ORIGINAL ARTICLE

Food insecurity increases risk of depression and anxiety among women in Senegal living with diabetes and/or hypertension

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Abstract. Food insecurity affects close to half the population of Senegal, West Africa, a country simultaneously affected by the ongoing global diabetes pandemic. Diabetes and food insecurity are associated with adverse mental health, yet research exploring the relationship between chronic physical illness, food insecurity, and mental illness in Senegal is currently lacking. The objective of this study was to investigate the association between food insecurity and depression and anxiety, separately, in Senegalese women living with diabetes and hypertension. Food insecurity was measured using the Household Food Insecurity Access Scale. Occurrence of depression and anxiety symptoms was assessed using the Modified Hopkins Symptoms Checklist Survey (HSCL-25). A sensitivity analysis examining the relationship between food insecurity and depression and anxiety was performed by comparing two previously validated cutoff values (1.75 and 2.25) on the HSCL-25. Most participants (83%) had some level of food insecurity. More than 80% of the sample were depressed or anxious using 1.75 as the cutoff, while 42 and 60% were depressed or anxious, respectively, using 2.25 as the cutoff. Food insecurity increased relative risk for depression (RRR: 1.40, 95% CI: 1.05-1.31, 1.75 as cutoff; RRR: 1.06, 95% CI: 0.99-1.14, 2.25 as cutoff) and anxiety (RRR: 1.17, 95% CI: 1.05-1.31, 1.75 as cutoff; RRR: 1.11, 95% CI: 1.04-1.19, 2.25 as cutoff). These findings demonstrate that among populations suffering from diabetes and hypertension, food insecurity is a modifiable risk factor for depression and anxiety and a potential intervention target in this setting.

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Introduction

Close to 40% of the Senegalese population lives in poverty (1) and is additionally burdened by food insecurity (2). Food insecurity has been shown to be largely associated with mental health disorders including anxiety, depression, PTSD, disruptions in sleep and cognition, and psychological or distress in sub-Saharan African populations (3-5).

Hypertension and diabetes are both problematic in Senegal. The Centers for Disease Control and Prevention (CDC) estimates hypertension prevalence in Senegal at 30% with control rates at only 8% (6). Diabetes is an ongoing pandemic; rates are projected to increase by 46% in the next 23 years, affecting close to 800 million people worldwide (7). Although not as prevalent as it is in other parts of the world (e.g., US, India, China), diabetes ranks number 7 in the top 10 causes of death in Senegal (8).

The relationship between food insecurity and diabetes in sub-Saharan Africa has been explored. There is a high prevalence of food insecurity among diabetic patients in Kenya (9), diabetes onset has been attributed to inadequate access to healthy food choices in Ethiopia (10), and food insecurity has been associated with unmanaged blood glucose levels in South Africa (11).

Diabetes and depression commonly co-occur (e.g., 12); meta-analysis indicates a 40% prevalence of these two comorbid conditions in sub-Saharan Africa (13). Further, anxiety and depression symptoms were both present in type 2 diabetics in Guinea, West Africa with a prevalence of 59 and 34%, respectively (14).

These, combined with the fractured health care system where out of pocket spending for health care nearly equals government and donor contributions combined (15), the increasing prevalence of both diabetes (16) and hypertension (6), and the high rate of food insecurity here (2), compel epidemiological investigations into how these factors affect mental health in this area. Saint-Louis, a predominantly urban area of Senegal, is an ideal geographical setting for conducting this research. The objective of this study was to investigate the association between food insecurity and depression and anxiety, separately, in women living with the

chronic illnesses of diabetes and hypertension, in Saint-Louis. This research focus, specific to Senegal, has previously been unexplored. Women participating in this study were part of a larger ethnographic research program which took place across 15 months between 2018 and 2019; ethnographic study results are published elsewhere (17-19). The focus of analyses in the current study was on the epidemiology of depression and anxiety as a way of making sense of women's lived experiences of diabetes, hypertension, and food insecurity in Saint-Louis, Senegal.

Material and methods

Ethical considerations. One-hundred seven women aged 24-80 years living in Saint-Louis, Senegal, West Africa with a diagnosis of diabetes and/or hypertension were enrolled in this cross-sectional study. Participants were recruited through the two Diabetes Association locations in Saint-Louis, the Saint-Louis public hospital, the Catholic mission, or referred by women already participating in the study. Survey data were collected between January and April 2019. All participants provided verbal informed consent prior to data collection and participation was voluntary. The study protocol was approved by the University of Arizona Institutional Review Board (protocol number 1711070105R002) and local research clearance was additionally obtained from the Senegalese Ministry of Health and Social Action (protocol number SEN18/13), the Saint-Louis Public Hospital (protocol number 00000032), and the Senegalese Ministry of Higher Education and Research (protocol numbers 0000267 and 0001717). Participants were eligible for the study if they completed the Modified Hopkins Symptom Checklist Survey (HSCL-25). One participant was excluded due to missing HSCL-25 data which resulted in a final sample size of 106.

Prior to administration, all surveys were translated from English into French and Wolof (the predominate local language in Senegal) and then back translated into English for consistency.

The modified Hopkins symptom checklist survey. The HSCL-25 Survey is a 25-item self-report questionnaire that assesses symptoms of anxiety across 10 items (HSCL-A) and depression across 15 items (HSCL-D) and has been described elsewhere (20,21). Briefly, question responses are presented on a Likert scale from 1-4 (with 1=not at all; 2=a little; 3=quite a bit; 4=extremely) with a recall period of the past 7 days. Two depression items (no sexual appetite and to have thoughts of suicide) were excluded prior to survey administration as they were deemed to be culturally insensitive/inappropriate. An average anxiety and depression score were calculated, consistent with previous studies (5,22,23). A cutoff value of 1.75 has been widely accepted as the threshold for determining the presence of depression and anxiety symptoms across different cultures (5,22,23). A higher cutoff value of 2.25 was established for women in a study of an Afghanistan population in a primary care setting (24). In this current study, both cut-off values (i.e., 1.75 and 2.25) were used in separate analyses. Participants were considered not depressed or not anxious if their average score fell below the cutoff value, moderately depressed or moderately anxious if their average score was

≥ the cutoff value and < the 90th percentile of the sample distribution, and severely depressed or severely anxious if their average score was ≥ the 90th percentile of the sample distribution.

Household food insecurity access scale. The HFIAS consists of 9 occurrence and 9 frequency of occurrence questions with a recall period of the past 4 weeks/30 days (25). The nine occurrence questions have a binary response (yes=1; no=0). 'Yes' responses are followed with the corresponding frequency of occurrence question presented on a Likert scale from 1-3 (1=rarely; 2=sometimes; 3=often). Frequency of occurrence questions were summed to obtain a total food insecurity score (maximum value of 27). Participants were categorized into four groups: food secure, mildly food insecure, moderately food insecure, and severely food insecure based on the indicator guide (25).

Data analyses. Descriptive statistics (e.g., mean, standard deviation, unweighted %) were calculated for the overall population. Multinomial regression analyses were used to explore the association between food insecurity and depression symptoms and food insecurity and anxiety symptoms in separate models. Three-category dependent variables for depression (not depressed, moderately depressed, severely depressed) and anxiety (not anxious, moderately anxious, severely anxious) were used for these analyses. The independent variable in these analyses was food insecurity score as a continuous variable. Based on preliminary analyses, other demographic variables (e.g., age, education status, marital status) were ruled out as potential confounders. Within each multinomial regression analysis, comparisons were made using both not depressed/not anxious and moderately depressed/moderately anxious as the referent groups enabling an exhaustive consideration of each of the three dependent variable groups. Association between depression and anxiety symptoms was examined through Fisher's exact analyses. All statistical analyses were carried out using Stata (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC). Statistical significance for all tests was established at $\alpha=0.05$.

Results

Participant characteristics. A description of the population is provided in Table I. Participants had a mean age of 53, most were Wolof (75%), married (66%), and had primary or no education (80%). More than half (55%) had a diabetes diagnosis, 26% were diagnosed with hypertension, and 19% reported a diagnosis of both diabetes and hypertension. On average, women had lived with diabetes and/or hypertension for 7.3 years. Most participants were moderately (26%) or severely (38%) food insecure. Approximately 14 and 11% of the study population was considered severely depressed or severely anxious, respectively. When using 1.75 as the cutoff value, 70 and 78% of the study population were considered moderately depressed or moderately anxious, respectively. When using 2.25 as the cutoff value, 27 and 49% of the study population were considered moderately depressed or moderately anxious, respectively.

Table I. Descriptive statistics from study population.

	Total sample (N=106)
Age [in years, M (SD)]	53 (12)
Education[a]	
None [% (n)]	44 (45)
Primary [% (n)]	36 (37)
Junior high [% (n)]	10 (10)
High school [% (n)]	11 (11)
Chronic disease diagnosis	
Diabetes [% (n)]	55 (58)
Hypertension [% (n)]	26 (28)
Diabetes and hypertension [% (n)]	19 (20)
Years living with diagnosis [M (SD)]	77 (7)
Ethnic group	
Wolof [% (n)]	75 (79)
Pulaar [% (n)]	14 (15)
Moor [% (n)]	6 (6)
Other [% (n)]	6 (6)
Marital status	
Married [% (n)]	66 (70)
Single[b] [% (n)]	34 (36)
Depression 1.75 cutoff[c]	
Not Depressed [% (n)]	16 (17)
Moderately Depressed [% (n)]	70 (74)
Severely Depressed [% (n)]	14 (15)
Depression 2.25 cutoff[d]	
Not depressed [% (n)]	58 (62)
Moderately depressed [% (n)]	27 (29)
Severely depressed [% (n)]	14 (15)
Anxiety 1.75 cutoff[c]	
Not anxious [% (n)]	10 (11)
Moderately anxious [% (n)]	78 (83)
Severely anxious [% (n)]	11 (12)
Anxiety 2.25 cutoff[d]	
Not anxious [% (n)]	40 (42)
Moderately anxious [% (n)]	49 (52)
Severely anxious [% (n)]	11 (12)
Food insecurity score [M (SD)]	9 (7.07)
Food insecurity category	
Food secure [% (n)]	17 (18)
Mildly food insecure [% (n)]	19 (20)
Moderately food insecure [% (n)]	26 (28)
Severely food insecure [% (n)]	38 (40)

All reported % are from unweighted sample size. M, mean; SD, standard deviation. [a]Data were missing from 3 participants. [b]The single category included: single, widowed, divorced, and married abandoned. [c]Refers to using 1.75 as the cutoff value on the HSCL-25 subscale for determining presence of depression or anxiety symptoms. [d]Refers to using 2.25 as the cutoff value on the HSCL-25 subscale for determining presence of depression or anxiety symptoms.

Association between depression and anxiety symptoms. Fisher's exact analysis revealed a significant association between depression and anxiety symptoms using 1.75 and 2.25 as the HSCL-25 subscale cutoff values (P's <0.001).

Depression symptoms and food insecurity. Regression analyses examining the relationship between food insecurity and depression are shown in Table IIA. Using 1.75 as the cutoff value on the HSCL-D, compared to no depression, for every one unit increase in food insecurity score there was a 1.17 times greater relative risk for moderate depression (95% CI: 1.05-1.31) and a 1.40 times greater relative risk for severe depression (95% CI:1.20-1.62). Compared to moderate depression, for every one unit increase in food insecurity score there was a 1.19 times greater relative risk for severe depression (95% CI: 1.07-1.32). Using 2.25 as the cutoff value on the HSCL-D, compared to no depression, food insecurity score did not significantly increase risk for moderate depression. For every one unit increase in food insecurity score there was a 1.24 times greater relative risk for severe depression (95% CI: 1.11-1.38). Compared to moderate depression, for every one unit increase in food insecurity score there was a 1.16 times greater relative risk for severe depression (95% CI: 1.04-1.29).

Anxiety symptoms and food insecurity. Regression analyses examining the relationship between food insecurity and anxiety are shown in Table IIB. Using 1.75 as the cutoff value on the HSCL-A, compared to no anxiety, for every one unit increase in food insecurity score there was a 1.29 (95% CI: 1.08-1.55) and 1.46 (95% CI: 1.19-1.79) times greater relative risk for moderate and severe anxiety, respectively. Using moderate anxiety as the referent group, for every one unit increase in food insecurity score there was a 1.13 times greater relative risk for severe anxiety (95% CI: 1.03-1.25). Using 2.25 as the cutoff value on the HSCL-A, compared to no anxiety, for every one unit increase in food insecurity score there was a 1.11 and 1.23 times greater relative risk for moderate anxiety (95% CI: 1.04-1.19) and severe anxiety (95% CI: 1.10-1.37), respectively. Compared to moderate anxiety, for every one unit increase in food insecurity score, there was a 1.11 times greater relative risk for severe anxiety (95% CI: 1.00-1.22).

Discussion

Results from the present study indicate that food insecurity was a risk factor for both depression and anxiety regardless of the cutoff value used on the HSCL-D and HSCL-A subscales. Using 2.25 as the cutoff value resulted in lower risk estimates, likely due to a smaller sample size in the moderate categories. These results are consistent with previous findings from sub-Saharan Africa. In South Africa, living in a food insecure area was shown to increase relative risk of incident depression by 11% (26). Further, food insecurity was associated with symptoms of both anxiety and depression among those 50 years and older in Ghana (27). Additionally, in Ethiopia, household food insecurity was associated with high prevalence of both depression (62%) and anxiety (65%) symptoms (5). Food insecure individuals in South Africa had a markedly higher odds (AOR=5.38) of having unmanaged blood glucose levels compared to those who were food secure (11) and in

Table IIA. Multinomial logistic regression models of presence of depression using 1.75 and 2.25 as the cutoff values on the HSCL-D and food insecurity.

No depression as referent group

	1.75 as Cutoff value			2.25 as Cutoff value		
	No depression[a] RRR (95% CI)	Moderate depression[b] RRR (95% CI)	Severe depression[c] RRR (95% CI)	No depression[a] RRR (95% CI)	Moderate depression[b] RRR (95% CI)	Severe depression[c] RRR (95% CI)
Food insecurity[d]	1.00 (Ref)	1.17** (1.05-1.31)	1.40** (1.20-1.62)	1.00 (Ref)	1.06 (0.99-1.14)	1.24** (1.11-1.38)

Moderate depression as referent group

	1.75 as Cutoff value			2.25 as Cutoff value		
Food insecurity[d]	-	1.00 (Ref)	1.19** (1.07-1.32)	-	1.00 (Ref)	1.16** (1.04-1.29)

RRR, relative risk ratio; CI, confidence interval. All models are unadjusted. *statistically significant at P<0.05; **statistically significant at P<0.01. [a]Corresponds to score of <1.75 or <2.25 on the self-reported HSCL-D. [b]Corresponds to score of ≥1.75 or ≥2.25 and <90th percentile on the self-reported HSCL-D. [c]Score of ≥90th percentile on the self-reported HSCL-D. [d]Self-reported score on Household Food Insecurity Access Scale (HFIAS) with Household Hunger Scale (HHS).

Table IIB. Multinomial logistic regression models of presence of anxiety using 1.75 and 2.25 as the cutoff values on the HSCL-A and food insecurity.

No anxiety as referent group

	1.75 as Cutoff value			2.25 as Cutoff value		
	No depression[a] RRR (95% CI)	Moderate depression[b] RRR (95% CI)	Severe depression[c] RRR (95% CI)	No depression[a] RRR (95% CI)	Moderate depression[b] RRR (95% CI)	Severe depression[c] RRR (95% CI)
Food insecurity[d]	1.00 (Ref)	1.29** (1.08-1.55)	1.46** (1.19-1.79)	1.00 (Ref)	1.11** (1.04-1.19)	1.23** (1.10-1.37)

Moderate anxiety as referent group

	1.75 as Cutoff value			2.25 as Cutoff value		
Food insecurity[d]	-	1.00 (Ref)	1.13* (1.03-1.25)	-	1.00 (Ref)	1.11* (1.00-1.22)

RRR, relative risk ratio; CI, confidence interval. All models are unadjusted. *statistically significant at P<0.05; **statistically significant at P<0.01. [a]Corresponds to score of <1.75 or <2.25 on the self-reported HSCL-A. [b]Corresponds to score of ≥1.75 or ≥2.25 and <90th percentile on the self-reported HSCL-A. [c]Score of ≥90th percentile on the self-reported HSCL-A. [d]Self-reported score on Household Food Insecurity Access Scale (HFIAS) with Household Hunger Scale (HHS).

Burkina Faso, depression was significantly associated with both chronic illness and food insecurity (28).

Food insecurity combined with a diabetes or hypertension diagnosis may have acted synergistically to contribute to depression and anxiety symptom development and/or magnified the severity of these symptoms. In the present study, the magnitude of risk for depression and anxiety associated with food insecurity was greater among those who were categorized as severely depressed or severely anxious and remained significant using moderate depression or moderate anxiety as the referent group. Among those classified as severely depressed or severely anxious, none were food secure and

most (73 and 83%, respectively) were severely food insecure. This strongly suggests that severity of food insecurity has a direct effect on severity of both depression and anxiety. This is a notable finding worthy of further exploration in subsequent research. Additionally, this suggests that food insecurity, along with depression and anxiety present on a 'sliding scale' and that interventions focused on alleviating some degree of food insecurity would be effective in also alleviating some degree of mental illness.

Findings from the current study suggest that the prevalence of mental illness may be higher among those with comorbid conditions and indeed, the literature suggests that living with diabetes and/or hypertension in sub-Saharan Africa further increases the prevalence of depression or anxiety symptoms. Prevalence estimates of co-occurrence of depression and diabetes and anxiety and diabetes are as high as 87% (29) and 59% (14), respectively, and estimates of concurrent hypertension and depression as high as 83% in sub-Saharan African populations (30). In the present study, results were robust using either cut-point, suggesting that the relationship between food insecurity and depression and anxiety among populations living with chronic physical illness is strong regardless of the prevalence of mental illness.

Co-occurrence of chronic illness with other adverse somatic/physiological conditions likely compounds disease burden and further increases risk for development of both anxiety and depression. This idea is supported by previous findings. In Burkina Faso, prevalence odds of having depression increased from 2.2 for those who had one chronic illness to 6.7 for those who had at least two chronic illnesses (28). Further, depression has been shown to be associated with incident diabetes-related complications among those with a diabetes diagnosis at baseline (31). This is particularly relevant considering that many of the participants in the current study reported additional adverse health conditions such as musculoskeletal dysfunction, hearing and vision loss, renal failure or anemia, all of which are frequent complications of diabetes (32,33). It is important to note that direct comparisons across studies are challenging due to the differences in clinical scales used to assess depression and anxiety.

In Western populations, diabetes management involves commitment to life-style modifications including adhering to a healthy diet and medication, and maintaining physical exercise (34). In Saint-Louis, women with diabetes or hypertension diagnoses are also advised to make healthy dietary changes, though from the initial diagnosis to the inability to monitor blood glucose, adhere to prescribed medications due in part to prohibitive out of pocket costs, and follow recommended diet changes, combined with the stigma of weight loss among women, the picture of diabetes management looks quite different (17,18). Well-defined gender roles within households are a barrier to diabetes self-care for women in Senegal. Women are responsible for meal preparation and families consume both lunch and dinner from a shared plate; stepping outside of these practices would transgress cultural norms (17,18,35). Following healthy diet recommendations requires preparation of meals for oneself and eating alone, an inconceivable practice in Senegal (18,35). Most meals in Senegal (including in Saint-Louis) are centered around rice and are prepared using seasoning cubes (e.g., Jumbo and Maggi) that are high in sodium (17). Over-fishing by large commercial ships has limited availability of fish, a traditional source of protein, in Saint-Louis (17). In this study population, rapid weight loss was a visible marker of diabetes and was perceived as particularly devastating due to the attached negative connotations of weight loss in this culture (e.g., an unhappy marriage, financial distress, presence of an active infection) which can contribute to feelings of isolation and depression (17). Moreover, the high cost of food in Senegal (1) and resulting food insecurity among this population further make this life-style change unfeasible.

In wealthy countries, educational programs designed to facilitate diabetes self-care are effective intervention methods and can additionally contribute to decreasing depression symptoms (e.g., 36). Feasibility of these approaches in sub-Saharan African populations is limited as numerous health care obstacles including insufficient human resources, healthcare funding, and lack of leadership/management have been identified (37). Community-based treatment methods may be a more practical approach in these populations, though this necessitates appropriate and sufficient training. In a rural setting in Senegal, staff members from a community health clinic reported numerous interactions with patients who had underlying mental health conditions and reported a need for additional training to adequately diagnose and treat these conditions (38). In Saint-Louis, among physically disabled participants under the age of 50, 79% reported challenges in acquiring health care in part due to lack of affordability and mistreatment by health care staff (39). Facing numerous obstacles in managing chronic illness, populations such as the one in the present study, require an integrated approach to disease treatment and prevention that considers physical health, mental health, and social context (e.g., food insecurity).

A particular strength of this study is that it is the first (to our knowledge) to provide evidence on the association between food insecurity and depression and anxiety among a specific Senegalese population of women living with chronic physical illness. The sensitivity analysis assessing the distribution or prevalence of depression and anxiety using two different HSCL-25 cutoff values, and the exploration of multiple mental health outcomes are additional strengths, as these were heretofore understudied in this context.

Limitations

Results from this study are limited in several ways. First, neither of the cutoff values on the HSCL-25 for establishing presence of either depression or anxiety examined in this study have been validated in this population. Validated cutoff values vary by culture and by comorbid condition (e.g., 23, 24); however, in the absence of 'gold standards' (e.g., PAS, DSM-IV), 1.75 as the cutoff value for establishing caseness has been well accepted across multiple cultures (e.g., 5, 22, 40). Another limitation of this study is its cross-sectional design which does not permit determination of causality and provides only indirect estimates of risk, though most research examining the relationship between food insecurity and depression and anxiety has been cross-sectional in nature (e.g., 41, 42).

Several biases in this study are possible. The extent to which the results can be generalized to other populations is limited due to the homogeneity of the study sample. Furthermore, participants comprising the study sample lived in predominately urban areas of Saint-Louis and generalizability of results to women living in rural areas is therefore limited. Participants were recruited primarily from the two Diabetes Association locales in Saint-Louis potentially resulting in healthy volunteer bias and therefore may not be representative of all women living with diabetes in Senegal. Recall bias is also a possibility in this study, though the recall period for each survey was relatively short (i.e., past 7 or 30 days) and this bias is expected to have resulted in non-differential misclassification of exposure. Social desirability may have resulted in response bias, though this is also expected to have resulted in non-differential misclassification of exposure. Finally, data were collected by a white woman from the United States and two local Wolof research assistants, and while not necessarily an inherent study limitation, mention of this is noteworthy as it may have affected the ways in which women interacted with study investigators.

Conclusions

Food insecurity was found to be a significant risk factor for depression and anxiety symptoms among a population of women living with diabetes and/or hypertension in Saint-Louis, Senegal, West Africa. Using either 1.75 or 2.25 on the HSCL-25 subscales for establishing caseness among this population was not validated though regression analyses yielded robust results across both cut points. These findings contribute to existing literature and provide insight into the association between food insecurity and depression and anxiety in a population of women living with chronic physical illness in Senegal. The combination of diabetes and hypertension with persistent food insecurity is likely to exacerbate mental illness and contribute to an intensification of disease burden. It is logical that management of diabetes using traditional approaches incorporating healthy lifestyle changes likely attenuates risk for depression and anxiety in Western contexts. Had this study been conducted in a high-income country, intervention approaches would be focused on ways to improve access to healthy food and on methods for receiving mental health treatment at the primary care level. However, for populations additionally afflicted with environmental injustice (e.g., food insecurity, climate change), these approaches are insufficient, not achievable, and not culturally sensitive, necessitating a new understanding of genesis of diabetes, food insecurity, and mental illness in Senegal. Successfully addressing this severity of disease burden will require a multi-disciplinary effort involving global public health epidemiologists, clinical researchers, and medical anthropologists, and an integration of culturally mindful intervention strategies developed and implemented at the community level.

Ethical approval and consent to participate

The study protocol was approved by the University of Arizona Institutional Review Board (protocol number 1711070105R002) and local research clearance was additionally obtained from the Senegalese Ministry of Health and Social Action (protocol number SEN18/13), the Saint-Louis Public Hospital (protocol number 00000032), and the Senegalese Ministry of Higher Education and Research (protocol numbers 0000267 and 0001717).

Availability of data and material

Data and materials are available by the authors.

Informed consent

All participants provided verbal informed consent prior to data collection and participation was voluntary.

Conflict of interest

The authors declare no potential conflict of interest.

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