



Original Article

Psychometric Evaluation of the Questionnaire to Assess the Perception of and Knowledge about Predisposing Factors Related to Cutaneous Leishmaniasis

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ABSTRACT

Assessing the knowledge of cutaneous leishmaniasis and associated risk factors among endemic communities is important for designing its management and control. Knowledge of CL-related factors and how CL is perceived is important in designing public health interventions against this disease in such endemic communities. The present study aimed to develop a questionnaire to evaluate the perceptions and knowledge of predisposing factors related to CL among patients with CL. Data obtained from a cross-sectional survey conducted among a cohort of 56 patients with CL were collected to evaluate the assessment questionnaire developed to determine CL-related factors. The internal consistency reliability and validity of the instrument were measured via the use of Cronbach's alpha test, whereas the dimensionality and item relationships were established via the ICLUST algorithm. Seven clusters with alpha values equal to or greater than 0.7 were generated corresponding to knowledge about the sand fly vector, knowledge and perception of the CL, knowledge about the clinical presentation of the CL, disease transmission and method of vector control, nature/household level and presence of vegetation around the house, how to differentiate vectors from mosquitoes, and health status and how to seek medical treatment. Finally, a 21-item questionnaire that is both reliable and valid was developed. CL perception and knowledge about its predisposing factors are independent of gender, education, family size and socioeconomic status.

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Keywords: Cutaneous leishmaniasis, internal consistency reliability and validity, Cronbach's alpha test, ICLUST algorithm.

1 Introduction

Leishmaniasis is a neglected tropical disease that is often associated with poverty and characterized by its complexity, presenting a growing array of social and public health challenges ^[1]. This disease affects approximately 12 million individuals globally, with significant levels of morbidity and mortality, and

is widespread across more than 80 nations, placing more than 300 million people at risk. Among all the disease presentations, cutaneous leishmaniasis (CL) stands out as the most common form ^[2].

Cutaneous leishmaniasis (CL) results in skin lesions predominantly in the form of ulcers, leading to permanent scars, significant disability, stigmatization, and psychological challenges, particularly among young females ^[3]. Each year, over one million individuals' contract parasites responsible for causing cutaneous leishmaniasis (CL), presenting as skin lesions or ulcers

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that exhibit delayed healing owing to varying responses to therapeutic interventions^[4]. Research indicates that individuals' perceptions of the disease are influenced by sociodemographic factors, economic status, and treatment conditions^[5]. The beliefs held about a patient's health condition are commonly known as illness perceptions, encompassing notions about the ailment itself, its etiology, progression, ramifications, treatment modalities, and emotional reactions. According to the health belief model (HBM), health-related behaviors are shaped by an individual's risk perception of the disease, which is contingent upon the perceived susceptibility and severity of the condition. Moreover, it is associated with the perception of obstacles and advantages of undertaking preventive measures, self-efficacy, and the intention to adopt recommended behaviors^[6]. The perspective of CL as a disease significantly influences the reporting and estimation of both incidence (annual new cases of CL) and prevalence (total cases of CL)^[7]. Understanding the profound impact of CL on patients necessitates acknowledging that the disease burden persists beyond the resolution of active infection^[8]. Nonetheless, the identification of disease risk factors is imperative for tailoring specific preventive strategies^[9]. This study's primary focus was to examine the perception and understanding of predisposing factors associated with CL among individuals with cutaneous leishmaniasis in Sokoto State, Nigeria.

2 Material and methods

2.1 Study population

A cross-sectional survey was conducted among patients diagnosed with CL attending two hospitals and a private dispensary known for CL treatment between 2021 and 2022 in Sokoto State, Nigeria. The target group consisted of all patients with CL who attended the hospitals but had not started receiving treatment and who voluntarily agreed to participate. All 56 patients were positive by molecular analysis via the HumPCR Leishmania Detection Kit from Bioingentech. The aim of the research was explained to the participants, and formal written consent was acquired from each participant.

2.2 Questionnaire development

Studies employing qualitative methods to research cutaneous leishmaniasis are notably limited in the literature^[10]. Given the growing number of cases of CL and the lack of knowledge about the predisposing factors and risk of acquiring CL among different communities, there is a need to understand and assess CL-related factors. This need forms the basis for developing an assessment questionnaire to determine predisposing factors.

The questionnaire used in this study had forty-eight questions rated on a scale of 0 (minimum) to 10 (maximum). The 48-item questionnaire has eight subscales assessing socio-demographic information (9 items), clinical presentation (7 items), knowledge and perception (9 items), knowledge about preventive measures (3 items), knowledge about risk factors (5 items), knowledge about the sand-fly vector (10 items), the social impact of CL (2

items) and the economic status (3 items) of the respondents. On the basis of previous studies on the illness perception questionnaire (IPQ)^[11], the Cutaneous leishmaniasis impact questionnaire^[12], the CL and its treatment impact on patients' quality of life questionnaire^[13], the brief illness questionnaire (BIQ), the CL knowledge attitudes and practices questionnaire^[14], and the CL impact questionnaire, some questionnaire items were also formulated to fit the assessed population, and a 48-item question pool was generated. The questionnaire was developed to evaluate the relationships between these factors concerning CL and its predisposing factors. Five experts read the content, and observations and suggestions were made. The questionnaire was pretested in a small population before it was administered. The questions were modified to fit the culture, tradition, and mode of life of the assessed communities. Following the methodology of^[15] who developed and validated a specific cutaneous leishmaniasis impact questionnaire, a CL predisposing factor questionnaire was created.

2.3 Statistical analysis

In accordance with the most recent findings from the validation process, as described by^[16], an analysis of the elucidative features pertaining to the replies to various things was carried out, followed by an assessment of each person's normalcy responses via the Lilliefors (Kolmogorov-Smirnov) test. The initial step in the validation process involved determining the Cronbach's α value, a commonly utilized metric for assessing item validity. The dependability of the scale was evaluated according to both Cronbach's alpha and Revelle's beta. Revelle's beta was debated to improve Cronbach's alpha^[17]. Given that the alpha coefficient is the primary reliability estimate reported in test manuals and academic publications, practitioners could also benefit from including both the alpha and omega coefficients in their reports^[18]. McDonald's omega was also used to estimate reliability. Therefore, the two tests were combined to ascertain the reliability of the scale used.

The instrument's dimensionality and the item relationships were established via the ICLUST algorithm. Hierarchical cluster analysis with polychoric correlations was conducted on the 48 instrument items to obtain the most suitable structure for consistent and homogenous items. Until new algorithms produced alpha coefficient values greater than or equal to 6.0 and 3.9, the instrument's final structure was established by removing clusters characterized by low alpha and beta values, representing split-half reliability.

The presence of a score relationship among the measures of the instrument was assessed via construct validity. This analysis aimed to determine how well the suggested instrument effectively measures the construct for which it was intended. To validate the associations among the scores assigned to all the items and their respective clusters, at the 95% confidence interval (CI) for the

correlation coefficient, the Spearman correlation coefficient was employed.

By comparing the instrument's scores for the various subscales and clusters with socio-demographic and clinical characteristics already known to be predictive of the impact of the disease, we were also able to assess the construct's validity. The regularity of the data generated was tested through the application of the Shapiro–Wilk and Kolmogorov–Smirnov tests. To confirm that the mean scores for each variable varied, an analysis of variance was subsequently conducted by applying nonparametric tests, the Wilcoxon signed-rank test and the Kruskal–Wallis test. The importance threshold was set at 0.05 ^[19].

The “psych” package of the R program for macOS, R Foundation-developed software version 4.2.2 for Statistical Computing, can be found at <https://www.r-project.org> and was used for all data visualizations along with data analysis.

3 Results and Discussions

3.1 Socio-demographic characteristics

The study population comprises 56 respondents, of which 67.86% were males and 32.14% were females. The majority of participants, accounting for 46.43%, fell within the 21–30 age brackets. The South Local Government area constituted the majority (28.57%) of the respondents. With respect to educational level, those with secondary school (39.29%) had the highest percentage. Those with household members of 6–10 persons (48.21%) constituted the majority, and those with students (23.21%) constituted the majority, with 35.71% having 6–10 years of highest occupational experience (Table 1).

Table 1: Socio-demographic data of the study participants.

Variables	Frequency	Percentage
Gender		
Male	38	67.86
Female	18	32.14
Age (years)		
1-10	3	5.36
11-20	14	25.00
21-30	26	46.43
31-40	7	12.50
40-50	5	8.93
50+	1	1.79
Residence		
Sokoto South	16	28.57
Wamako	9	16.07
Dange Shuni	7	12.50
Sokoto North	7	12.50
Kware	5	8.93
Bodinga	3	5.36
Gudu	2	3.57
Tureta	2	3.57
Illela	1	1.79

Kebbi	1	1.79
Rabah	1	1.79
Tambuwal	1	1.79
Zamfara	1	1.79
Educational background		
Child	2	3.57
Informal	12	21.43
Basic	5	8.93
Secondary	22	39.29
Tertiary	15	26.79
Family size (Household members)		
0-5	14	25.00
6-10	27	48.21
11-15	12	21.43
16-20	1	1.79
21-25	1	1.79
Not indicated	1	1.79
Occupation		
Student	13	23.21
Housewife	10	17.86
Business	8	14.29
Farmer	8	14.29
Artisan	6	10.71
Civil servant	6	10.71
Child	2	3.57
Carpentry	1	1.79
Corp member	1	1.79
Driver	1	1.79
Duration in the sector		
Less than 1 year	2	3.57
1-5 years	20	35.71
6-10 years	20	35.71
11-15 years	7	12.50
16-20 years	4	7.14
30+ years	3	5.36

3.2 Questionnaire Validation

3.2.1 Assessment of the internal consistency reliability and validity of the questionnaire

This involves tests aimed at establishing the extent to which all elements within the questionnaire are interrelated and the degree to which these elements should be retained. These assessments are conducted on groups of elements designed to capture specific attributes of a common concept, with each assessment focusing

on a single aspect of the concept. To assess the interior validity or consistency of our questionnaire, a Cronbach's alpha (α) was used. A Cronbach's α is an essential statistic that has been used in the area of psychometrics, especially when a questionnaire or survey is used. Its main function is to measure the interior validity, reliability or consistency of items that are expected to evaluate the same underlying concept. A higher Cronbach's α suggests that the things are potentially assessing the same underlying construct and vice versa ^[20]. The overall Cronbach's α value of the current study questionnaire was 0.8. Therefore, these findings, in line with previous studies, suggest that the interior validity, reliability or consistency of items has been achieved ^[21].

Table 2 shows the outcomes of Cronbach's alpha when an item is deleted and the correlation item-total. The item-total correlations, otherwise known as polyserial correlations for categorical variables and biserial correlations for binary variables, were utilized to explore the associations among all the items and the final scores of the scale items.

Table 2: Item-level analysis of a newly developed questionnaire.

Item	Range	Median	Alpha if deleted	Correlation Item-total
B1	1-2	1.0	0.79	0.19
B2	1-13	1.0	0.79	0.51
B3	1-3	2.0	0.79	-0.06
B4	1-3	1.0	0.78	0.19
B5	1-7	2.0	0.78	0.05
B6	1-10	4.0	0.78	0.35
B7	1-3	1.0	0.79	0.14
C1	1-3	2.0	0.79	-0.21
C2	0-3	2.0	0.79	0.21
C3	1-3	2.0	0.79	-0.01
C4	1-3	2.0	0.79	0.19
C5	1-3	3.0	0.79	0.20
C6	0-6	2.5	0.78	0.17
C7	0-7	3.0	0.79	0.24
C8	1-2	1.0	0.78	0.18
C9	0-6	0.0	0.78	0.04
C10	0-5	0.0	0.78	0.17
D1	1-2	1.0	0.78	-0.02
D2	1-2	1.0	0.79	-0.14
D3	1-5	2.0	0.78	0.35
E1	1-2	1.0	0.78	-0.31
E2	1-2	1.0	0.77	0.28
E3	0-4	0.0	0.77	0.26
E4	0-3	0.0	0.77	0.38
E5	1-4	4.0	0.78	0.12
E6	0-3	3.0	0.79	-0.08
F1	1-2	1.0	0.79	0.21

F2	0-4	0.0	0.79	0.29
F3	0-3	3.0	0.79	0.40
F4	1-2	1.0	0.78	0.32
F5	1-3	3.0	0.78	-0.26
F6	0-3	0.0	0.79	0.32
F7	0-3	3.0	0.79	-0.06
F8	0-5	5.0	0.79	-0.01
F9	1-2	2.0	0.77	-0.16
F10	0-4	0.0	0.77	0.20
G1	0-4	4.0	0.78	0.26
G2	0-6	5.0	0.78	0.54
H1	1-3	3.0	0.78	0.21
H2	1-2	2.0	0.78	-0.00
H3	1-3	3.0	0.78	0.20

3.2.2 Result validation via hierarchical cluster analysis

The questionnaire employed during the cross-sectional study consisted of sections A-H with a mix of multiple-choice and open-ended questions. The questionnaire's content validity was assessed via the item-clustering (ICLUST) nesting clustering algorithm proposed by ^[22]. Figure 1 shows a tree diagram generated through the application of hierarchical cluster analysis (ICLUST) to the 48-item dataset. The questionnaire (a higher-order scale) is grouped into 7 subscales measuring separate aspects of CL. All the listed items are displayed on the left side and ordered according to their relationships, and clusters are formed by conjointly merging similar items to form clusters. The coefficients α and β for each cluster are provided. Those clusters with lower alpha and beta values were deleted because they did not increase the overall construct of the scale. While Figure 2 shows final clustering after trimming out clusters with lower alpha and beta values. Seven main clusters (C2, C19, C18, C17, C16, C15, and C14) with alpha values equal to or with perceptions of CL, the clinical presentation of CL, the disease transmission method, the method of vector control, the nature/household level and the presence of vegetation around the house, the methods used to differentiate vectors from mosquitoes, and the health status of the mosquitoes need medical treatment.

As shown in Table 3 below, the interitem correlation of the CL perception scale score with several categorical variables. The social impact of cutaneous leishmaniasis was significantly associated ($P=0.004$), whereas the other variables were not significantly associated with CL perception, risk factors, or preventive measures ($P>0.05$). This implies that CL perception and knowledge about its predisposing factors are irrespective of gender, education, family size and socioeconomic status. However, education had a slight effect on the perception of CL and knowledge of its predisposing factors, but the association was not significant ($P=0.07$).

Neglected tropical diseases (NTDs) refer to those diseases typically found in impoverished and somewhat secluded areas that have been overlooked through efforts in pharmaceutical,

public health, and research development. Neglected tropical diseases (NTDs) linked to the skin are defined by skin manifestations [23]. On June 8, 2022, the World Health Organization (WHO) issued "Ending the Neglect to Achieve the Sustainable Development Goals: A Strategic Framework for Integrated Control and Management of Skin-Related Neglected Tropical Diseases." It advances on previous work 'A road map for neglected tropical diseases 2021–2030 in which the priority area is community initiatives tailored toward awareness and mobilizations [24].

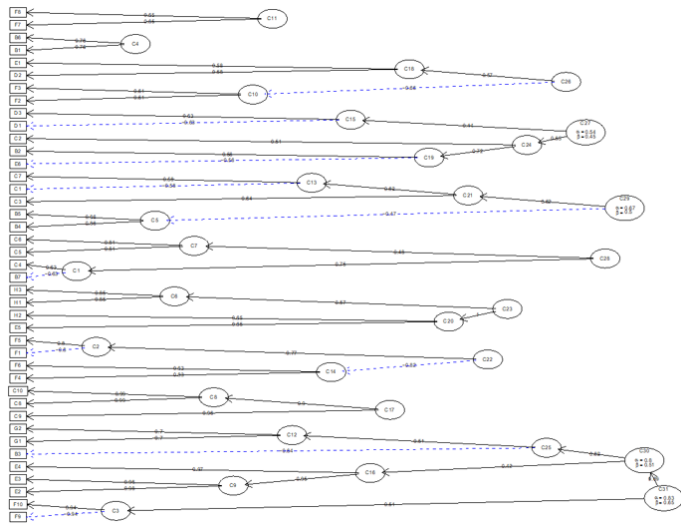


Figure 1: Initial iclustering before trimming out clusters with alpha values less than 0.7: Shows a tree diagram created with hierarchical cluster analysis (ICLUST) for the 48-item questionnaire (a higher-order scale) grouped into 7 subscales measuring separate aspects of CL.

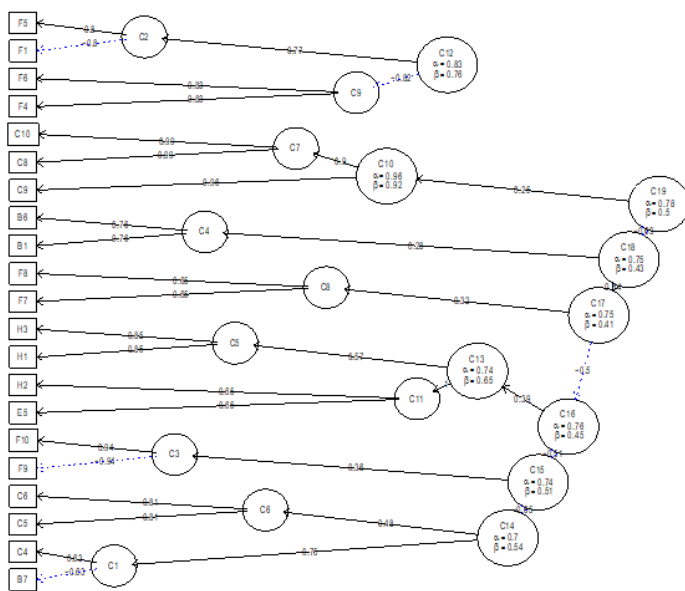


Figure 2: Final iclustering before trimming out clusters with alpha values equal to or greater than 0.7 with lower α and β values.

Assessing knowledge of CL and its associated factors among endemic communities is important for designing its management

and control. Knowing how different CL endemic communities perceive CL and its predisposing factors is important in designing public health interventions against this disease in such communities. The present study aimed to develop a questionnaire to evaluate the perceptions and knowledge of predisposing factors related to CL among patients with CL.

Scales are commonly used to describe a behavior, emotion, or activity that is not possible expressed in just one variable or item. The inclusion of numerous items to assess a hidden underlying concept can also control for and separate measurement errors related to an item, resulting in increased accuracy. A scale is often created by merging two or more objects designed to assess the same concept into a single composite scale. This is done to improve the dependability and universality of the final scale [25]. In science, measurement is of utmost importance, and arguably, reliability and validity are the two most significant qualities related to measurement.

Reliability is the most important compartment of test quality. It is the final consistency of a certain measure. An instrument is regarded as dependable if it can show the exact value, followed by the reduction of the residual (error) factor. For any survey to be regarded as significant and advantageous, it ought to be trustworthy and legitimate. When a scale is legitimate, it ought to be dependable. In the present study, reliability and validity tests were conducted to ascertain the internal consistency of the scale developed.

ICLUST is a hierarchical item-clustering methodology that uses alpha and beta coefficients collectively to determine the appropriate moment at which to terminate the clustering process. Through the utilization of product-moment correlation, adjusted for diminishment, as a metric of likeness, likeable items are grouped at the same time successively by implementing a straightforward conclusion criterion for the establishment of clusters. A novel cluster is created by fusing any two items or clusters only if both the coefficient alpha and the coefficient beta for that cluster surpass the average values of these coefficients for the two individual items (or clusters) under consideration for merging [26]. Progressively, hierarchical clusters are constructed stepwise until the internal consistency of the combined clusters ceases to improve. The hierarchical diagram depicts the linkage of increasingly dissimilar items and clusters from left to right: the most similar items are merged initially, whereas the other disparate items are incorporated last. Each cluster is accompanied by alpha and beta coefficients, whereas each link that exists between clusters and items is associated with correlation coefficients [26] emphasized that the broader the concept (i.e., the higher its position in the hierarchy), the more crucial it becomes to elucidate its underlying compartments—that is, to clarify the multidimensional aspect of the concept. An alpha value exceeding 0.8 and a beta value surpassing 0.7, with a discrepancy among these coefficients less than 0.1, indicate good homogeneity and internal consistency. The information on items incorporates the average split-half reliability (α) and the global split-half reliability (β). The initial step in examining the structure of the scale involved the estimation of the coefficients α and β for

the overall scale. The overall Cronbach's α value of the questionnaire was 0.8. This indicated an acceptable degree of internal consistency of the scale. [26] suggested that a Cronbach's

alpha value within the range of 0.6--0.8 is sufficient. This indicated good consistency within the scales.

Table 3: Comparison of the mean scores of the questionnaire and sub-questionnaire (scales) with categorical criterion-related validity measures. The statistical tests used for this comparison included the Mann–Whitney test and the Kruskal–Wallis test.

Variable	CL perception	Knowledge about CL risk factors	Knowledge about preventive measures	Total Score
Gender	P = 0.57*	P = 0.41*	P=0.96*	P = 0.26*
Education	P = 0.57**	P = 0.15**	P = 0.80**	P =0.07**
Occupation	P = 0.69**	P = 0.78**	P = 0.50**	P = 0.68**
Family size	P = 0.07**	P = 0.42**	P = 0.15**	P = 0.36**
Social impact of cutaneous leishmaniasis	P = 0.004**	P = 0.02**	P = 0.62**	P = 0.004**
Socioeconomic status	P = 0.74**	P = 0.20**	P = 0.27**	P = 0.23**

Evaluation methods also include the calculation of measures such as Cronbach's alpha coefficient, interitem correlation, item–total correlations, and Cronbach's alpha if an item is deleted. If the item is deleted, it measures the value of Cronbach's alpha coefficient after the withdrawal of the related item. In the present study, no item from among the items will increase the overall Cronbach's alpha if deleted; removal of any item would cause a decrease from the collective total of 0.8. This finding indicates that each item contributes to the construct's reliability, despite their notably low item–total correlation scores.

[27] argued that the ICLUST perspective to scale development has two advantages: it is a psychometrically logical method for quantifying the coefficient beta to enhance the quality of judgments regarding scale homogeneity, and it is a more practical way of displaying scale internal components than traditional factor or component analysis. If a significant number of items have been written to assess the construct of interest, some are superior to others. As a result, the best elements are selected to build a scale, whereas those that do not improve the scale's quality are rejected. The results of the present study indicated that, among the pool of 48 items developed, several questions were removed because of low internal consistency and therefore might not be good for the scale. This could be because of mistakes concerning the variation between the test items. Similarly, subjectivity in scoring may also introduce variability. The small number of respondents could have also contributed to the low internal consistency of those scales removed. When these questions were removed, the scale became more reliable and valid.

Items exhibiting extremely low correlations (<0.30) are considered less positive and may signal a need for removal from the provisional scale. In the current investigation, only B2, B6, D3, E4, F3, F4, F6, and G2 had greater item–total correlations. However, most of the items had item–total correlations of less than 0.30. Finally, a 21-item questionnaire with a 7-level subscale corresponding to knowledge about the sand-fly vector, knowledge and perceptions of the CL, the clinical presentation of the CL, disease transmission, the method of vector control, the nature/household level and presence of vegetation around the

house, how to differentiate the vector from mosquitoes, health status and the need to seek medical treatment was developed. The 21-item scale was found to be both reliable and valid for measuring perceptions of and knowledge about CL and its predisposing factors.

The results of the survey revealed that the social impact of CL was significantly associated with other variables associated with the disease. The reason could be CL, a disease associated with poverty and low socioeconomic status. Therefore, high levels of knowledge about social conditions such as unsanitary conditions might be linked to perceptions of and knowledge about CL risk factors and preventive measures. Importantly, the primary risk variables involved in acquiring every type of leishmaniasis are related to societal situations. Poverty causes malnutrition, which eventually impairs immunity and results in the development of a full-fledged disease. Climate change, occupational exposure, and poor sanitary conditions cause humans to contact parasites in wooded areas, while the migration of non-immune individuals to endemic regions facilitates transmission cycles.

Conclusion

The perceptions of and knowledge about CL and its predisposing factors were assessed, and a psychometric evaluation of the scale was conducted, which led to the development of a 21-item questionnaire that is both reliable and valid. CL perception and knowledge about its predisposing factors are independent of gender, education, family size and socioeconomic status.

Conflict of interest

The authors declared no conflict of interests.

Author's contribution

This work exemplifies a collaborative spirit, with each author providing equally vital contributions. The researchers carefully designed and executed the research framework, conducted comprehensive data analysis, and unified their findings into a well-structured manuscript. Their coordinated teamwork and

collective expertise propelled every stage of the project, showcasing their mutual commitment to its success.

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