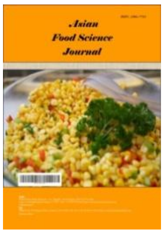

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Reliability of the General Nutrition Knowledge Questionnaire among Head Teachers from Schools in Uganda

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Authors' contributions

This work was carried out in collaboration among all authors. Authors RB and JEA conceived and designed the experiments. Authors RB and BE performed the experiments. Authors RB and JMA mined and analyzed the data. Authors RB and JEA contributed materials and analysis tools. Authors RB, DSGT, JMA, JM, RM and JEA wrote the paper. All authors read and approved the final manuscript.

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ABSTRACT

Valid and reliable questionnaires are necessary to improve the existence and quality of nutrition information, which determines interventions in low-resource settings, especially among decision makers and change agents.

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The present study evaluated the internal consistency and test-retest reliability of the data collected among 255 head teachers from schools in Mukono and Wakiso districts in Uganda using a general nutrition knowledge questionnaire (GNKQ) earlier developed. Cronbach alpha (α) was used to determine internal consistency. Pearson's correlation coefficient (r) and intraclass correlation coefficient were used to measure test-retest dependability on scores ($ICC_{2,1}$).
Overall internal consistency on 94 items was α = 0.89 at time one and 0.92 at time two. All items yielded data with a satisfactory internal consistency (α > 0.7). Two domains, Expert advice (ICC = 0.64) and Selecting food (ICC = 0.41), were determined to have insufficient test-retest reliability (r < 0.7 and ICC = 0.7), and their items were removed from the next analyses. The remaining nutrition knowledge topics with adequate test-retest reliability were food groupings (ICC = 0.9), nutrition and sickness (ICC = 0.91), and food fortification (ICC = 0.95). According to the findings, the prototype nutrition knowledge questionnaire had acceptable internal consistency and test-retest reliability.
These findings indicate that the previously established questionnaire can be used to assess general nutrition knowledge among head teachers. To boost generalizability, future studies could use the questionnaire on a different group of adults.

Keywords: Reliability; nutrition knowledge; head teachers; school feeding.

1. INTRODUCTION

In a previous study [1], 60 items from the GNKQ produced results that were unreliable. These findings were attributable to several population groups selected for the study. The study enlisted students and principals, which may have resulted in a greater diversity of demographic features. Differences in dietary knowledge are connected with demographic variables such as education and age [2,3], lowering dependability. Because of the diversity of demographic variables, differences in nutrition knowledge enhance variability in responses and thereby influence reliability [4].

The objective of the present study was: 1) to continue with the validation process of the GNKQ by determining the internal consistency and test-retest reliability on a larger sample of head teachers; and 2) gather baseline data on the nutrition knowledge of school head teachers in the Mukono and Wakiso Districts.

The results are important because, for the first time, the nutritional knowledge of head teacherss or another population in Uganda has been captured using psychometric measurements. The rationale for the present study was that, it was then able to examine the nutrition knowledge of head teachers and its impact on school nutrition and the implementation of nutrition interventions. The head yeachers implement various school food intervention programs. However, the nutrition knowledge of school head teachers and the community is still unknown. Therefore, this study provides basic data on the nutrition knowledge of head teachers in the Mukono and Wakiso districts of Uganda.

2. METHODS

2.1 Population and Sample Size Calculation

For this study, 255 head teachers from the Mukono and Wakiso districts were selected at random. The sample size was calculated with G-power power software (Germany) and a sample calculation algorithm [5]. The World Bank study [6] used found that 40% of students attend school without meals and 60% attend school with meals. The sample size was calculated using a 5% error, a power of 85%, and an allocation ratio of one. The District Education Officers (DEOs) of Mukono and Wakiso Districts provided the school lists.

2.2 Subjects

The contact information of the head teachers corresponding to the selected schools was obtained from the respective District Education Offices (DEO) of Mukono and Wakiso. After being informed of the study's purpose and the possibility of participating, the head teachers were asked to provide oral consent. The characteristics of schools and head teachers are reported in Table 1.

2.3 Instrument

The general nutrition knowledge questionnaire (GNKQ) was reviewed and modified based on pervious study [1]. The GNKQ consisted of five domains (137 items) that is: *Expert recom-mendations* (16 items), *Food groups* (67 items), *Selecting food* (10 items), the *Relationship between nutrition and disease* (22 items), and *Food fortification* (22 items).

Table 1. Characteristics of the selected schools and head teachers

Characteristic of head teacher	*n*	%
Gender (N=255)		
Male	138	54.1
Female	117	45.9
Age (N=255)		
18–24	4	1.6
25–34	48	18.8
35–44	83	32.5
45–54	93	36.5
55–64	25	9.8
65–74	2	0.8
Education (N=255)		
Primary	6	2.4
Ordinary Secondary school	11	2.0
High School (A' level)	3	1.2
Technical college	36	14.1
Diploma	113	44.3
Degree	82	32.2
Post graduate degree	10	3.9
Number of children (N = 255)		
None	17	6.7
1	15	5.9
2	36	14.1
3	47	18.4
4	58	22.7
≥5	82	32.2
Ownership status and location of schools		
Government	117	53.7
Private	101	46.3
Rural	100	45.9
Urban	118	54.1
Availability of SFP		
Yes	155	71.1
No	63	28.9

Table 2. Internal consistency and test-retest reliability of nutrition knowledge domains before and after removal of items based on item-difficulty and item-discrimination

Topic on General Nutrition (items before, after)	Internal reliability (α)				Test-retest reliability (*r*)	
	Before		After		[1]Before	[2]After
	Time 1 N= 255	*Time 2 N= 227*	*Time 1 N =255*	*Time 2 N= 227*	*N = 136*	*N = 136*
Expert recommendations (16,10)	0.65	0.68	0.70	0.75	0.67	0.65
Food groups (67, 45)	0.81	0.86	0.86	0.89	0.90	0.90
Selecting food (10, 2)	0.19	0.34	0.80	0.83	0.72	0.42
Relationship between nutrition and disease (22, 15)	0.61	0.66	0.70	0.73	0.83	0.91
Food fortification (22, 22)	0.86	0.87	0.86	0.87	0.95	0.95
Total (137, 94)	0.87	0.91	0.89	0.92	0.96	0.97

[1]Before removing items with poor item difficulty and discrimination from analysis. [2]After removing items with poor item difficulty and discrimination from analysis. ONLY 136 head teachers who filled the questionnaire at exactly the second week (time two) are included

Table 3. Test-retest reliability of nutrition knowledge scores and measures

Topic (Max score)	Time one Mean (SE)	Time two Mean (SE)	Mean diff (SE)	*t* (*p*-value) df =135	ICC $_{2,1}$	ICC 95% interval
			***N* =136**			
Expert recommendations (10)	8.4 (0.16)	8.5 (0.15)	-0.1 (0.13)	-1.0 (0.32)	0.64	0.53 - 0.73
Food groups (45)	33.1 (0.59)	32.9 (0.61)	0.2 (0.27)	0.6 (0.55)	0.90	0.86 - 0.93
Selecting foods (2)	0.9 (0.08)	0.7 (0.08)	0.2 (0.08)	1.9 (0.06)	0.41	0.26 - 0.54
Relationship of nutrition and disease (15)	7.9 (0.22)	8.1 (0.23)	-0.2 (0.09)	-1.9 (0.06)	0.91	0.87 - 0.93
Food fortification (22)	7.1 (0.47)	7.2 (0.45)	-0.1 (0.15)	-0.6 (0.55)	0.95	0.93 - 0.96
Total (94)	**57.4 (1.02)**	**57.5 (1.03)**	**-0.1 (0.25)**	**-0.3 (0.77)**	**0.97**	**0.96 - 0.98**

*Intraclass correlation coefficient (ICC), using a two-way random model with an absolute agreement type, single measure), with 95% confidence interval (CI). Standard error (SE). *P < 0.05 for the mean differences*

2.4 Data Analysis

All data were entered in the Statistical Package for Social Sciences. The GNKQ consisted of the same five domains on nutrition knowledge and 137 items (Table 2), which represented the maximum score.

2.5 Human Subject Research Compliance

The Institutional Review Board at the University of Illinois (IRB#15469) and the Uganda National Council for Science and Technology (No. SS 3700) approved all research protocols. District Education Offices of Mukono and Wakiso provided permissions to conduct studies. All subjects provided oral and written consent before participation.

3. RESULTS AND DISCUSSION

Table 1 shows the demographic characteristics of teachers and schools. The sample had more male head teachers (54%) than female head teachers (46%). Many head teachers had a diploma (44%) and a degree (32%). Most of the head teachers were adults between the ages of 35 and 55. About 29% of the schools where the principal worked did not have a school feeding program.

3.1 Reliability of Items in the General Nutrition Knowledge Questionnaire

3.1.1 Internal consistency

At time one and two, the overall scale (GNKQ) had satisfactory internal consistency (α = 0.87 and 0.91 respectively) before eliminating items with unacceptable items-difficulty and discrimination (Table 2). For both time points, the internal consistency (α) for expert recommendations (α = 0.65, 0.68), diet choices (α = 0.19, 0.34), and the link between nutrition and disease (α = 0.61, 0.66) was less than 0.7. The total number of items was decreased to 94 after deleting items with defenseless things and segregation difficulties, and the internal consistency of the entire instrument was α = 0.89 and 0.92 at time one and two, respectively. Expert suggestion (10 items, α = 0.7 and 0.75), selecting foods (2 items, α = 0.8 and 0.83), and the relationship between nutrition and disease (15 items, α = 0.7 and 0.73) were the domains with a α > 0.7 at time one and two, respectively. At time one and two, before and after removing items with unacceptable item-difficulty and discrimination, food categories and fortification had satisfactory internal consistency (α > 0.7).

3.1.2 Test-retest reliability

The overall test-retest reliability using correlation coefficient, r of the GNKQ earlier than and after getting rid of items with unacceptable item difficulty and discrimination become 0.96 and 0.97 respectively (Table 2). Before and after getting rid of items with unacceptable difficulty and discrimination, the test-retest reliability, r for scores of expert recommendations (r = 0.67 and 0.65) were below 0.7. After disposing of items primarily based on item difficulty and discrimination, the final, r on scores for selecting food (r = 0.42) was below 0.7. All other domain had acceptable, r before and after removal of items based on item difficulty and discrimination.

The intraclass correlation coefficient for every domain become received the usage of simplest the rankings generated from gadgets with desirable item-issue and discrimination (Table 3). The general icc for the overall rating among time one and two changed into 0. Ninety seven. Ratings on expert recommendations (0. 64) and selecting meals (0. Forty one) had iccs under zero. 7. Different nutrients understanding domain names had iccs above zero. 7. The suggest distinction of the full rankings between time 1 and a pair of become now not unique from 0, t (135) = -zero. 30, p= zero. 77.

The overall test-retest reliability of the GNKQ using the correlation coefficient, r, before and after deleting items with unacceptable item difficulty and discrimination was 0.96 and 0.97, respectively, before and after removing items with unacceptable item difficulty and discrimination (Table 2). The test-retest reliability, r, for scores of Expert recommendations (r = 0.67 and 0.65) was below 0.7 before and after deleting questions with unacceptable difficulty and discrimination. The final r on scores for Selecting food (r = 0.42) were below 0.7 after deleting items based on item difficulty and discrimination. Before and after the elimination of items based on item difficulty and discrimination, all other domains had acceptable, r. Only scores generated from items with appropriate item-difficulty and discrimination were used to calculate the intraclass correlation coefficient for each domain (Table 3). The combined score between times one and two had an ICC of 0.97. Expert recommendations (0.64) and food selection (0.41) both had ICCs < 0.7. The ICCs for other dietary knowledge domains were greater than 0.7. The mean difference in total scores between time 1 and 2 was not different from zero, t (135) = -0.30, P= 0.77.

3.2 Association of Nutrition Knowledge Scores and Head Teacher Characteristics

Male head teachers scored higher than their female counterparts, although not statistically different ($P > 0.05$) (Table 4). There were no significant differences in the nutrition knowledge scores among head teachers of different age groups. Head teachers with at least a degree had higher nutrition knowledge scores than those without degrees; however not reaching significance. The mean scores among the head teachers with different number of children were not significantly different ($P > 0.05$).

3.3 Association of Nutrition Knowledge Scores and School Characteristics

Availability of school feeding. There was no significant difference in the scores of head teachers from schools with and without a school feeding program (P > 0.05) (Table 5).

Ownership of the school. Government school head teachers outperformed private school head teachers in several areas, including *total score (t (203) = -2.1, P = 0.03), food groups (t (203) = -2.5, P = 0.01), and the relationship between nutrition and disease (t (203) = -2.6, P = 0.01).* The effect sizes of the mean score differences were Food groups (0.4), Relationship of nutrition and disease (0.4), and Total score (0.3).

Location of the school. There were no differences ($P > 0.05$) in the knowledge scores between head teachers from rural and urban schools.

Table 4. Association of nutrition knowledge scores and head teachers' characteristics

		Food groups (Max score =45)	Relationship of nutrition and disease (Max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Gender					
Male (*n* =138)	Mean (SE)	33.0 (0.62)	7.4 (0.24)	7.9 (0.43)	48.3 (0.96)
Female (*n* =117)	Mean (SE)	32.0 (0.69)	7.9 (0.24)	6.9 (0.48)	46.9 (1.04)
t (df =253)		1.0	-1.3	1.5	1.0
Effect size (*d*)		0.1	0.2	0.2	0.1
Age					
18-34 (*n* =52)	Mean (SE)	32.8 (1.10)	7.1 (0.37)	8.2 (0.72)	48.1 (1.65)
35-54 (*n* =176)	Mean (SE)	32.8 (0.55)	7.8 (0.20)	7.4 (0.38)	48.1 (0.84)
Above 54 (*n* =27)	Mean (SE)	30.1 (1.25)	7.5 (0.61)	6.2 (1.07)	43.8 (2.06)
F (2,252)		1.59	1.59	1.35	1.74
Effect size (η_p^2)		0.01	0.01	0.01	0.01

		Food groups (Max score =45)	Relationship of nutrition and disease (Max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Highest attained education level					
No degree (*n* = 163)	Mean (SE)	32.2 (0.63)	7.5 (0.21)	7.7 (0.40)	47.4 (0.93)
With degree (*n* =92)	Mean (SE)	33.2 (0.63)	7.9 (0.28)	7.1 (0.54)	48.1 (1.07)
t (df =253)		-1.1	-0.9	0.87	-0.5
Effect size (*d*)		0.1	0.1	0.1	0.1
Number of children					
None (*n* =17)	Mean (SE)	30.9 (2.36)	7.3 (0.72)	7.6 (1.41)	45.9 (3.77)
1 (*n* =15)	Mean (SE)	31.9 (1.74)	8.0 (0.52)	8.6 (1.38)	48.5 (2.42)
2 (*n* =36)	Mean (SE)	33.5 (1.13)	7.3 (0.41)	7.3 (0.87)	48.1 (1.69)
3 (*n* = 47)	Mean (SE)	34.1 (0.91)	7.9 (0.40)	7.4 (0.78)	49.3 (1.47)
4 (*n* =58)	Mean (SE)	31.8 (1.00)	7.4 (0.36)	7.1 (0.63)	46.3 (1.46)
More than 4 (*n* = 82)	Mean (SE)	32.2 (0.84)	7.8 (0.31)	7.6 (0.56)	47.6 (1.31)
F (5, 249)		0.9	0.4	0.2	0.5
Effect size (η_p^2)		0.0	0.0	0.0	0.0
Do you children below 18 years?					
Yes (*n* =194)	Mean (SE)	33.0 (0.50)	7.8 (0.18)	7.4 (0.37)	48.2 (0.77)
No (*n* =59)	Mean (SE)	31.0 (1.12)	7.0 (0.40)	7.6 (0.65)	45.6 (1.67)
t (df=251)		1.9	2.0*	-0.3	1.553
Effect size (*d*)		0.3	0.3	0.1	0.2

**P < 0.05, **P < 0.01, ***P < 0.001.*

Table 5. Association of nutrition knowledge scores and school characteristics

		Food groups (Max score =45)	Relationship of nutrition and disease (Max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Availability of the school feeding					
No SFP (*n* =57)	Mean (SE)	34.1 (0.76)	8.3 (0.39)	7.9 (0.66)	50.3 (1.34)
SFP (*n* = 148)	Mean (SE)	33.3 (0.58)	8.0 (0.21)	8.4 (0.44)	49.7 (0.94)
t (df =203)		0.7	0.7	-0.6	0.3
Effect size (*d*)		0.1	0.1	0.1	0.1
Ownership of the school					
Private (*n* = 96)	Mean (SE)	32.3 (0.78)	7.6 (0.26)	8.3 (0.54)	48.2 (1.18)
Government (*n* =109)	Mean (SE)	34.7 (0.54)	8.5 (0.25)	8.2 (0.51)	51.4 (1.00)
t (df =203)		-2.5*	-2.6*	0.1	-2.1*
Effect size (*d*)		0.4	0.4	0.0	0.3
Location of the school					
Urban (*n* =112)	Mean (SE)	34.1 (0.62)	8.0 (0.24)	8.4 (0.51)	50.4 (1.05)
Rural (*n* = 93)	Mean (SE)	32.9 (0.72)	8.2 (0.29)	8.0 (0.52)	49.2 (1.14)
t (df =203)		1.2	-0.8	0.6	0.8
Effect size (*d*)		0.2	0.1	0.1	0.1

**P < 0.05, **P < 0.01, ***P < 0.001. School feeding program (SFP). Uganda Bureau of Statistics [7] defines an urban area as gazetted cities, municipalities, and towns with a population of 2,000 people or more [8]*

3.4 Association of Nutrition Knowledge Scores and Sources of Information

3.4.1 Internet

On the total nutrition knowledge score, head teachers who used the internet as a source of nutrition information scored higher than those who did not (*t* (239) = 2.2, *P* = 0.03) (Table 6). *Relationship of nutrition and disease* (*t* (239) = 2.6, *P* = 0.01) and *Food fortification* (t (239) = 2.2, *P* = 0.03) were two nutrition knowledge domains that changed with internet use.

3.4.2 Schools

Nutritional data was gathered from schools where head teachers had previously attended at various stages of their schooling. Total score (*t* (247) = 3.0, *P* = 0.001) showed that schools (i.e., past primary, secondary, or university classes) were a significant source of nutrition information for head teachers (Table 6).

3.4.3 Peers and friends

Head teachers who sought nutrition information from peers and friends received higher scores in only the domain of *Relationship of nutrition and disease* (*t* (248) = 2.0, *P* = 0.05).

3.4.4 Health workers

All nutrition knowledge domains, *Food groups* (*t* (249) = 2.7, *P* = 0.01), *Relationship of nutrition and disease* (*t* (249) = 3.1, *P* = 0.002), and *Food fortification* (*t* (249) = 2.3, *P* = 0.02), and *Total score* (*t* (249) = 3.6, *P* < 0.001), were higher in the head teachers who referred to health service providers as a source of nutrition information.

3.4.5 Parents

Head teachers who referred to their parents as a source of nutrition information in the domain of *Food fortification* (*t* (246) = 2.1, *P* = 0.03) had higher nutrition scores.

3.4.6 Radio, television and margazines

Food groupings (*t* (248) = 2.6, *P* = 0.01), *Food fortification* (*t* (248) = 2.7, *P* = 0.01), and the Total score (*t* (248) = 3.3, *P* < 0.001) were higher in the knowledge items of the head teachers who used radio, television, and magazines to get nutrition information.

Table 6. Association of nutrition knowledge scores and sources of nutrition information

		Food groups (Max score =45)	**Relationship of nutrition and disease (max score =15)**	**Food fortification (Max score = 22)**	**Total (after test-retest) (Total score = 82)**
Internet					
Yes (*n* = 170)	Mean (SE)	32.9 (0.5)	7.9 (0.2)	7.8 (0.4)	48.6 (0.8)
No (*n* = 71)	Mean (SE)	31.9 (1.0)	6.9 (0.3)	6.2 (0.6)	45.0 (1.5)
t (df =239)		1.0	2.6*	2.2*	2.2*
Effect size (*d*)		0.1	0.4	0.3	0.3
Schools					
Yes (*n* = 210)	Mean (SE)	33.2 (0.46)	7.8 (0.19)	7.7 (0.35)	48.6 (0.73)
No (*n* =39)	Mean (SE)	30.0 (1.59)	6.9 (0.39)	5.8 (0.87)	42.8 (2.26)
t (df = 247)		2.5*	1.9	2.1*	3.0**
Effect size (*d*)		0.4	0.3	0.4	0.5
Peers and friends					
Yes (*n* = 170)	Mean (SE)	32.9 (0.51)	7.9 (0.20)	7.8 (0.38)	48.6 (0.79)
No (*n* = 80)	Mean (SE)	32.0 (0.96)	7.2 (0.32)	6.6 (0.59)	45.7 (1.48)
t (df = 248)		0.9	2.0*	1.8	1.9
Effect size (*d*)		0.1	0.3	0.2	0.2

		Food groups (Max score =45)	Relationship of nutrition and disease (max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Health workers					
Yes (*n* = 203)	Mean (SE)	33.2 (0.47)	7.9 (0.18)	7.8 (0.35)	48.8 (0.73)
No (*n* = 48)	Mean (SE)	30.0 (1.35)	6.6 (0.40)	5.9 (0.76)	42.5 (1.91)
t (df =249)		2.7**	3.1**	2.3*	3.6***
Effect size (*d*)		0.4	0.5	0.4	0.5
Parents					
Yes (*n* = 163)	Mean (SE)	32.2 (0.59)	7.9 (0.21)	7.9 (0.39)	48.0 (0.89)
No (*n* = 85)	Mean (SE)	33.3 (0.76)	7.2 (0.29)	6.4 (0.59)	47.0 (1.25)
t (df = 246)		-1.1	1.7	2.1*	0.6
Effect size (*d*)		0.1	0.2	0.3	0.1
Radio, television, and magazines					
Yes (*n* = 211)	Mean (SE)	33.1 (0.46)	7.8 (0.19)	7.8 (0.34)	48.7 (0.72)
No (*n* = 39)	Mean (SE)	29.9 (1.63)	6.9 (0.41)	5.4 (0.86)	42.2 (2.23)
t (df = 248)		2.6*	1.8	2.7**	3.3***
Effect size (*d*)		0.4	0.3	0.5	0.5

**P < 0.05, **P < 0.01, ***P < 0.001.*

3.5 Discussion

The objective of this study was to establish the revised GNKQ's internal consistency and test-retest reliability, as well as to gather information on basic nutrition knowledge among school principals. It's also the first study to look into the general nutrition knowledge of Uganda's head teachers, a group of powerful adults. The components of the questionnaire employed in this study had appropriate content and face validity to assess nutrition knowledge in this population, according to a previous study [1]. However, a handful of items across a variety of knowledge domains were shown to have unacceptable reliability. Several authors [2, 4, 9, 10, 11] have recommended evaluating nutrition knowledge instruments using larger sample before items and domains are removed. The earlier study [1] used a small sample size (n = 117) i.e. below 200 [12], and a larger sample size (n = 255) was used in the current study.

The internal and re-test reliability of school head teachers' nutrition knowledge using the 94 items of the GNKQ were acceptable (α > 0.7). These results showed a higher number of items with acceptable reliability compared to a previous study [1]. All knowledge areas had acceptable internal consistency, which differed from the pilot study [1]. Within the same population, it is also known that internal consistencies differ between samples [9]. The food groups domain had the highest results in internal consistency, 0.86 and 0.89 for times one and two, respectively. This could be attributed to the large number of items included in this area. In general, internal consistency can be changed by increasing the sample size, increasing the number of items in the questionnaire and revising the questionnaire to reduce ambiguous and difficult items, and having clear instructions to reduce the number of items. response burden [12,9]. Other factors influencing reliability: a long test like GNKQ gives better reliability; heterogeneous samples produce better reliability; objective tests obtain reliable scores; and misunderstanding the test instructions can lead to variations in test results, hence low reliability [13].

Because the results from items showed unsatisfactory test-retest reliability (r 0.7, ICC 0.7) after the test-retest reliability, a measure of the stability of results within a period, two domains (Expert recommendations and Selecting food) were omitted from the next study. Only questions with satisfactory reliability for subsequent investigations involving nutrition knowledge were used in previous studies on validation of nutrition knowledge questionnaires

[2, 14-16]. In this study, removing items from the analysis does not mean they are removed from the questionnaire. The characteristics that can affect test-retest reliability are comparable to those that can affect internal consistency, according to different studies [4, 9]. Test-retest reliability is influenced by the participants' response load and recall ability. The low dependability after two weeks in this study could be related to the fact that there were fewer items in both domains (i.e. expert advice (10 things) and meal selection (10 items) (2 items). With a small number of items, Pearson's correlation and intraclass correlation coefficients are reduced [4]. The number of items in these domains should be increased in future investigations (Expert recommendations and Selecting food). Most schools were preparing for end-of-year examinations by the end of October 2016. During this time, head teachers were involved in a lot of decision-making for numerous activities. The head teachers' severe workload may have hampered their recollection ability and raised their response burden. Because of these findings, future research involving head teachers will be required to avoid survey periods spanning two academic terms. Furthermore, low test-retest reliability in these two domains could be related to sample inherent variations [17]. The sample consisted of head teachers who used information from various sources. Individual (e.g., source of nutrition information) and school (private vs. public) characteristics had varying effects on nutrition knowledge, as will be explored later.

Future research should account for these variances and ensure that sample sizes are appropriate for each group. The lack of trust in the Expert recommendations' outcomes could be linked to the contradictory messages adults receive from the effective media and other sources of information, as well as the fact that Uganda lacks dietary guidelines. Furthermore, in Uganda, available health and nutrition regulations and guidelines have not been widely publicized [6]. The changes in the replies at time one and two may be explained by the high level of ambiguity that leads to guessing of answers, lowering the test-retest reliability. These findings highlight the importance of developing country-specific dietary guidelines as well as a clear and effective dissemination plan [18,19].

Demographic variables of head teachers, such as gender, age, educational achievement, and the number of children living with them at home, had minimal or minor, non-significant influence on knowledge scores. This was to be expected, given Ugandan head teachers are chosen from among all teachers in the system, who do not undergo specialist nutrition instruction. The total mean score (47.6 0.71) for all head teachers (n = 255) in this study was not significantly different from that of a smaller sample (n = 40) of head teachers (43.9 1.53 vs. 47.6 0.71; P > 0.05) in a previous study [1]. In a recent study [1] the nutrition knowledge score of head teachers was not significantly different (P > 0.05) from that of engineering students, although it was lower than that of Makerere University nutrition students. This meant that without specialist nutrition training, the scores of any other adult group in Uganda, including those pursuing Bachelor of Science degrees, would be similar. The current study's findings on the demographic features of head teachers differed from those reported in a study employing a comparable questionnaire in the United Kingdom [2]. When compared to the current study, the discrepancy could be attributable to the various samples and participant characteristics such as race, age, gender, and education. The majority of participants in the UK study were white (90.7%), between the ages of 18 and 35 (43.2%), female (74.3%), had at least a bachelor's degree (47%) and a considerable proportion had a nutrition certificate (31.5%). All of the participants in this study were black Africans, the majority of them were between the ages of 35 and 54 (69%), male (54.1%), had a diploma (44.3%), and none had a nutrition certification. The analysis of relationships between demographic variables and nutrition knowledge in the UK study utilized a higher sample size than the current study (n = 451 vs. n = 255 respectively). As a result, the current study may have been unable to achieve statistical significance due to its small sample size. However, none of those demographic variables were taken into account in this investigation.

In Uganda, the availability of school feeding programs (meals at schools) is determined by a number of factors, including parental and community support for school activities, the availability of school gardens, school-level requirements such as fuel (firewood, charcoal, etc.), the availability of facilities such as school kitchens, water, and serving facilities, and the availability of a functional and effective institutional framework for sustenance and functional and effective institutional framework for community mobilization and participation, as well as proper records management for trust, transparency, and accountability [6]. As a result, it was assumed that the presence of school feeding would have no bearing on knowledge scores. This is due to the fact that the focus of such programs is frequently on providing a cold or hot meal to children rather than supporting programming such as dental hygiene, food safety, nutrition education, or infrastructure (e.g., kitchens), human resource, and nutrition information.

The school's ownership status had a minor to moderately significant effect on nutrition knowledge scores. This observation was made regardless of the location of the school. In general, most government schools in Uganda have more resources than private schools [20]. More teachers, cooks, and health-care volunteers, as well as a supportive and well-defined organizational structure, a library, and other resources [20], could be among them. These materials may have played a role in the dramatically improved nutrition knowledge ratings.

The internet, previous schooling and coursework, health care professionals, and media (radio, television, and periodicals) all had a small to medium effect on nutrition knowledge scores. These sources are well-known for providing nutritional information [21, 22]. High nutrition knowledge is linked to the use of online platforms as information sources [23]. Radios were also useful for getting nutrition information [24]. In a sample of individuals from the Special Supplemental Nutrition Program for Women, Infants, and Children, using media and family members as sources of information was linked to having a high level of nutrition awareness (WIC) in the United States [25]. Nutritional knowledge was linked to previous maternal schooling in an Indonesian study [26]. Nutrition education is part of the Ministry of Health's organizational framework in Uganda [27]. As a result, it was envisaged that health-care providers would be used as a source of information.

The GNKQ's internal consistency and reliability have been proven, although the results are confined to the population under investigation (head teachers). This is because the study only included a group of head teachers, who may not represent the characteristics of other adult groups in Uganda. As a result, the questionnaire's external validity and generalizability may be compromised because it does not collect trustworthy nutrition knowledge data from different population groups. External validity and generalizability will benefit from future studies with a variety of adult populations.

The questionnaire created for the UK has been used in multiple surveys in other countries to collect nutrition knowledge from a variety of adult groups [2, 14, 15, 28], enhancing the external validity of the current study's findings. Another disadvantage of this study was that the sample sizes used to compute internal consistency at time one and two (n = 255 and 227) were fewer than the original version established for the United Kingdom (n = 391) [29]. Because of the decreased sample size, low internal consistency was obtained at time one, resulting in the removal of 43 items in subsequent analysis.

Also, it's possible that deleting items contributed to reduced test-retest reliability in the two domains of expert recommendations and food selection. Aside from food selection, the power analysis demonstrated that the sample sizes employed at time one and two (n = 255 and 227) were sufficient for internal consistency calculations. Future research should examine the items and employ a sample size (n) of not less than 391 in order to use the questionnaire without deleting any. Furthermore, the GNKQ, like the previous study [1] can be used to assess declarative rather than procedural nutrition knowledge. Future research could also look into identifying items to measure procedural knowledge in order to promote various recommended nutrition practices.

4. CONCLUSION

The findings of this study revealed that the GNKQ had knowledge domains and items that provided credible data on head teachers' general nutrition knowledge in Uganda. The test-retest reliability of items in the Expert recommendation and Selecting food domains was not acceptable. These domains and things can't be ignored because they contribute to the range of nutrition knowledge. The nutrition knowledge of head teachers was linked to characteristics of the head teachers and schools such as school ownership status and nutrition sources. The questionaire can be used without deleting any items to collect reliable nutrition knowledge data among head teachers in Uganda. The questionnaire should be administered to other population groups in Uganda to improve generalizability.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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