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The Impact of Maternal Literacy Skills on Child Weight in Mozambique

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ABSTRACT

THE IMPACT OF MATERNAL LITERACY SKILLS ON CHILD WEIGHT IN MOZAMBIQUE

By

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Background: Infant mortality rate is a serious problem in today's society. This statistic is often used as one measure of a country's success and growth. One factor that is strongly associated with infant mortality is low weight in children. In Mozambique, the percentage of underweight children under the age of five was 16% in 2012 (UNICEF, 2013). In order to reduce the number of underweight children in this country, characteristics of caregivers that could potentially contribute to this problem should be investigated. One particularly important characteristic is maternal literacy, which to date has been under investigated.

Objective: This study aimed to determine whether maternal literacy affected the weight and body-mass-index (BMI) of children ages 0 to 3 years old in Mozambique.

Methodology: A cross-sectional study of 6,762 children between the ages of 0 and 47 months was conducted using the 2011 Demographic and Health Survey for Mozambique. Analysis of covariance (ANCOVA) procedures with Scheffe post hoc tests were performed in order to identify differences in mean child weight and BMI Z-score in reference to maternal literacy level. The data were analyzed using Statistical Analysis Software Version 9.4.

Results: 396 (6.05%) of the children in the study sample were found to be underweight and 4467 (58.69%) of mothers were found to be illiterate. There was a statistically significant association between maternal literacy level and the weight and BMI of children between the ages of 0 and 3 years of age. Interestingly, a trend of stronger association was observed for each one-year increase in child age.

Conclusion: Maternal literacy is significantly associated with child weight and BMI. Therefore, prioritizing secondary education for women is one important approach for ameliorating the risk of underweight children. Increased literacy rates in women could lead to better understanding of child nutritional needs, and ultimately, an overall reduction in the number of underweight children.

The Impact of Maternal Literacy Skills on Child Weight in Mozambique

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APPROVAL PAGE

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Author's Statement Page

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Introduction

The mortality rate of children under the age of five is relatively high in Mozambique, especially in the rural areas of the country (World Health Organization, 2011). However, according to the World Health Organization (WHO), the percentage of under-five mortality has decreased significantly between the years 1997 and 2011: nearly fifteen percent in the urban areas and thirteen percent in rural areas. Still, this statistic remains over 100 deaths per 1,000 live births each year (World Health Organization, 2011). An important contributing factor to infant mortality is child weight (Vesel et al., 2010). WHO defines underweight as "weight-for-age less than -2 standard deviations of the WHO Child Growth Standards median" (World Health Organization, 2011). The percentage of underweight children in Mozambique is very high, sixteen percent in 2012 (UNICEF, 2013). This is especially apparent when compared to the United States' percentage of underweight children under the age of 5, which has consistently remained less than one percent since 2007 (World Health Organization, 2011). Child growth is also measured by body-mass-index (BMI), which is defined as "weight in kilograms divided by the square of height in meters" (Centers for Disease Control, 2015). In 2006, WHO created new Child Growth Standards that addressed growth in children from birth to age five. Among these new standards was the BMI-for-age, which is used specifically for children and teenagers (World Health Organization, 2016).

Prior research exploring factors that lead to young children being underweight have commonly examined low rates of maternal education as a major preceding factor (Francesco, 2012; Mallard et al., 2014; Wolde, Berhan, & Chala, 2015). The proposed pathway for this relationship is that a lack of formal education in mothers is associated with a lack of nutrition knowledge, which ultimately leads to poor child nutrition and low child weight. Past research has

also shown that factors such as household wealth, region of residence, and anthropomorphic measures at birth can significantly affect child weight (Mallard et al., 2014).

Formal education is an important resource for females, specifically mothers because this can be imperative for women learning about vital skills for raising healthy children. It is important to recognize the significant need for increased education of females in Mozambique. Only five percent of the nation's gross domestic product (GDP) is spent on education. In 2013, a Mozambican female only spent an average of nine years in school. This is almost half of the amount of time spent in school by American females (Central Intelligence Agency, 2014).

Previous research has shown a significant association between maternal education and child nutrition (Makoka and Masibo, 2015; Rajalakshmi, et al., 2013; Wolde et al., 2015). For instance, Makoka and Masibo (2015) found that mothers with more education have a better knowledge of recommended child feeding practices. The researchers also found that educated mothers tend to have fewer children and provide better care for their children. Similarly, research conducted in rural China observed that child stunting and wasting was significantly associated with low maternal education (Rajalakshmi, et al., 2013). Another study by Wolde and colleagues (2015) investigated the anthropomorphic measures of Ethiopian children between the ages of 7 and 14 through the use of questionnaires, stool microscopy and body measurements. Researchers found that mothers who had never received a formal education were more likely to have children who were stunted or underweight than mothers who had received a formal education (Wolde, Berhan, & Chala, 2015).

This phenomenon has also been demonstrated in child height (Burchi, 2010; Francesco, 2012; Mallard et al., 2014). Burchi (2010) investigated the possible link between maternal education and child height in Mozambique. An increase in mothers' primary education was

found to be directly associated with an increase in nutrition knowledge and children's height-for-age Z-score. Another study that was also conducted in Mozambique found a similar association between years of schooling and a child's height-for-age Z-score, as well as a positive association between schooling and child weight-for-age Z-score (Francesco, 2012). A mother's education was also significantly associated with the weight-for-height Z-scores of 18 month olds in Zambia (Mallard et al., 2014). This could suggest that measures such as BMI, which takes into account weight and height, are also affected by maternal education.

Research has shown that maternal education affects child anthropomorphic measures at birth (Matijasevich, Howe, Tilling, Santos, Barros, & Lawlor, 2012). In Zambia, a study revealed that the length of a child at birth is affected by a mother's level of education. The difference in height of children with mothers of low and high educational levels increased with the child's age, up to age 4. However, once researchers controlled for maternal height, height differences among education categories decreased (Matijasevich et al., 2012). This study demonstrates that a mother's formal schooling can affect a child's prenatal development. It also acknowledges the fact that that maternal characteristics can significantly affect the outcomes of the child.

It has been shown that improved understanding of nutrition can be achieved by increasing secondary education among women (Makoka & Masibo, 2015). Improved nutritional knowledge can affect a child's diet. For example, mothers with increased years of schooling provide a better quality and higher quantity diet to their infants (Wachs, 2008). Likewise, better nutrition knowledge in Mozambican mothers resulted in a more diverse and healthy diet being chosen for their children (Burchi, 2010). Similar findings were observed in Zambia, where increased maternal education was found to predict increased diversity in infant diet at 12 months of age (Mallard et al., 2014). Additionally, a study of 300 Nigerian children under the age of five found

a significant difference in the number of stunted children based on whether their mothers had received any formal education (Sufiyan, Bashir, & Umar, 2012). Therefore, it can be deduced that formal education is beneficial to child nutrition. A mother's knowledge of nutrition was even found to off-set deficiencies of other types of knowledge (Mallard et al., 2014).

Household wealth is also a predictor of child weight (Mallard et al., 2014). This is not a novel discovery as many studies focus on the poor, rural regions of a country and child weight statistics are often poorer in rural areas (Esposito et al, 2011; Rajalakshmi et al, 2013). Household wealth was found to be significantly associated with the weight-for-height Z-scores of 18 month olds in Zambia (Mallard et al., 2014). Additionally, Makoka & Masibo (2015) suggested that improved child nutrition status was associated with increased economic status.

Very few studies have considered the importance of maternal reading level on the nutrition and weight of children, because it is often categorized under general education. However, the literacy skill of reading is a specialized form of education that can be applied to everyday situations. In Mozambique, an estimated 45.5% of females over the age of fifteen can read and write. This pales in comparison to the 73.3% of literate Mozambican males (Central Intelligence Agency, 2014). A case study by Esposito and colleagues (2011) investigated schooling practices in the poorest region of Mozambique. Researchers found that even when controlling for variables such as gender, wealth, and artisanal occupation, years of schooling was positively correlated with "achievement of everyday literary practices in adults" (Esposito, Kebede, & Maddox, 2011). Everyday literary practices included activities such as helping children with homework and signing one's name; reading a nutritional label could also be viewed as an everyday literary practice. Therefore, it can be assumed that one's nutrition knowledge can be affected by years of formal education.

Purpose of current study

This overwhelming evidence supports the theory that maternal education affects child weight (e.g. Francesco, 2012; Mallard et al., 2014; Sufiyan, Bashir, & Umar, 2012; Wolde, Berhan, & Chala, 2015). Since reading is a specific type of education, this paper will focus on the reading level of mothers. For the purposes of this paper, maternal literacy is defined as all of the knowledge that relates to being a mother. However, the focus of this paper is maternal reading level, also referred to as maternal literacy level. The purpose of the current study is to examine the relationship between maternal literacy and child weight, while controlling for factors that have been found to contribute to child weight in prior research. In order to test this hypothesis, this study will compare child weight amongst different categories of maternal literacy.

Methods

The data source for this project was the Demographic and Health Survey (DHS) for the country of Mozambique (IDHS, 2011). Specifically, data from the Women's Questionnaire subset was used for analyses. Permission to use these data was granted by the Demographic and Health Survey Program. Sampling was done through a stratified two-stage cluster design that involves drawing Enumeration Areas from the country's Census files and sampling households from each area. The data were collected through interviewer-assisted questionnaires, which took place in the subject's home. These questionnaires were administered in the home by DHS field workers.

Participants

A total of 13,745 females between the ages of 15 and 49 were sampled from the population of Mozambique with the goal of obtaining general demographic information. However, for this specific analysis, the data was subset to exclude all females who were not mothers. A female's maternal status was determined by entries in the maternity table, a record of number of children each woman had given birth to in her lifetime. After excluding non-mothers, the sample size was reduced to 7,623 women. The weight of 6,762 children between the ages of 0 and 3 years were included in this analysis. The age distribution of these children was as follows: 1210 (17.89%) between the ages of 0-11 months, 1691 (25.01%) between the ages of 12-23 months, 1917 (28.35%) between the ages of 24-35 months, and 1944 (28.75%) between the ages of 36-47 months.

Measures and Variables

Two dependent variables were investigated. One variable was child weight. Weight was measured using a digital scale. Once the scale was placed on an even surface, each respondent would stand on it separately and the weight would be recorded by the interviewer or the interviewer's assistant. For infants who were unable to stand on the scale by themselves, an adult would hold the child after the adult's weight had been recorded. When having their weight measured, respondents were instructed to remove their shoes, sandals and heavy clothing. For younger children, all clothing with the exception of undergarments were removed. This measure was reported by DHS in hectograms but was converted to kilograms for this analysis.

The second variable that was evaluated was child body-mass-index (BMI). This variable was examined as a continuous variable by using the standard deviations of each child BMI from

the mean child BMI, which was represented by zero. BMI was also categorized according to the WHO standards. Categories were as follows: underweight (-2 standard deviations from the mean), normal weight, and overweight (+2 standard deviations from the mean). Therefore in order to be considered underweight, a child would need to have a BMI z-score below 2 standard deviations (-2SD) of the median of the sample.

The independent variable was maternal reading level. In order to assess this literacy skill, interviewers asked patients to read a simple statement like "Farming is hard work." Four statements similar to this one would be displayed on a card in the language in which the respondent was most likely to be literate. If the participant was unable to read the statement, the interviewer would probe the respondent and ask if they could read any part of the sentence. Three categories were used for this variable: cannot read at all, able to read only parts of a sentence, and able to read whole sentence.

Finally, multiple control variables were included in the statistical models for this study. Control variables included weight of females of reproductive age (respondent weight), birth weight of child, respondent's highest year of education, wealth index, and region of residence (rural or urban). Wealth and maternal education have been shown to have a significant effect on both the independent and dependent variables used in the proposed relationship (Esposito, Kebede, & Maddox, 2011; Makoka & Masibo, 2015; Mallard et al., 2014).

Statistical Analysis

The software used for analysis was Statistical Analysis Software (SAS) Version 9.4. Frequency tables were created for each categorical variable, including maternal reading level and maternity. A univariate procedure was performed in order to obtain descriptive statistics for the

continuous variables of interest, such as child weight. The proposed relationship between maternal reading level and child weight was examined by performing analyses of covariance (ANCOVA). This procedure was used to determine whether significant differences existed in child weight and in child BMI based on the mother's reading level, controlling for other known predictors. These included weight of females of reproductive age (respondent weight), birth weight of child, respondent's highest year of education, wealth index, and region of residence (rural or urban). The same procedures were performed for all children ages 0-47 months, as well as separately for each year of age being evaluated, to test whether maternal reading level had a greater effect on child weight at a specific age (under 4).

Missing values were excluded in the analysis of each variable. In the case of specific variables (respondent's weight and child's weight), missing variables were coded as a large value, such as 9996. These variables were recoded in order for SAS to recognize these observations as missing data.

Results

The majority of mothers from this sample could not read at all (58.69%), a small number of mothers had partial literacy skills (7.67%), and approximately one-third were completely literate (33.64%). The majority of study subjects (83.36%) were in the "normal" BMI category. The underweight BMI category consisted of 396 study subjects (6.06%) [See Table 1].

Table 1: Child Anthropomorphic Measures by Age Group

Age Group	Body Mass Index Category			Average Weight (Kilograms)
	Underweight	Normal Weight	Overweight	
0-11 months Frequency	81 (7.37%)	893 (81.26%)	125 (11.37%)	6.94
12-23 months Frequency	115 (7.40%)	1256 (8.77%)	184 (11.83%)	9.59
24-35 months Frequency	95 (5.55%)	1423 (83.07%)	195 (11.38%)	10.48
36-47 months Frequency	98 (5.72%)	1444 (84.35%)	170 (9.93%)	10.41
Total Frequency	396 (6.05%)	5447 (83.36%)	691 (10.59%)	9.99

Bivariate Results

A two-by-two frequency table of child BMI category by maternal literacy level demonstrated that the majority of children categorized as underweight (77.72%) had mothers who had an absence of literacy skills. This table also showed that a mere 16.96% of underweight children had mothers who were completely literate [See Table 2].

Table 2: Child Body Mass Index Category by Maternal Literacy Level

Body Mass Index Category	**Maternal Literacy Level**			
	Can Not Read at All	Able to Read Parts of a Sentence	Able to Read a Whole Sentence	Total
Normal Weight Frequency	3171 (58.30%)	427 (7.85%)	1841 (33.85%)	5439 (83.36%)
Overweight Frequency	389 (56.30%)	56 (8.10%)	246 (35.60%)	691 (10.59%)
Underweight Frequency	307 (77.72%)	21 (5.32%)	67 (16.96%)	395 (6.05%)
Total Frequency Average Weight	3867 (59.26%) 9.64	504 (7.72%) 9.88	2154 (33.01%) 10.63	6525 9.99

Analysis of Covariance Results

Analysis of covariance (ANCOVA) tests were performed to determine differences in mean weight and standard deviation of BMI among children in each age group in reference to maternal literacy level. All ANCOVA models controlled for respondent weight, wealth index, birthweight, place of residence, and respondent's highest year of education.

There was a statistically significant ANCOVA results in mean weight between different levels of maternal literacy for children younger than one ($F[7, 849] = 2.90$, $p = 0.005$), one year-olds ($F[7, 1107] = 7.88$, $p = <.0001$), two year-olds ($F[7, 1159] = 14.21$, $p = <.0001$) and three year-olds ($F[7, 1133] = 25.08$, $p = <.0001$). Post hoc analyses indicated significant differences in mean weight of one-, two-, and three-year olds with mothers who were illiterate and mothers who were completely literate. Significant mean differences in weight were also indicated between mothers who have some literacy and mothers who are completely literate. There were

no significant differences in mean weight between mothers who were completely literate and mothers with some literacy. There was also no significant difference in mean weight of child under the age of based on different literacy levels [See Table 3].

Table 3: Analysis of Covariance Results for the Effects of Maternal Literacy Level on Mean Differences in Child Weight by Age Group

Age Group	**F-Value (df)**	**p-value**	**Maternal Literacy Level**			**Post hoc**
			No Maternal Literacy (1) M	Some Maternal Literacy (2) M	Complete Maternal Literacy (3) M	
0-11 months Weight (kilograms)	2.90 (7, 849)	0.005	6.95	6.84	7.00	3=2=1
12-23 months Weight (kilograms)	7.88 (7, 1107)	<.0001	9.67	9.52	9.84	3 > 2, 1
24-35 months Weight (kilograms)	14.21 (7, 1159)	<.0001	10.51	10.34	10.94	3 > 2, 1
36-47 months Weight (kilograms)	25.08 (7, 1133)	<.0001	10.28	10.59	11.20	3 > 2, 1

Note: M=Mean; df=Degrees of Freedom

With regard to BMI, there was a statistically significant difference between levels of maternal literacy for children younger than one (F[7, 779] = 5.34, p = 0.0001), one year-olds (F[7, 1064) = 2.73, p = 0.008), two year-olds (F[7, 1102] = 4.87, p = <.0001) and three year-olds (F[7, 1072] = 6.71, p = <.0001). Post hoc analyses indicated significant differences in mean BMI of children with mothers who were illiterate and mothers who were completely literate for all age

groups. There was no significant difference between mothers with some literacy skills and other maternal literacy groups [See Table 4].

Table 4: Analysis of Covariance Results for the Effects of Maternal Literacy Level on Mean Differences in Body-Mass-Index Age Group

Age Group	**F-Value (df)**	**p-value**	**Maternal Literacy Level**			**Post hoc**
			No Maternal Literacy (1) M	Some Maternal Literacy (2) M	Complete Maternal Literacy (3) M	
0-11 months	5.34 (7, 779)	<.0001	0.17	0.11	0.25	3>1
12-23 months	2.73 (7, 1064)	0.0082	0.32	0.65	0.48	3>1
24-35 months	4.87 (7, 1102)	<.0001	0.50	0.47	0.60	3>1
36-47 months	6.71 (7, 1072)	<.0001	0.20	0.41	0.48	3>1

Note: M=Mean; df=Degrees of Freedom

Discussion

The purpose of this study was to examine the possible effects of maternal reading level on child anthropomorphic measures. It was proposed that a mother's literacy level would affect the weight and BMI of children ages 0-3. When controlling for various factors, the hypotheses were partially supported as maternal reading level was significantly associated with both child weight and BMI. However, there was not a significant difference in mean weight amongst

maternal reading levels for children ages 0-11 months. This suggests that the relationship needs to be further investigated, as well as the importance of child age in the proposed relationship.

The results support the proposed relationship between maternal literacy and child weight. This is especially evident in children ages one to three. The study results demonstrated an increase of effect for each year of age, indicating a more significant effect in older children. Since the need for dietary diversity has already been identified in previous research, it can be inferred that this increase in effect results from the need for dietary variation as the child grows (Mallard et al., 2014; Wachs, 2008). Also, significant mean differences in weight were identified between all levels of maternal literacy. This supports the idea that even small increases in literary skills can have a positive effect on child weight. However, this will need to be tested in future research using regression models.

Interestingly, there was no difference in mean weight based on maternal literacy level for children ages 0-11 months. The similarity in means for this age group was likely the result of a large amount of variability in weight within each maternal literacy group. Increased variability could be the result of the large sample size of this study. Additionally, an effect could have been more difficult to detect because of this variability. This lack of effect due to variability was also observed for BMI between the group of mothers with some literacy skills and other maternal literacy groups.

The results also support the proposed relationship between maternal reading level and child BMI. As seen with child weight, the effects of maternal literacy on child BMI also increased with each year of age. This further supports the hypothesis that the effects of maternal literacy level are more significant as the child gets older. However, the associations for BMI

were much smaller than those for child weight. This could suggest that maternal literacy rate has a significant, but weak, effect on child height as compared to child weight. This finding could help expound on previous research by comparing the effects of maternal literacy rate on weight and its effects on height (Burchi, 2010; Francesco, 2012).

Compared to BMI, we observed greater differences in weight based on maternal reading level. The measure of BMI was used for this study because it provides a more complete picture of child health by incorporating height, weight and standards by age. However, it did not allow us to investigate height and weight separately. Since the effect of maternal literacy level was less significant for BMI, it will be important to examine the effect of maternal reading level on height.

Strengths

A major strength of this study was the large sample size. This can provide a more representative depiction of the population and can decrease variability in the sample. Another strength of the study was the novel approach that was taken by focusing on maternal literacy rate, as well as the use of BMI for children under the age of 5. Very few studies have investigated maternal reading level as a predictor variable for child anthropomorphic measures and none have examined the possible association between maternal literacy rate and child weight. Also, studies on children under the age 5 typically use alternative child growth measures, such as head circumference or weight-for-length. However, this study used the BMI standard deviation measure, which was developed as part of the new WHO Child Growth Standards (World Health Organization, 2016).

Limitations

One limitation of this study was that the sample did not accurately represent the Mozambican population, despite being relatively large. The percentage of underweight children in Mozambique in 2011 was reported to be as high as sixteen percent (World Health Organization, 2011). However, the percentage of underweight children in the study sample was approximately six percent. This resulted from the exclusion of children with missing weight data and children whose mothers had missing literacy rate data.

Another limitation of the study was the use of respondent measures rather than maternal measures. Covariates in the ANCOVA model included respondent weight and respondent's highest year of education. In future studies, subsetting these variables to be specific to mothers will provide a more accurate depiction of the effect of maternal characteristics on child weight.

Finally, the measure of maternal reading level was not tested thoroughly. In future studies, a more thorough test of both reading and writing should be utilized to accurately assess maternal literacy level. Additionally, maternal nutrition knowledge should also be assessed. This will provide a better understanding of maternal literacy as a whole, as well as its effects on child outcomes.

Future Directions

Future directions of this research include the investigation of the effect of maternal literacy on child weight in other countries, as well as a deeper understanding of the interaction between weight and socioeconomic status. Weight and wealth were found to be significantly correlated in the current study. It is likely that these two variables are connected by nutrition. A lack of financial resources could lead to lower nutritional education for various reasons, such as

dropping out of school in order to provide additional income. However, a more direct consequence could result from the purchase of inexpensive foods with little to no nutritional value. It is possible that increased literacy level could aid mothers in healthy food selection, even with limited financial resources. Therefore, future studies should assess whether increased maternal reading level can offset the effect of low socioeconomic status.

Furthermore, study findings would be further advanced by the inclusion of additional variables including observational measures that will allow for a more accurate assessment of maternal literacy. Additionally, child feeding practices, like breastfeeding, should also be included in future studies. These practices can influence child nutrition and weight, which would also influence the relationship between maternal literacy and child weight.

Additionally, researchers should also investigate the potential effects of the father's reading level on child weight. Since Mozambican men have higher literacy rates and more completed formal education than Mozambican women, it is possible that the education and literacy of a father could balance out the negative effects of a mother's lack of literacy skills (Francesco, 2012; Central Intelligence Agency, 2014).

Finally, previous studies have already examined the effect of maternal literacy and education on child nutrition. Future studies should include child nutrition information in order to further investigate the maternal literacy-child weight relationship. Since nutritional status has a direct effect on a child's weight, it would be interesting to explore the potential effect of maternal literacy on nutrition. If a mother's reading level is significantly correlated with child nutrition, a pathway explaining the maternal literacy-child weight relationship could be developed. This pathway would propose that low maternal literacy level leads to a lack of

nutrition knowledge and, subsequently, a nutrition-poor diet and lower weight in children. Additionally, access to nutrition and health information should also be taken into consideration. With less than one physician for every 1,000 people in Mozambique, many mothers are not able to consult with a healthcare provider about their child's nutritional needs (Central Intelligence Agency, 2014). Policies need to be created to increase female education so that mothers can gain the skills necessary to access nutritional information.

Implications

In the future, programs need to be developed that focus on increasing literacy rates for females and improving child health in Mozambique. The development of programs that address both issues could easily be developed. For instance, educational programs could incorporate mothers in the process of teaching children how to read. This could improve the literacy skills of mothers while also increasing literacy rates among younger generations. The programs would also be appealing to low income mothers who cannot afford child care.

Other skills that should be considered for classes include financial literacy, health literacy, and nutrition. All of these skills could be applied to improving child nutrition and welfare. For example, a matriarch for a low income family would become empowered with the knowledge of how to buy healthy food with a small budget. This would lead to improved nutrition in her child, as well as herself. It would also encourage girls in the next generation to empower themselves by learning similar skills, and most importantly, by obtaining literacy skills.

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