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Measurement of food literacy among the adult population in urban Uganda and Kenya: development and validation of an East African food literacy scale

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Abstract

Objective: Food literacy (FL) is a potential approach to address the nutrition transition in Africa, but a validated tool is lacking. We developed and validated a scale to assess FL among Ugandan and Kenyan adult populations.

Design: A mixed-method approach was applied: (1) item development using literature, expert and target group insights, (2) independent country-specific validation (content, construct, criterion and concurrent) and (3) synchronisation of the two country-specific FL-scales. Construct validity was evaluated against the prime dietary quality score (PDQS) and healthy eating self-efficacy scale (HEWSE).

Setting: Urban Uganda and Kenya.

Participants: Two cross-sectional cross-country surveys, adults >18 years (n = 214) and university students (n = 163), were conducted.

Results: The initial development yielded a forty-eight-item FL-scale draft. In total, twenty-six items were reframed to fit the country contexts. Six items differed content-wise across the two FL-scales and were dropped for a synchronised East African FL-scale. Weighted kappa tests revealed no deviations in individuals' FL when either the East African FL-scale or the country-specific FL-scales are used; 0·86 (95 % CI: 0·83, 0·89), Uganda and 0·86 (95 % CI: 0·84, 0·88), Kenya. The FL-scale showed good reliability (0·71 (95 % CI: 0·60, 0·79), Uganda; 0·78 (95 % CI: 0·69, 0·84), Kenya) and positively correlated with PDQS ($r = 0{\cdot}29$ $P = 0{\cdot}003$, Uganda; $r = 0{\cdot}26$ $P < 0{\cdot}001$, Kenya) and HEWSE ($r = 0{\cdot}32$ $P < 0{\cdot}001$, Uganda; $r = 0{\cdot}23$, $P = 0{\cdot}017$, Kenya). The FL-scale distinguishes populations with higher from those with lower FL ($\beta = 14{\cdot}54$ (95 % CI: 10·27, 18·81), Uganda; $\beta = 18{\cdot}79$ (95 % CI: 13·92, 23·68), Kenya).

Conclusion: Provided culture-sensitive translation and adaptation are done, the scale may be used as a basis across East Africa.

Keywords
Food literacy scale
Development
Validation
Adult population
Uganda
Kenya

Urban sub-Saharan Africa (SSA) is experiencing an epidemiological transition from infectious to non-communicable diseases, resulting in a double burden of disease[1]. Currently, non-communicable diseases account for almost half of all deaths and disabilities in low- and middle-income countries including SSA[1]. In urban SSA, the non-communicable diseases are projected to overtake infectious diseases by 2030[2–5]. Africa is the only region in the world with a projected increase in type 2 diabetes prevalence of more than 100 % (134 %) by 2045[6]. Over the last two decades, the prevalence of type 2 diabetes in Uganda and Kenya has, respectively, risen from 3 % to 5·6 % and from 4·3 % to 7·2 %[1]. The increasing non-communicable disease burden is attributed to the ongoing nutrition transition in urban SSA characterised by a shift towards energy-dense nutrient-poor diets. Dietary patterns

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observed among urban populations in SSA show poor alignment with the WHO dietary recommendations[7,8]. For example, it is estimated that 90 % of urban Ugandans and Kenyans do not achieve the daily recommended intake of 400 g of fruits and vegetables[7,8].

Our recent findings show that unhealthy dietary patterns in urban SSA are due to socio-cultural misconceptions, knowledge or skills gaps and low self-efficacy amidst a fast-changing food environment[9–11]. Detrimental socio-cultural misconceptions include the perception that vegetables are foods for the poor[9–11]. Recent evidence from high-income countries depicts food literacy (FL) as an easy-to-contextualise and effective approach to improve complex dietary behaviour determinants[12–15]. FL may enhance an individual's capacity to function within the prevailing environment. FL is defined as 'the interrelated combination of knowledge, skills and self-efficacy required to evaluate information about food, and plan, manage, select, prepare and eat foods with the ultimate goal of developing a lifelong healthy, sustainable and gastronomic relationship with food within a prevailing socio-economic, cultural, physical and virtual environment[16,17].' Hence, improving FL may be a potential strategy to improve dietary patterns in urban SSA.

Interventions that aim to improve FL require proper evaluation studies to assess their effectiveness and future reproducibility. However, there is a lack of tools to measure FL that are (1) validated (reasonably accurate and reliable) and (2) culture-specific[18]. Consequently, most nutrition interventions are evaluated based on their effects on specific behavioural determinants (e.g. attitudes or self-efficacy towards healthy eating) but not on people's overall capability to plan, manage, select, prepare and eat healthy foods[18]. Further, measuring FL requires instruments that are population- and culture-specific because FL is a complex, highly contextual and culture-dependent concept. As such FL scales need to be developed and validated in the appropriate context[16,17,19]. To the best of our knowledge, presently there are no tools that have been specifically developed and validated to measure FL in SSA. The lack of validated culture-specific assessment tools is a setback to both observational and intervention research applying FL[18]. For instance, it is of interest to identify individual, social or contextual factors that influence FL. Likewise, due to resource constraints, culturally adaptable tools are needed in SSA. Cross-cultural usage of tools necessitates tools that can be linguistically translated (language framing) and retain content validity at the conceptual level across the different cultures[20]. This study aimed to develop and validate a multidimensional food literacy scale (FL-scale) culturally adaptable to the adult population (18–69 years) in urban East African settings.

Methodology

Study design

Currently, there is no gold standard to validate FL-scales[21]. Therefore, a mixed approach consisting of three phases with ten underlying steps was used to develop and validate the new FL-scale (Fig. 1)[21].

In Phase 1, the FL-scale was developed through an iterative process involving literature review, consultation of experts (content validity) and insights from the target population (face validity). Phase 1 was conducted between April 2020 and March 2021.

In Phase 2, two sets of cross-sectional surveys were conducted to evaluate the newly developed FL scale. The first set of cross-sectional surveys was conducted to assess (1) the reliability and internal consistency of the FL-scale, (2) construct validity by comparing the developed FL-scale against healthy eating self-efficacy scale (HEWSE)[22] and the prime dietary quality score (PDQS)[23] and (3) criterion validity by exploring the association between developed FL-scale with fruit and vegetable consumption. FL may optimise one's healthy dietary behaviour; hence, we used dietary quality assessment scales (PDQS and HEWSE) to validate our FL scale. We considered fruit and vegetable consumption as 90 % of urban Ugandans and Kenyans do not meet the WHO recommendations. The second set of cross-sectional surveys was conducted to assess the concurrent validity.

In Phase 3, the two country-specific validated FL-scales were synchronised into one FL-scale to act as an FL-scale for urban Uganda and Kenyan settings, the East African FL-scale.

Phase 1: development of the food literacy-scale

Step 1: item development

The FL-scale items were generated by a team of five core academic experts in the domain of FL. In the first stage of the FL-scale development, one expert (PY) generated a comprehensive list of items relating to FL in Uganda and Kenya's context. To compile the list, initially, a search of the literature for existing questionnaires on FL and questionnaires covering the determinants of FL was conducted. In the second stage, the compiled list was shared with four academic experts (CM), (PO), (MM) and (FK) to provide feedback by (1) highlighting important and unclear items, (2) adding missing items and (3) deleting or merging double items or non-FL items. Based on the input of the experts, the items were critically revised to a final draft of the FL-scale.

Step 2: content and face validity

Content validation was conducted with experts and face validity with the target population[21,24].

Content validation. In Uganda, an independent expert panel (n=7) consisting of lecturers from the department of Human Nutrition of Kyambogo University was used, while in Kenya, a panel (n=7) selected from the Ministry of Health, the Kenya Nutritionists and Dieticians Institute, the Nutrition Association of Kenya, Kenyatta University and Kenyatta National Hospital validated the FL-scale for its

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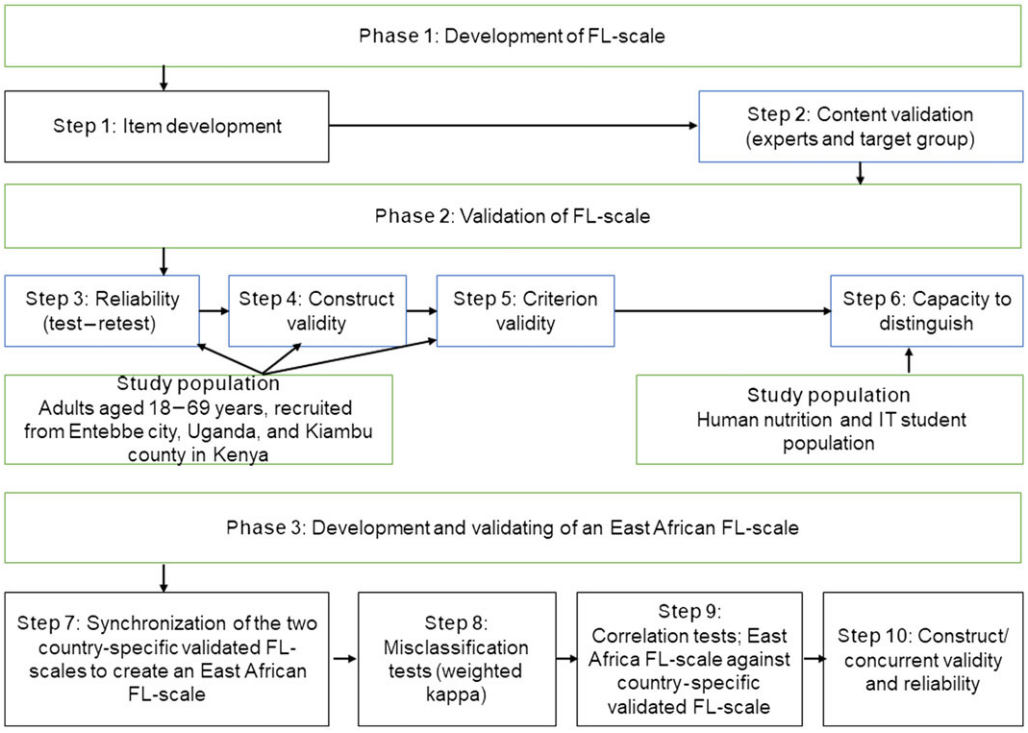

Fig. 1 Overview of the study design: the study consisted of three phases (boxes with green borders) and 10 steps in line with recent guidelines[21]. *Legend*: In Step 1, a team comprising FL experts (core expert panel) generated a universal FL-scale. To ensure cultural adaptability to urban Kenya and Ugandan settings, Steps 2–6 of this figure were executed independently in the two countries. In Steps 7–10, the two-country-specific FL-scales were synchronised into an East African FL-scale. Boxes with blue borders represent the steps that were conducted independently in each country, and boxes with black borders represent the steps which were executed universally.

content. Letters of invitation were sent to the experts soliciting their participation in the content validation. Consenting experts were emailed the FL-scale and asked to rate each question's relevance to the concept of FL on a four-point Likert scale: 1 (item not relevant) to 4 (item highly relevant), Additional file 1. The item content validation index (I-CVI) and Scale content validity index (S-CVI/Ave) were calculated from experts' responses to measure content validity[25,26]. I-CVI was computed as the proportion of experts rating an item at either 3 (quite relevant) or 4 (highly relevant), divided by the total number of experts. Scale content validity index/Ave was computed as the average I-CVI scores for all items on the scale judged by all experts[25]. The I-CVI and Scale content validity index should be at least 0·78 and 0·9, respectively, to qualify the questionnaire as content valid[26,27].

Face validity. Semi-structured cognitive interviews were conducted according to Patrick *et al.*[28] with Ugandan (n=10) and Kenyan adults (n=10) to assess the clarity and understandability of the FL-scale. In Uganda, participants were recruited in Entebbe City through the Full Gospel Church while in Kenya, the recruitment site was the Seventh Day Adventist Church Juja, Kiambu County. During the interviews (the tool was administered on paper in person), participants were encouraged to think aloud about the questions and explain how they interpreted the questions. At the end of the interviews, participants were asked to comment on: (1) aspects they thought were not in the questionnaire but would be relevant to include and (2) what they thought about the length of the questionnaire. All interviews were audio recorded, and qualitative analysis was performed according to the principles of Patrick *et al.*[28]. The number of participants who misinterpreted a question was counted for each question. Where necessary, the misinterpreted questions were revised according to the feedback of participants during the interviews.

Phase 2: validation of food literacy-scale

Study population

Two sets of study sample were recruited to validate the developed FL-scale. First, to assess reliability, construct and criterion validity, a sample of Ugandan (between April 2021 and May 2021) and Kenyan (November to December 2021) adults (18–69 years) were recruited through the institutional religious groups of Entebbe Full Gospel church in Entebbe city, Uganda and the Seventh Day Adventist Church Juja, Kiambu County, Kenya. The institutions were selected owing to their established social networks and community outreach across Entebbe and Kiambu. On church service days, the researchers presented the study and invited potential participants to take part in the study.

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According to Willett, a reasonable sample size for validation studies includes about 100–200 participants[29]. Second, to assess the concurrent validity, undergraduate Human Nutrition (final year) and IT (second year) students were recruited from Kyambogo University in Kampala, Uganda (April 2021) and Jomo Kenyatta University of Agriculture and Technology in Nairobi, Kenya (February 2022). To recruit the students, the researchers and heads of the respective departments made brief presentations about the study during the routine lectures. At the end of the presentations, interested students were invited to participate in the study.

Measures

Socio-demographic characteristics

Data on age, sex, occupation or employment status, marital status and education level were collected using a socio-demographic questionnaire.

Food literacy

A total FL score was calculated from the newly developed FL-scales based on the individual scores obtained for each question. Response options included a four-point Likert scale (1='strongly disagree/never' to 4='strongly agree/always'). Response options for questions on eating practicalities were based on the WHO recommendations[30]. Questions on nutrition knowledge and fruit and vegetable consumption were scored according to the WHO recommended daily allowance. We generated a scoring scheme where participants scores decreased as consumption deviated from the recommended daily allowance. The rest of the questions were evaluated based on a four-point Likert scale and were scored accordingly. Negative items received an inverse score, indicating that the higher the score, the higher the FL, Additional file 2. The FL score was obtained by summing up the scores of the individual questions and dividing the total obtained score by the maximum possible score. If a participant indicated that he/she was not employed, questions assessing FL practices in the work environment were excluded from calculating the total FL score. The total FL score was recalculated to a percentage score of 100, where a score of 0 suggests a low level of FL and a score of 100 suggests the highest level of FL.

Dietary quality

PDQS was taken as a proxy for dietary quality. PDQS was assessed using a validated PDQS-based diet quality screener[23]. The PDQS is a global rapid and cost-efficient food-based diet quality index developed to measure dietary quality at a global level. PDQS has been evaluated among US women against 24-h dietary recall Healthy Eating Index 2015, and energy nutrient intakes from the 24-h dietary recalls. The PDQS positively correlated with energy-adjusted nutrient intakes and Healthy Eating Index 2015. The granular scoring approach was applied to generate the PDQS[23]. In the granular scoring approach, healthy components are scored as 0 = once or less/month, 1 = 2–3 times/month, 2 = 1–2 times/week, 3 = 3–4 times/week, 4 = 5–6 times/week, 5 = once/day, 6 = 2 or more times/day and a reverse coding for the unhealthy components.

Healthy eating self-efficacy

Healthy eating self-efficacy was assessed using the seven-item healthy eating self-efficacy subscale of the HEWSE[22].

Validation steps

Step 3: reliability

To assess reliability, participants completed the FL-scales twice after a 2-week interval[21]. Intraclass correlation was conducted to ascertain the test–retest reliability. The cut-off for reliability was an intraclass correlation of 0·7[26]. Additionally, internal consistency was assessed by calculating Cronbach's alpha. A value of Cronbach's alpha above 0·7 was considered to be an indicator of adequate internal consistency, while a value below 0·4 indicated low internal consistency[26].

Step 4: construct validity

To evaluate the construct validity of the developed FL-scales, Pearson correlation coefficients (normal distribution of the scores) between PDQS and HEWSE and FL scores were calculated. Correlations were categorised as follows: 0·3 < 0·5 implying a small correlation; 0·5 < 0·7, a moderate correlation and 0·7–1·0 a large correlation[25,26].

Step 5: criterion validity

Linear regression analyses were conducted to determine whether the consumption of healthy foods (fruit and vegetables) is associated with FL scores. A model was built where FL scores were fitted as a continuous dependent variable while fruits and vegetable intake was the independent variable[15]. From a conceptual point of view, FL score would be the logical independent variable and fruits and vegetable intake the dependent variable in the analyses. However, we reverted the order to conduct linear regression analyses (with FL scores as a continuous dependent variable) to enable easier interpretation of the coefficients[15]. Poelman *et al.*[15] have applied a similar logical approach. The model was adjusted for potential FL confounders: age, marital status, sex and educational level[15]. Regression coefficients and 95 % CI were obtained.

Step 6: concurrent validity

Concurrent validity evaluates the capacity of the developed FL scale to distinguish between subgroups with an assumed higher or lower FL. We hypothesised that fourth- and third-year Human Nutrition students would, on average, have higher levels of FL compared with the general population (IT students). Linear regression analyses were conducted to

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determine the FL-scales' capacity to distinguish between high and low FL. A model was built in which the 'population' (Human Nutrition students *v.* IT students) were the independent variable, and the FL score was the dependent variable. The model was adjusted for age and sex. Regression coefficients and 95 % CI were obtained.

Phase 3: development and validation of an East African food literacy scale

Step 7: synchronisation of the two country-specific validated food literacy-scales to create an East African food literacy scale

The two FL-scales generated from the independent validation process from each country were compared to identify variations. Items only present in both FL-scales were maintained in the East African FL-scale. The items which were found to differ in content in the two FL-scales were dropped. Items that were different in framing (modified to fit the specific context) but elicited the same content were maintained in the East-African FL scale.

Step 8: misclassification tests

Using data collected in Phase 2, weighted kappa tests were carried out between the East-African FL-scale and the country-specific validated FL-scale to ascertain whether the synchronisation process could have resulted in the misclassification of individuals' FL levels. Strength of agreement was categorised as $\kappa < 0{\cdot}00$: poor; $\kappa = (0{\cdot}00–0{\cdot}20)$: slight; $\kappa = (0{\cdot}21–0{\cdot}40)$: fair; $\kappa = (0{\cdot}41–0{\cdot}60)$: moderate; $\kappa = (0{\cdot}61–0{\cdot}80)$: substantial; $\kappa = (0{\cdot}81–1{\cdot}00)$: almost perfect[31].

Step 9: correlation tests

Using data collected in Phase 2, Pearson correlation tests were carried out between the East African FL-scale and country-specific FL-scale for each country to ascertain whether the East African FL-scale and country-specific validated FL-scales were correlated.

Step 10: construct/concurrent validity and reliability of the East African food literacy scale

Using data collected in Phase 2, the construct validity of the East-African FL-scale was evaluated using Pearson correlation tests between PDQS and HEWSE and the East-African FL-scale scores. In addition, reliability and concurrent validity were calculated using the methodology described in Phase 2.

Results

Phase 1: development of the food literacy scale

Step 1: item development

Based on the literature search, the Self-Perceived Food Literacy Scale (SPFL) designed by Poelman *et al.*[15] was selected as a starting reference for generating the items for the new FL-scale. The SPFL scale has good reliability, internal consistency, high criterion validity and the capacity to distinguish populations with high FL compared with those with low FL. The SPFL scale was adapted to the Ugandan and Kenyan context by considering determinants of dietary behaviour in urban Uganda and Kenya[9–11]. Based on the determinants of dietary behaviour in urban Uganda and Kenya, the adapted items from SPFL were further supplemented with items from the FL framework (plan and management, select, prepare and eat) proposed by Vidgen *et al.*[16] and (information evaluation) Perry *et al.*[17]. The iterative process involving the literature review and the FL core expert panel feedback sessions yielded a draft FL-scale consisting of forty-eight questions, Additional file 3.

Step 2: content and face validation

Content validation. Although the content validity as measured by Scale content validity index was slightly lower than the recommended 0·90 (0·82 in Uganda and 0·84 in Kenya), the relevance of the FL-scale was considered acceptable to the concept of FL. In Uganda, twenty items on (1) selection (making a shopping list, storage and stocking), (2) preparation (hygiene and capabilities regarding the preparation of vegetables) and (3) eating practicalities (knowledge of recommendations for fruits and vegetables and consumption in potential food desert contexts) had an I-CVI below the recommended 0·78. Of the items which received an I-CVI < 0·78, questions only on 'hygiene' were removed from the scale. Items assessing the hygiene of fruit and vegetables prepared at home were rated less relevant as it may be difficult for people to confess that their home (cooking) environment is unhygienic. Other items were considered important by the core academic expert panel and were maintained in the FL-scale. Additionally, even though items probing consulted sources of information were considered relevant by nutrition experts, they were removed from the FL-scale as it would be difficult to evaluate the reliability of different sources. For instance, somebody's source of information may be friends or peers/family members who are nutritionists. In addition, mass or social media may be a source of information when either person discussing nutrition on mass or social media is not a nutritional expert (which is very common in Uganda) or an expert.

In Kenya, a total of sixteen items received an I-CVI < 0·78. Four items had an I-CVI < 0·70 and were eliminated: (i) ability to cook vegetables in at least three different ways, (ii) confidence in changing recipes to make them healthier, (iii) ability to choose relevant nutrition information and (iv) ability to judge whether healthy eating information shared on various platforms can be trusted. Drawing from the models of FL by Vidgen *et al.*,[16] and Perry *et al.*[17], the other items with an I-CVI < 0·78 were considered relevant by the expert panel and hence maintained in the FL-scale. The propositions that were

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suggested to reframe questions were considered because experts considered them essential for contextual fitness to the Kenyan setting.

Face validity. In Uganda, the content validity assessment with the target population revealed that our FL-scale was clear and well understood by the adult population and had a suitable length. However, some participants remarked that the item 'rate your confidence in changing recipes to make them healthier' was difficult to understand. The item was reframed as it was judged important by the expert FL panel. Additionally, the item on 'how often do you cook meals at home' was rephrased to 'how often do you cook/eat meals prepared at home' as the respondent may not be directly involved in food preparation, but they eat meals prepared at home. Content validation yielded a final draft of an FL-scale used in Uganda consisting of forty questions, Additional file 4.

Likewise, in Kenya, the target group rated the FL-scale as being clear. However, some participants noted that the questions on fruit and vegetable consumption with a nine-point Likert scale were confusing. As such, the nine-point Likert scale was reduced to a five-point Likert scale. Additionally, some participants noted that the numbering of some items (e.g. 38a, 38b, 38c) would imply that the respondent had the option of choosing one item on the scale. As result, the numbering of the entire FL-scale was reordered to be continuous, and each question was structured to be complete, without having to read part of the question separately. In total, after content validation, the FL-scale used in Kenya was composed of forty-one questions, Additional file 4.

Phase 2: validation

Socio-demographic characteristics

General adult population. A total of 105 participants in Uganda and 109 in Kenya took part in the reliability and construct validity of the FL-scale. The majority were women and had attained a higher institution qualification, Table 1.

Student population. In Uganda, a total of 109 students participated, of which fifty-four were human nutrition students while in Kenya fifty students took part in the study, of which twenty-five were studying Human Nutrition.

Step 3: reliability

In Uganda, average FL scores of 51·02 ± 10·52 and 51·78 ± 11·01 were, respectively, recorded for measurements 1 and 2. While in Kenya, FL scores of 55·18 ± 11·74 and 55·95 ± 13·13 were recorded. The intraclass correlation for test–retest showed good reliability of the Ugandan FL-scale ($\beta = 0{\cdot}70$ (95 % CI: 0·59, 0·79). The FL-scale also had good internal consistency (Cronbach's $\alpha = 0{\cdot}83$ (95 % CI: 0·75, 0·88). Equally, the Kenyan FL-scale also showed good reliability ($\beta = 0{\cdot}78$ (0·69, 0·84) and internal consistency (Cronbach's $\alpha = 0{\cdot}87$ (95 % CI: 0·82, 0·91), Table 2.

Step 4: construct validity

Regarding construct validity (Table 2), PDQS and FL were positively correlated to weak magnitude (Pearson correlation $r = 0{\cdot}28$, $P = 0{\cdot}004$ in Uganda and $r = 0{\cdot}24$, $P = 0{\cdot}012$ in Kenya). HEWSE and FL also showed weak positive correlations (Pearson correlation $r = 0{\cdot}35$, $P < 0{\cdot}001$ in Uganda and $r = 0{\cdot}21$, $P < 0{\cdot}031$ in Kenya).

Step 5: criterion validity

As theoretically predicted, a higher FL was associated with a higher frequency of fruit consumption (≥ 1 time/day, $P = 0{\cdot}023$, Table 3). Participants who reported consuming fruits every day had higher FL levels ($\beta = 5{\cdot}03$ (0·69, 9·37). However, no association was observed after adjustment for sex, education, age and marital status ($\beta = 3{\cdot}64$ (–0·52, 7·80). With regards to vegetable consumption, no association was observed ($\beta = 4{\cdot}27$ (–0·46, 8·99).

Step 6: capacity to distinguish

On average, the Human Nutrition students had a higher FL score compared with IT students, as shown in Table 2. In Uganda, the linear regression analysis showed statistically significant differences between the two student groups ($\beta = 15{\cdot}70$, SE = 2·151, 95 % CI = 19·97, 11·44, $P < 0{\cdot}001$) that remained statistically significant after adjustments for age and sex ($\beta = 15{\cdot}20$, SE = 2·796, 95 % CI = 20·75, 9·66). A similar observation was noted in Kenya ($\beta = 20{\cdot}61$, SE = 2·557, 95 % CI = 25·75, 15·47, $P < 0{\cdot}001$) and ($\beta = 19{\cdot}81$, SE = 3·008, 95 % CI = 25·87, 13·76) before and after adjustments.

Phase 3: synchronisation of the Kenyan and Ugandan food literacy scales into an integrated food literacy scale for East Africa

Step 7: creating an East African food literacy scale

Compared with the universally generated FL-scale (Additional file 3) in Step 1, a total of twenty-six items had been rephrased to fit the different country contexts, while ten items were unchanged.

Six items were present in the Ugandan FL-scale but had been excluded in the Kenyan FL-scale. These included items assessing (i) ability to cook vegetables in at least three different ways, (ii) confidence to change recipes to make them healthier, (iii) behaviour to pack fruits when going to work, (iv) behaviour to pack vegetables when going to work, (v) ability to screen relevant information from available information on healthy eating and (vi) ability to judge whether information on healthy eating that is available through various platforms can be trusted. Likewise, six items were present in the Kenyan FL-scale but had been dropped in the Ugandan version. These include items assessing (i) confidence about the hygiene of fruits eaten at home, (ii) behaviour of using nutritional information from friends, (iii) mass media, (iv) social media, (v) health workers who are not nutrition specialists and (vi) nutrition specialists.

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Table 1 Socio-demographic characteristics of participants

	Uganda				Kenya			
	General population (*n* 105)		Student population (*n* 109)		General population (*n* 109)		Student population (*n* 50)	
Characteristic	*n*	SD or %	*n*	SD or %	*n*	SD or %	*n*	SD or %
Age ± (SD)	38·15	13·22	22·94	2·79	40·41	11·46	22·34	1·29
Sex								
Female	62	59 %	57	51·8 %	55	50·5 %	23	46·0 %
Male	43	41 %	52	47·3 %	54	49·5 %	27	54·0 %
Education								
Non	8	7·6 %			2	1·3 %		
Completed primary level	12	11·4 %			2	1·3 %		
Completed lower secondary	22	21 %			51	46·8 %		
Completed upper secondary	19	18·1 %			0	0·0 %		
Completed/enrolled at a higher institution	44	41·9 %	109	100 %	54	49·5 %	50	100 %
Employment status								
Student	8	7·6 %	109	100 %	8	7·3 %	50	100 %
Not employed	15	14·3 %			21	19·4 %		
Employed	82	78·1 %			80	73·3 %		
Marital status								
Married	50	47·6	1	0·9 %	72	66·1 %	0	0·0 %
Single	55	52·4	108	99·1 %	37	33·8 %	50	100 %

Table 2 Reliability, construct validity and capacity to distinguish FL-scale

	Uganda					Kenya				
Test–retest reliability	FL score					FL score				
	Mean	SD	ICC	95 % CI	*P* value	Mean	SD	ICC	95 % CI	*P* value
Measurement 1	51·02	10·52	0·70	0·59, 0·79	<0·001	55·18	11·74	0·78	0·69, 0·84	<0·001
Measurement 2	51·78	11·01				55·95	13·13			
	Score					Score				
Construct validity	Mean	SD	Pearson correlation with FL		*P* value	Mean	SD	Pearson correlation with FL		*P* value
PDQS	45·49	6·30	0·28		0·004	59·97	10·62	0·24		0·012
HEWSE	68·38	14·73	0·35		<0·001	70·67	17·76	0·21		0·031
	FL score					FL score				
Capacity to distinguish	Mean	SD	Mean difference	95 % CI	*P* value	Mean	SD	Mean difference	95 % CI	*P* value
Human nutrition students	63·64	10·98	15·70	11·44, 19·96	0·003	69·00	9·05	20·61	15·47, 25·75	<0·001
IT students	47·94	11·46				48·39	9·04			

FL-score, food literacy score; ICC, intra class correlation; PDQS, prime dietary quality score; HEWSE, healthy eating and weight self-efficacy scale; IT, information technology. Test to retest reliability and concurrent validity (*n* 105, Uganda; *n* 109, Kenya). Concurrent validity (*n* 109, Uganda; *n* 50, Kenya).

In total, these twelve items, which were different across the two country-specific validated FL-scales, were dropped from either FL-scale to arrive at a synchronised East African FL-scale, composed of thirty-four items, Additional file 5. For comparability purposes, Steps 8–10 were executed based on the thirty-four-item scale. However, the core academic expert panel noted that five of the twelve items considered unimportant by the content validation experts were fundamental to the concept of FL. The items included (i) the ability to cook vegetables in at least three different ways, (ii) the behaviour to pack fruits when going to work, (iii) the behaviour to pack vegetables when going to work, (iv) the ability to screen relevant information from encountered information on healthy eating and (v) ability to judge whether healthy eating information shared on various platforms can be trusted. The core academic experts recommended extending the thirty-four items scale with the five items. As a result, the suggested East African scale is composed of thirty-nine items, Additional file 6.

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Table 3 Linear regression analyses for the associations between fruit and vegetable consumption (categorical variables) and FL-scale (continuous variable) for Ugandan adults

	Crude model			
Vegetable consumption (# times per day)	β	SE	95 % CI	*P* value
<1 time/day	(Ref)	(Ref)	(Ref)	(Ref)
>1 time/day	4·27	2·39	–0·46, 8·99	0·077
			Adjusted model	
<1 time/day	(Ref)	(Ref)	(Ref)	(Ref)
>1 time/day	3·36	2·35	–1·30, 8·02	0·156
Fruit consumption (# times/day)			Crude model	
<1 time/day	(Ref)	(Ref)	(Ref)	(Ref)
>1 time/day	5·03	2·19	0·69, 9·37	0·023
			Adjusted model	
<1 time/day	(Ref)	(Ref)	(Ref)	(Ref)
>1 time/day	3·64	2·09	–0·52, 7·80	0·086

FL, food literacy; PDQS, prime dietary quality score.
Vegetable and fruit consumption calculated from the PDQS 30-day food frequency screener.

Table 4 Construct validity, correlation and misclassification tests of the East African FL-scale as evaluated in a Ugandan and Kenyan population

	Uganda				Kenya			
	FL score				FL score			
Pearson correlation	Mean	SD	Pearson correlation	*P* value	Mean	SD	Pearson correlation	*P* value
Country specific FL-scale	51·02	10·52	0·98	<0·001	63·31	13·81	0·98	<0·001
East African FL-scale	52·03	10·25			61·11	13·65		
	Score				Score			
Construct validity	Mean	SD	Pearson correlation	*P* value	Mean	SD	Pearson correlation	*P* value
PDQS	45·49	6·30	0·29	0·003	59·97	10·62	0·26	<0·001
HEWSE	68·38	14·73	0·32	0·001	70·67	17·76	0·23	0·017
	Weighted kappa				Weighted kappa			
Misclassification tests	Mean		95 % CI	*P* value	Mean		95 % CI	*P* value
Weighted kappa	0·86		0·83, 0·89	0·000	0·86		0·84, 0·88	0·000

FL, food literacy; PDQS, prime dietary quality score; HEWSE, healthy eating self-efficacy scale.

Step 8: misclassification tests

Weighted Kappa tests revealed no deviations in individuals' FL levels when either the East African FL-scale or the country-specific validated FL-scales were used (0·86 (95 % CI: 0·83, 0·89) $P = 0·000$) in Uganda and (0·86 (95 % CI: 0·84, 0·88) $P = 0·000$) in Kenya, Table 4.

Step 9: correlation tests

Pearson correlational analyses revealed very strong correlations between the two country-validated FL-scales and the East African FL-scale (Table 4).

Step 10: construct validity of the East African food literacy scale

Regarding construct validity, Pearson correlational analyses revealed weak positive correlations between FL and PDQS, and HEWSE (Table 4). Likewise, the FL-scale showed good reliability (0·71 (95 % CI: 0·60, 0·79) $P < 0·001$, Uganda; 0·78 (95 % CI: 0·69, 0·84) $P < 0·001$, Kenya), internal consistency (0·83 (95 % CI: 0·75, 0·88) $P < 0·001$, Uganda; 0·88 (95 % CI: 0·82, 0·92) $P < 0·001$, Kenya) and capacity to distinguish populations depending on their FL levels ($\beta = 14·54$ (95 % CI: 10·27, 18·81), Uganda; $\beta = 18·79$ (95 % CI: 13·92, 23·68), Kenya).

Discussion

A thirty-nine-item East African (using Uganda and Kenya as case examples) FL-scale was developed to measure FL among the East African adult populations. The East African FL-scale covers the five major FL domains (plan/manage, select, prepare, eating practicalities and information

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evaluation)[16,17]. The East African FL-scale has been validated using both quantitative and qualitative approaches based on guidelines by Boateng *et al.*,[21]. The East African FL-scale was developed based on the globally recognised FL frameworks[16,17] and a validated SPFL scale by Poelman *et al.*[15]. Building on existing scales to develop scales for use in new contexts has been shown to result in scales with good psychometric properties provided cultural adaptation (language and culture of the new setting) guidelines are followed[32]. Beaton *et al.*[20] recommend a process that ensures semantic, idiomatic, experiential and conceptual equivalence between the source and target scales, and retesting of the psychometric properties especially where considerable differences exist across the two contexts. During the development of the current FL-scale, the determinants of dietary behaviours in urban Uganda and Kenya were considered[9–11]. For example, our qualitative inquiries showed lower consumption of fruits and vegetables largely due to cultural misconceptions, planning and preparation skills, food deserts at work environments and misinformation regarding healthy eating. Accordingly, the developed scale focussed mainly on FL themes relating to these determinants of fruit and vegetable consumption. Additionally, the FL-scale was content validated by local nutrition experts and the target population. Content validation of scales with the target group is especially important as it minimises unforeseen discrepancies between the intended meaning and participants' interpretation of the questions[28] and is a unique inclusion in our study. The two FL scales were shown to be well understood through evaluations of cognitive validity and it reasons that the East Africa FL scale would also be reasonably understood by the population.

The newly developed East African FL-scale is a product of independent validation in two countries: Kenya and Uganda. The independent validation in the two country settings is a unique approach and shows the importance of contextualising a tool. Even though tools may have identical content, it is important that the question framing is adapted to specific contexts. For example, our approach revealed the need to adapt the question framing even though the contexts of Kenya and Uganda are closely related.

The content validation with the experts recommended the removal of five items which are fundamental to the concept of FL[16,17]. Topical studies have reported a limited shared understanding of FL by nutritional experts across the globe[33,34]. This finding may indicate that FL as a concept is yet to be understood by nutritional experts in Uganda and Kenya. The finding further demonstrates that a Delphi consensus could be an additional approach to conduct expert content validation when designing scales on new domains like FL. In light of the increasingly complex determinants driving the nutrition transition in urban Africa[9–11], the core expert panel recommended maintaining the five items in the East African FL-scale. For example, the item 'how often do you pack fruits when going to work' is an important practicality amidst the increasing food deserts across urban East Africa. Likewise, the complexity of the virtual food environment requires the skills and self-efficacy to choose relevant nutrition information and evaluate the information for facts and non-facts.

The FL-scale showed a positive correlation with healthy eating assessed by the PDQS. However, like the findings of the two countries' specific validated FL-scales, the correlation was of a small magnitude, and this could be attributed to the use of PDQS. The PDQS is a new global diet quality index that is still under testing in low- and middle-income countries and may not yet be an optimal measure for dietary quality in SSA settings[23]. For example, according to the scoring scheme, it was difficult to assess whether to score 'matooke', a staple food in Uganda, positively or negatively. Such limitations could have resulted in the observed small correlations between both methods. Nevertheless, as there are no currently validated dietary quality assessment tools in East Africa, the PDQS is the closest quality assessment tool we could use.

Our FL scale emphasises the consumption of fruits and vegetables due to the consistently low consumption levels in urban SSA[7–9]. Capturing people's FL in terms of fruit and vegetable consumption is vital in urban SSA settings like Uganda and Kenya. Our FL-scale showed associations between FL and fruit and vegetable consumption, but no associations were observed after adjusting for socio-demographic factors, sex, age, education and marital status. Furthermore, the current FL-scale focuses on the individual level, but it may be important to ascertain how FL varies across the different socio-demographic levels, both at intra-individual (age, sex, education status) and external level (access to education, minimum wage, physical food environment). Understanding the contextual external factors that interfere with the potential of having a higher FL is vital for designing contextual-specific/personalised FL interventions.

Strengths and limitation

Our scale is comprehensive (covers all the five major FL domains), of an acceptable length and the first in SSA. To the best of our knowledge, our study is the first to develop and validate a scale to assess adult FL concerning healthy eating in urban SSA.

Apart from the scales' by Boedt *et al.*[19], Poelman *et al.*[15] and Thompson *et al.*,[35], all developed for high-income country settings, globally there is a lack of adult FL scales collectively covering the five FL domains[18]. The majority of the existing FL scales focus on specific sub-domains of FL, making their transferability to assessing FL as a whole challenge[18]. Comprehensive FL scales may have higher practical applicability. Even though we developed and validated a comprehensive FL-scale based on theory and expert views, we recognise that FL is a

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complex aspect which remains a challenging concept to measure[15–18]. Aside from individual FL domains, themes like cultural aspects, emotions, socio-economic status, food systems and related infrastructure arrangements at the community and national level may variably influence FL[15–18]. Without capturing all the FL-related themes, it may be difficult to ascertain people's FL.

The use of a mixed-method approach comprising experts, target groups, qualitative studies and globally recognised FL theoretical frameworks is a unique strength of our study and results in a FL scale which showed the ability to distinguish a population presumed to have high food literacy (final year Human Nutrition undergraduate students), from the general population.

Our study had some limitations. First, all our measures in the cross-sectional survey were self-reported. This may introduce reporting bias as participants express their ideas instead of the actual behaviour or induce a social desirability bias. Unfortunately, these limitations are common in the behavioural nutrition research domain. Secondly, our approach slightly deviated from the recommendations proposed by Boateng *et al.*[21] for developing scales. As we worked by contextualising the scale designed by Poelman *et al.*[15] and the globally recognised FL frameworks of Vidgen & Gallegos[16] and Perry *et al.*[17] to generate the items for the new tool, questions may arise on the validity of our approach. Generally, building on existing scales to develop scales for use in new contexts has been shown to result in valid scales, provided cultural adaptation guidelines are followed[32,36]. For example, Jomori *et al.*[32] contextualised a cooking skills and healthy scale from North America for use in Brazil. The scale showed a good validity in Brazilian context and has been successfully used for the evaluation of interventions in this context[37]. As seen above, our FL scale showed a good validity. In our view, the approach of contextualisation of evidence from other settings for use in new contexts has no methodological flaws, provided cultural adaptation guidelines are followed. Lastly, even though, our recruitment strategy was random, we observed that unintentionally, the majority of our sample had post-secondary education and were employed. Accordingly, this may limit the generalisability to the general population. Specifically, caution may need to be taken when using the scale among populations with education below post-secondary.

Implications for practice and research

The new East-African FL-scale is unique as it covers most of the essential attributes of individual FL and is a handy tool to give a clear perspective of an individual's FL. With the need for interventions to address the nutrition transition in urban SSA, attempts to improve FL could be a holistic strategy.

Our FL-scale can be used to assess FL in adults and as well to evaluate behaviour change lifestyle interventions aimed at increasing FL and fruit and vegetable consumption in urban Kenya and Uganda. Nevertheless, the ability of the scale to capture pre–post intervention changes still needs to be evaluated. Furthermore, there is still a need to explore/examine the specific domains of FL with outcomes to determine any drivers of specific behaviours or intake. The FL-scale can be used as basis in other East African and SSA settings when the cultural adaptation guidelines elaborated by Beaton *et al.*[20] are applied. When applying the FL-scale, it may be important to adjust for confounding factors like economic and socio-demographic factors. Adjustment for gender particularly may be important in SSA, as some of the FL practicalities, particularly within the 'preparation domain', are still largely charged with women. As well, there is a need to establish cut-off points for defining high *v* low FL to guide future intervention studies, evaluating interventions targeted at improving FL. Additionally, the performance of any validated scales may be compromised when as a result of changes in the population or context, errors in measurement or unforeseen variables affecting the outcomes[21].

Conclusion

The results of this study demonstrate the development and validation of a comprehensive FL-scale for the measurement of FL among adults living in Uganda and Kenya. The thirty-nine-item FL-scale is a valid, reliable and theory and expert-based scale covering the five major domains of FL. The FL-scale can be applied in a range of studies, particularly in research measuring FL. Provided culture-sensitive translation and adaptation are performed, the FL-scale can be used as a basis in other East African and SSA countries.

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Conflict of interest

None to declare.

Authorship

P.Y., C.M. and M.M. designed the study. P.Y., T.K., M.M. and F.K. conducted the study. P.Y., M.M. and C.M. analysed the data. P.Y. wrote the first draft of the manuscript, and C.M., M.M., A.K., F.K., T.B., P.O. and T.K. read, revised, improved and approved the final manuscript. Joint first co-authorship of Peter Yiga and Mokaya Moses.

Ethics of human subject participation

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Uganda National Council for Science and Technology (Registration number: HS1415ES) and the African Medical Research Foundation (Registration number: ESRC P972-2021). Written informed consent was obtained from all subjects.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S136898002400168X

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