-0.35)***	0.000	0.20(0.10-0.45) ***	0.00
24-59(Ref)	1		1	
Mother's Age at Childbirth				
˃20 years	0.27(0.15-0.49)***	0.000	2.77(1.33-5.77)**	0.006
≤ 20 years(Ref)	1		1	
Mother's education				
≤Primary level	2.26(1.36-3.73) **	0.002	1.25(0.59-2.67)	0.563
˃ Primary level(Ref)	1		1	

Early initiation of Breast-feeding Within an hour Delayed(Ref)	2.13(1.13-4.05) * 1	0.02	2.07(0.92-4.70) 1	0.081
Exclusive Breast-feeding for six months Yes Less than six months(Ref)	2.13(1.12-4.05) * 1	0.02	1.14(0.51-2.53) 1	0.748

**p≤0.05, ** p≤0.01, ***p≤0.001; cOR=crude odds ratios for unadjusted model; aOR=adjusted odds ratios for adjusted model; CI: confidence interval; Ref: reference category.*

Discussion

This study examined cross-sectional data collected from Lumbini Province, Nepal, and intended to identify the factors as well as various predictors associated with SAM among children under the age of 5 years residing there. It revealed that the SAM prevalence in Lumbini Province was high, with various risk factors being identified, including household income, toilet facility, occupation, ethnicity, kitchen garden, sex of the child, mother's age at childbirth, food security access, and wealth index of the family. However, only the child's age and mother's age at childbirth were observed as significant predictors of SAM among children in our targeted study site.

Our study found that the child's age is a predictor of SAM, which is in line with the study conducted in Nepal[20]. Furthermore, the odds of being SAM were higher among younger children aged 12-23 months and 6-11 months compared to older children aged 24-59 months, which was similar to the results concluded by studies done in Ethiopia [29], Niger [30], and Ghana [31]. This might be because most children in low-income countries do not transition smoothly when initiating complementary feeding practices due to many social and cultural reasons [32].

Similar to the finding of this study, where mother's age at childbirth (<20 years) was concluded to be a significant predictor of SAM, another case-control study conducted here in Nepal [33] and a systematic review and meta-analysis performed by WHO had reported that maternal age below 25 years is a risk factor for severe malnutrition [34]. This is owing to the fact that mothers aged below 20 years have premature bodies and are hence at risk of giving birth prematurely [35].

Despite nutritional experts' advice of exclusive breastfeeding for the first 6 months of life[36], and the results observed from studies conducted in Chad [37] and Ethiopia [38], this study showed no statistically significant association between

exclusive breastfeeding of children and the initiation of breastfeeding with SAM in children under 5. These results, however, are supported by the results observed in a case-control study conducted in Nepal [33], and other consistent findings from studies conducted in India [36][37], and Vietnam [39]. During the data collection, the authors of this study observed multiple nutrition-oriented community-based intervention programs being implemented targeting pregnant women, mothers, and their newborns, which might be the reason for these findings.

Interestingly, households where the family size was greater than five members were found to be factors affecting SAM in children; however, it was not found to be an independent determinant for SAM, which is consistent with the findings of other studies conducted in Ethiopia [40], Bangladesh [41], Vietnam [39], India [42], and Nepal itself [43]. Proper reasoning for this might be the economic growth Nepal has achieved since 1995/96, whereby poverty declined substantially from 42% in 1995/96 to 25% in 2010 and a reduction in food inadequacy from 31% in 1999/2001 to 19% in 2011/13, along with improved education for those in the poorest quintile [44][45].

Unexpectedly, it was observed that the mother's educational level was not significantly associated with SAM among children. This finding is similar to the studies from Nepal [33], Ethiopia [42][39], Iran [46], and Bangladesh [44][45], but is inconsistent with studies from India [47], Vietnam [48], and Pakistan [49]. Similarly, multiple studies conducted in India have shown a strong association between maternal education and poor nutrition among children [50][51], which completely contrasts with the finding of this study that showed no significant association between these two. Pre-existing social, geographical, as well as the cultural variation of our study area, where multiple communities are living in a socially integrated environment, might have influenced childcare practices, even of those children whose mothers have a low level of education.

Although socio-economic status was observed to be a factor associated with SAM, it was not found to be a significant predictor of SAM, which also contrasts with a finding of case–control studies from India [47], Iran [46], and Vietnam [48]. Following this trend, access to a toilet facility, household having a kitchen garden, and food security access status of a household were found to be the risk factors but were not observed to be the independent predictors of SAM in our study. This opposes the common belief that children from families of high socioeconomic status have better access to food, health services, hygiene, and sanitation.

Strengths and limitations

This study provides facility-based evidence on factors and predictors of SAM, which could be adopted into policies and strategies to sequentially reduce malnutrition beginning with the root cause. However, this study isn't exempt from any limitations. Since the study was conducted in selected NRHs and OTCs of province 5 in Nepal, these presented findings are not a true representation of acute malnutrition in children aged below 5 years throughout the entire country. Additionally, this study has other limitations as well. The cross-sectional design of this study limited the authors' ability to assess the actual prevalence of acute malnutrition among children.

Conclusion

This study concluded that the SAM prevalence in Lumbini Province was found to be 34.9%. As observed in our study, household income, toilet facility, occupation, ethnicity, kitchen garden, sex of the child, mother's age at childbirth, food security access, and wealth index of the family were significant determining factors of severe acute malnutrition, whereas only the child's age and mother's age at childbirth were observed as significant predictors of SAM.

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Author's contribution

The authors' responsibilities were as follows: D.K.C., D.R.S., S.P., and S.T. collaboratively designed and conducted the research; D.K.C. and N.S. analyzed the data; K.A. and D.R.S. provided support in data analysis and final report preparation; D.K.C. and N.S. drafted this manuscript with the support of all the involved researchers. K.A. provided supervisory support throughout the study period and in preparing this manuscript. All involved authors read and approved the final manuscript.

Abbreviations

ERB	Ethical Review Board
SAM	Severe Acute Malnutrition
NHRC	Nepal Health Research Council
OTC	Outpatient Therapeutic Center
NRH	Nutrition Rehabilitation Home
WHO	World Health Organization

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