

# A tool to assess underlying factors to water provision among Guinean children

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## Abstract

In many countries, water is provided to children under 6 months of age (CU6M) in addition to breast milk (BM), hence increasing the risk of child mortality and morbidity. Factors related to this practice have not been thoroughly investigated either a tool to assess them. Based on the extended theory of planned behaviour (eTPB), we aim to develop and validate a questionnaire to assess psychosocial and environmental factors that may contribute/limit the water provision in addition to BM by mothers of CU6M in the Republic of Guinea. A three-step process was used. Ten focus group discussions (FGDs) were held to identify salient beliefs related to each of the four constructs of the eTPB. Data from FGDs were used to develop a questionnaire composed of 88 items administered to 428 mothers. Exploratory factor analyses were conducted to identify latent factors for each construct. A shorter version of the questionnaire was administered to another sample of 300 mothers. Confirmatory factor analyses (CFAs) were performed. Hancock and Mueller's *H* reliability indices were computed on final models to assess the tool's validity and reliability. The final questionnaire included 57 items. For all four final models, most criteria for fit indices of CFA were generally met. Reliability coefficients were all equal to or above 0.90 for each construct. This research offers a tool that could be used to investigate determinants of water provision besides BM among mothers of CU6M. Further validation in other contexts is warranted.

## KEYWORDS

breastfeeding, children under 6 months, measurement tool, theory of planned behaviour, water

## 1 | INTRODUCTION

Exclusive breastfeeding (EBF) is a cornerstone of child survival and development. It also offers well-documented benefits for mothers and society (Keats et al., 2021; Victora et al., 2016).

Globally, there has been some progress towards EBF. The latest data show that EBF has increased from 35% in 2005 to 42% in 2018, indicating that the world is on track to achieve the 2025 nutrition target of 50% (UNICEF, 2019). However, the African region's pace needs to be accelerated to achieve the global target (WHO &

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UNICEF, 2014). The West and Central Africa region shows the lowest rates, with 34% of children under 6 months exclusively breastfed (UNICEF, 2019).

The provision of water is a common practice in West African countries, hence jeopardising EBF and putting infants at risk of malnutrition, illness and death (Smith & Becker, 2016; WHO, 2015; Williams, 2006). Giving water to a breastfed healthy baby before the age of 6 months has been proven as not necessary and should be discouraged, even when it is in a hot climate (Almroth & Bidinger, 1990; Ashraf et al., 1993; Cohen et al., 2000; Sachdev et al., 1991). The most recent data show that in Niger, Senegal and Mali, between 4 and 6 out of 10 breastfed children aged below 6 months were receiving water in addition to breast milk (Institut National de la Statistique du Mali & ICF, 2018; Institut National de la Statistique du Niger & ICF, 2013; Institut National de la Statistique du Sénégal & ICF, 2017). In the Republic of Guinea, 35% of breastfed children under 6 months receive water, and 33% are exclusively breastfed (Institut National de la Statistique de la Guinée/INSG & ICF, 2018).

A systematic review on barriers to EBF shows that individual, settings and structural factors can affect its practice (Kavle et al., 2017; Rollins et al., 2016). However, to our knowledge, no study has investigated in a comprehensive way individual and environment-related factors simultaneously (or in one unique study) to determine those impacting EBF, including the provision of water.

Various tools, mostly questionnaires, have been developed and used either in low- and middle- or high-income countries to investigate breastfeeding determinants. A systematic review of available instruments measuring breastfeeding attitudes, knowledge and social support was conducted by Casal et al. (2017), whereas Tuthill et al. (2016) have explored self-efficacy's measurements. Their results showed that although a few studies reported the use of a framework to guide the development of measurement tools when it was the case, the theory of planned behaviour (TPB) was the most common framework applied. Moreover, the authors concluded that there was no best measurement but provided recommendations for future research (Casal et al., 2017; Tuthill et al., 2016). First, identifying the purpose of the measurement should be clearly stated: Does one want to assess determinants of EBF, early initiation, any breastfeeding or some specific practice that may affect breastfeeding? Second, the use of a systematic approach that includes assessing content and construct validity and reliability is advised. If an existing tool is planned to be used in a different cultural context, all information about the tool's modifications, the methodology and psychometric results should also be reported. However, even though tools have been used to assess factors impacting breastfeeding, to our knowledge, none has been developed to identify individual and environmental factors to the provision of water among children aged under 6 months.

Given that one of the key challenges to EBF in African countries is the water provision among breastfed children, knowing which factors, either psychosocial, environmental or both, may jeopardise its practice, is crucial to design appropriate interventions that protect, promotion and support EBF. However, to do so, one needs to have a valid and reliable measurement tool to investigate these underlying

### Key messages

- Water provision, in addition to breast milk, is a common practice in West African countries and hampers exclusive breastfeeding.
- To increase the EBF rate, having a good knowledge of psychosocial and environmental factors related to water provision may help define and tailor social and behaviour change programmes to populations' needs.
- This research proposes a questionnaire that could be used to assess factors associated with water provision among mothers of children under 6 months of age.

factors. In addition, social and behavioural theory-based interventions would be valuable as it has been shown effective for successful breastfeeding behaviour change (Bai et al., 2019).

Based on the extended TPB (Godin, 1991), which integrates individual and environmental factors that may determine behaviour as they may both impact the provision of water in addition to breast milk, the objective of this study was to develop and to validate a new measurement tool that could be used to assess the psychosocial and environmental determinants of the water provision in addition to breast milk among mothers of children under 6 months of age (CU6M) living in two regions of the Republic of Guinea. To do so, specific indicators and criteria were used. This study is part of larger research aiming at defining, implementing and assessing an intervention to reduce the proportion of mothers who provide water to their child before 6 months.

## 2 | METHODS

### 2.1 | Study area

This study is part of larger research aiming at defining, implementing and assessing an intervention to reduce the proportion of mothers who provide water to their baby before 6 months. Conakry and Kindia regions were selected, given that breastfeeding's median duration among children was among the lowest in the country (INSG & ICF, 2018). Moreover, both regions contain 30% of Guinea's total population and encompass the bulk of urban households (Ministère du Plan et de la Coopération Internationale, 2015). No regional data were available on EBF practice.

### 2.2 | Design and sampling

The research has a quasi-experimental design. The health centres were used as units of sampling. For each region, a listing of all health centres with their population coverage was obtained. Then, from that

listing (29 in Conakry region and 16 in Kindia region), a minimum of 10 health centres were chosen randomly to obtain each desired samples size. In each health centre, all mothers of CU6M were invited to participate.

The study includes the three following samples (one for each of the steps required to develop, test and validate the measurement tool) (Figure S1):

- Sample 1: 120 mothers from 10 different health centres who were asked to participate in 10 focus group discussions (FGDs), findings of which were used to develop the tool.
- Sample 2: 428 mothers from 10 different health centres than Sample 1, selected for the first phase of the tool's validation process. The sample size was defined based on Comrey and Lee (1992) and Tabachnick and Fidell (2013), who recommend a minimum sample size of 300 to validate a measurement tool.
- Sample 3: 300 mothers from another 10 different health centres were selected for the second phase of the validation process.

For each sample, the inclusion criteria were the following: being a mother aged 20 years or older who gave birth vaginally to a unique child with a birth weight greater than 2.5 kg and was breastfeeding. Mothers of CU6M who had severe medical (e.g., mental health issues), obstetric complications (e.g., C-section), babies with severe medical conditions (e.g., HIV/AIDS) or congenital malformations, and those aged below 20 years were excluded. To check if the inclusion criteria were met, each mother's maternal and child health card was examined.

## 2.3 | Preparatory work

Local surveyors were recruited on the basis of the following criteria: having completed a university degree, be fluent in all the three local languages (Soussou, Maninka and Poular), available throughout the entire duration of the study, being motivated and having experience in nutritional or health surveys. Eight surveyors, including seven women, were recruited and trained on survey tools and methodology. The theoretical training was complemented by in-class and field practical exercises. During the training, the questionnaires were translated into the three main local languages spoken in both regions.

## 2.4 | Theoretical framework

The extended TPB (eTPB) (Ajzen, 1988; Ajzen & Fishbein, 1980; Godin, 1991) was used to guide the questionnaire's development (Figure S2) as it integrates an environmental component to the traditional individual constructs (attitude [ATT], subjective norm [SN] and the perceived behavioural control [PBC]) of the TPB. According to this model, the intention of an individual is the main predictor of behaviour. The intention is determined by (a) the ATT of the mother towards the behaviour, (b) the SN and (c) the PBC

(Ajzen, 1991). In turn, the ATT is determined by the mother's beliefs about the behaviour (behavioural beliefs or BB subconstruct) and the evaluation she makes about consequences (EC subconstruct) in adopting it or not (Ajzen, 1991) or by what we called 'subconstructs', which refer to individual beliefs about the outcome of performing a behaviour and the evaluation of those outcomes. SN is determined by the importance given by the mother to the opinion of people or groups of people around her (normative beliefs or NB subconstruct) and by her motivation to comply (MC subconstruct) with their opinion (Ajzen, 1991). Lastly, the PBC is the degree of control the mothers believe (control beliefs or CB subconstruct) can exercise over a given behaviour (his or her self-efficacy or perceived control over the behaviour or PC subconstruct). It is defined as the perception of the degree of ease or difficulty with which behaviour can be adopted (Ajzen & Madden, 1986). Moreover, PBC might also directly predict behaviour (Ajzen, 1991).

Environmental factors are external factors that can operationalise (or not) the adoption of the behaviour (Figure S2). They are social or physical characteristics that can influence the three constructs of the TPB (through moderation) as well as the transition from the intention to a concrete behaviour (Godin, 2012). They include but are not limited to health centres, family, workplaces, community, maternity and paternity leave policies, childcare benefits and health insurance, and sociodemographic characteristics.

## 2.5 | Questionnaire development and validation process

The questionnaire's development and validation process was based on Gagné and Godin's (1999) recommendations.

### 2.5.1 | Identification of salient beliefs and factors related to the environment through focus groups

FGDs were held in health centres of each region, and each FGD lasted about 60 min. A discussion guide was used to collect data on each of the construct of the theoretical model, namely: (a) perceived advantages and disadvantages associated with adopting the behaviour (the ATT construct), (b) individuals or groups of individuals who would approve or disapprove of the behaviour (SN), and (c) perceived barriers and factors facilitating the adoption of the behaviour (PBC) (Gagné & Godin, 1999). Information was also collected on mothers' environment that may or may not facilitate water provision. Each question was asked to the group first, but every mother was also invited systematically to respond individually.

FGDs were conducted either in French or in the local language by the first author of this paper, assisted by a surveyor who did the tape-recording. For each FGD, the first author (N.R.N.) conducted the transcription of the content in French. A qualitative analysis of all transcriptions was conducted manually afterwards by N. R. N. and S. B. to identify salient beliefs related to each of the three constructs

using the following approach: (a) familiarisation by the two authors with the content by reading each transcription several times, (b) organisation of all answers under each appropriate and aforementioned subconstruct, (c) sum of the number of occurrences for each similar response associated to each subconstruct, and (d) identification of themes emerging from all different answers and grouping of answers under each theme for each subconstruct followed by their interpretation (Krueger & Casey, 2009). Answers, which cannot be placed under a theme with an occurrence of 1, were not further considered in the analysis. N. R. N. and S. B. analysed the document's content separately and discussed their findings afterwards.

### 2.5.2 | Questionnaire design

A questionnaire was developed on the basis of all information that emerged from FGDs. This information was the primary source for the formulation of items for each construct to be assessed with the questionnaire. Still, it was supplemented with data from the determinants from the conceptual framework proposed by Rollins et al. (2016). Items to assess the intention of implementing the behaviour were also included as well as those to measure each construct directly (ATT: one item; social norm: three; and PBC: five) (Gagné & Godin, 1999; Montañó & Kasprzyk, 2008). The initial questionnaire included 88 items: 29 for ATT, 23 for SN, 19 for PBC and 17 for environmental factors. Five-level Likert scales were used to collect participants' responses to each questionnaire item (Gagné & Godin, 1999). To facilitate the record of answers among mothers with Likert scales, pictograms of angry/smiley faces were used (Akpaki et al., 2020).

### 2.5.3 | Questionnaire validation

The third stage of the questionnaire development was its validation. To this end, its content was reviewed by five nutrition experts from the Ministry of Health of the Republic of Guinea. After some minor modifications, the questionnaire was pretested with a sample of 10 mothers in the Conakry region's health centre to ensure clarity and consistency in items' wording. Subsequently, in November 2020, the first questionnaire was administered to Sample 2 during a face-to-face interview conducted by surveyors. First, the surveyor explained to each mother how to express each item's answer on the Likert scale. After that, the surveyor read each questionnaire item. Each mother was invited to indicate with her finger on the item or mark the selected answer on each scale with a pen. Using the same approach, the questionnaire was subsequently administered to Sample 3 in December 2020 by the same surveyors as Sample 2. For both samples, sociodemographic characteristics were collected using an adapted version of the Demographic and Health Survey questionnaire (Institut National de la Statistique de la Guinée & ICF, 2018).

## 2.6 | Data analysis

For each item of the questionnaire, a numeric value was assigned to each response on the Likert scale, ranging from a score of  $-2$  (e.g., *strongly disagree/unlikely/disapprove*) to a score of  $+2$  (e.g., *strongly agree/likely/approve*). Frequency distributions were performed to ensure data completeness and accuracy. Using data collected in Sample 2, a principal component analysis (PCA) was conducted on data related to each construct to reduce the number of items while still respecting the following assumptions for sampling adequacy: having a Kaiser–Meyer–Olkin (KMO) measure  $>0.7$  and ensuring that correlations between items were sufficiently significant (Bartlett's test  $<0.05$ ) (Field, 2009). Correlation matrices were examined, and items with more than 90% of bivariate correlations below 0.3 or above 0.9 were removed. For constructs on ATT, SN and the PBC, four items, one item and one item were respectively removed. No item was deleted for the environmental construct.

Thereafter, exploratory factor analyses (EFAs) were conducted on final models using an orthogonal rotation (varimax). All factors with eigenvalues above 1 were retained. For each factor, items having a value above 0.4 were interpreted (Stevens, 2002). Results were examined, and factors with fewer than four factors loading above 0.6 were eliminated (Guadagnoli & Velicer, 1988). Consequently, items that were not loading on the remaining factors (ATT: one item; SN: two items) were removed from the questionnaire.

To confirm the scale's structure, confirmatory factor analyses (CFAs) were performed on data collected on Sample 3 using the shorter version of the questionnaire (after the removal of the three aforementioned items, Table S1). For each construct, CFA was solely conducted on items loading on Factors 1 and 2, given that both explained over 65% of the variance. Moreover, items loading on Factor 1 were related to one of the subconstructs (BB, NB and CB), whereas Factor 2 included items loading on the other subconstructs (EC, MC and PC). Direct measurements of each construct were not included in CFA as they provided a general overview of each construct and were the outcome of subconstructs.

The data were entered into SPSS and then transferred to Mplus for CFA analysis. As the data were not continuous, the weighted least squares means and variances adjusted (WLSMV) estimator was used. The following five indicators and criteria were used to conclude the 'goodness of fit' of the final factorial models that were tested: (a) chi-squared statistic with a  $p$  value greater than 0.05, (b) comparative fit index (CFI) with a value above 0.95, (c) Tucker–Lewis index (TLI) with a value above 0.95, (d) root mean square error of approximation (RMSEA) and its 90% confidence interval (CI) below 0.08, and (e) standardised root mean square residual (SRMR) of 0.05 or below.

In each model, the Wald test was also conducted to assess if each item significantly contributed to the model fit. Hence, items with non-significant  $p$  values ( $\geq 0.05$ ) were removed from the subsequent analysis model (Gana & Broc, 2019). The Lagrange multiplier method, interpreted with modification indices in Mplus, was also used to modify the models. However, theoretical considerations and justifications were always used as the primary motivations for model

modifications (Byrne, 2011). For both tests, every modification was treated as a new model to test, resulting in relatively high numbers of models tested for each construct, even though some changes did not change the constructs' overall interpretation.

Hancock and Mueller's *H* reliability coefficient was estimated using the items' standardised factor loading to evaluate all final models' construct fidelity. An *H* value above 0.08 was considered satisfactory (Hancock & Mueller, 2001).

Frequency distributions were performed on answers for each item and both samples. Chi-squared tests were conducted to assess the difference in sociodemographic characteristics between the two samples. A *p* value below 0.05 indicated significant differences between proportions.

## 2.7 | Ethical considerations

The study was approved by the *Comité d'éthique de la recherche avec des êtres humains* of the Université de Moncton (Moncton, New Brunswick, Canada, No. 1920-073) as well as the *Comité d'éthique* of the *Ministère de la santé* of the Republic of Guinea (No. 132/CNERS/20).

For each mother, verbal and written informed consent was obtained. Their participation in the study was voluntary, and they can withdraw at any time without negative consequences or prejudice and without having to justify their decision.

## 3 | RESULTS

### 3.1 | Populations' characteristics

In total, 120 mothers (Sample 1) participated in FGDs. Characteristics of Samples 2 and 3 are presented in Table S2. There were significant differences in proportions between the two samples concerning mothers' age ( $p < 0.05$ ), level of education ( $p < 0.001$ ) and occupation ( $p < 0.001$ ).

### 3.2 | Exploratory factor analysis

KMO values for PCA were respectively 0.898, 0.893, 0.801 and 0.901 for ATT (25 items), SN (22 items), PCB (18 items) and environmental factors (17 items), which are well above the acceptable limit of 0.8 considered as significant (Field, 2009); *p* values of Bartlett's test of sphericity  $\chi^2$  were also all below 0.05, which indicated that correlations between items were sufficiently significant (results not shown).

Results of EFA for each construct are shown in Table 1. For the ATT construct, four factors had eigenvalues over Kaiser's criterion of 1, and the combination explained 60.31% of the variance. In contrast, for the SN, PCB and environmental constructs, five, five and three factors respectively had eigenvalues above 1, and these components

were explaining respectively 68.08%, 65.23% and 68.13% of their respective variance. For each construct, two factors were explaining more than 65% of the variance.

For the ATT construct, 12 items had a factor loading coefficient above 0.4 for Factor 1, and besides two items, all coefficients were above 0.6. These items were related to the prevention of health conditions if the mother decides not to provide water in addition to breast milk to CU6M. On the other hand, the nine items loading on Factor 2 (with a coefficient above 0.4 and eight of them above 0.6) were all related to the importance for the mother to avoid health problems for her child. The four items loading on Factor 3 were associated with the potential negative consequences of providing water to children.

For the SN construct, 13 items had a loading coefficient above 0.4 for Factor 1 (seven above 0.6). They were related to the mother perception about the approval/disapproval of several persons (mainly her husband, mother-in-law, spouse's grandmother and her grandmother) in her immediate surroundings to provide water to her child in addition to breast milk. Nine items were loading on Factor 2, and they were related to the mother acting according to the expectations of individuals around her perceived to be important.

For the PBC construct, Factors 1 and 2, had respectively five and four loading items (with all factor loading coefficient above 0.6 but 1). Five items loaded on Factor 3 and they refer to the limited access to information on the advantages of EBF or dangers of giving water to their children.

As for the environment-related factors, seven items were loading on Factor 1. They were related to the fact that accessing counselling and group sessions on EBF could prevent mothers from giving water in addition to breast milk. The seven items loading on Factor 2 were related to conditions that facilitate the provision of water to the child, whereas the four items loading on Factor 3 were related to breastfeeding support. Except for one item, all factor loading coefficients were above 0.6.

The first CFA for each construct included all items that were at first loading on the two main factors of the EFA, therefore excluding Items 9, 10, 11 and 13 (Table 1). For the ATT construct, seven models were tested. The fit indices for the first model, Model 0, comprised 19 items, were unmet (Table 2). Model 1 was run in which a correlation between the errors of Item 8 ('Giving water to my CU6M ... allows him/her to get used to the water') and Item 7 ('Milk of some colours causes tingling of the tongue and/or diarrhoea, so water should be given ... to CU6M') was added. The model fit indices improved but remained unmet. Models 2 and 3 were subsequently run, and for each of them, a correlation between the errors of two items was added: (a) Model 2: Item 22 ('For you, preventing your CU6M from reacting abnormally to the introduction of water is ...') with Item 21 ('For you, preventing your CU6M from having tingling of the tongue and/or diarrhoea ...') and (b) Model 3: Item 6 ('CU6M must be given water ... or their throat will become dry') with Item 5 ('CU6M should be given water ... to avoid fatigue due to thirst'). After Model 3, the CFI criterion

**TABLE 1** Results of exploratory factor analysis for items of each construct of the questionnaire (N = 428)

Constructs and items	Rotated factor loadings				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
<b>Attitude</b>					
1. Giving water to children under 6 months of age (CU6M) in addition to breast milk (BM) is good for their growth	0.810	-0.165	0.052	-0.003	-
2. Giving water to the CU6M ... is necessary because BM is the food and water is the drink	0.791	-0.152	0.120	0.066	-
3. Giving water to CU6M ... helps prevent constipation and clear the dirt from his belly	0.757	-0.134	0.155	0.068	-
4. Children U6M should be given water ... when there is little or no milk production	0.690	-0.060	0.219	0.259	-
5. Children U6M should be given water ... to avoid fatigue due to thirst	0.801	-0.112	0.241	0.266	-
6. Children U6M must be given water ... to BM or their throats will become dry	0.756	-0.084	0.273	0.263	-
Since breast milk of certain colors is not good for the child <6 months of age, water should be given ... <sup>a</sup>	0.263	0.010	0.018	0.826	-
7. Milk of certain colors causes tingling of the tongue/diarrhea, so it is necessary to give water ...	0.435	-0.097	0.027	0.684	-
8. Giving water to my CU6M, even if he is breastfed, allows him to get used to water	0.784	-0.024	0.184	0.162	-
9. The more my CU6M will suck, the more milk I will have for him ...	0.112	0.048	0.566	0.361	-
10. Giving my CU6M water ... will cause coughing and/or bronchitis	-0.323	0.127	-0.713	0.054	-
11. Giving my CU6M water ... will help him lose weight	0.067	-0.005	0.820	-0.041	-
12. Giving my CU6M water ... will cause abdominal pain	0.450	0.079	0.605	-0.070	-
13. Giving water to my CU6M ... causes tingling of the tongue and/or diarrhea	0.396	-0.026	0.652	0.042	-
14. Giving my CU6M water ... will help prevent constipation	0.530	-0.177	-0.022	0.364	-
15. Children U6M should be given water when given medication	0.676	-0.023	0.104	0.056	-
16. For you, preventing your CU6M from becoming thirsty is ...	-0.282	0.622	0.051	-0.130	-
17. For you, preventing your CU6M from having a fever is ...	-0.037	0.827	0.005	-0.074	-
18. For you, preventing your CU6M from losing weight is ...	0.019	0.847	-0.019	-0.159	-
19. For you, preventing your CU6M from having abdominal pain ... is ...	0.060	0.858	-0.068	-0.065	-
20. For you, preventing your CU6M from making gurgling noises is ...	0.011	0.759	-0.053	-0.023	-
21. For you, preventing your CU6M from getting tingling tongue/diarrhea ... is ...	-0.381	0.536	-0.035	0.189	-
22. For you, preventing your CU6M from reacting abnormally to the introduction of water is ...	-0.181	0.606	0.002	0.097	-
23. For you, preventing your CU6M from getting constipated is ...	-0.270	0.754	-0.077	0.021	-
24. For me, giving water to my CU6M in addition to BM would be ... <sup>b</sup>	0.642	-0.212	0.203	0.072	-

TABLE 1 (Continued)

Constructs and items	Rotated factor loadings				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Eigenvalues	8.37	4.19	1.88	1.24	–
% of variance (60.31)	32.21	16.11	7.23	4.77	–
<b>Subjective norm</b>					
1. Your spouse/partner	0.400	0.103	0.057	0.522	0.111
2. Your mother-in-law	0.675	0.141	0.475	0.117	–0.077
3. Your spouse's grandmother	0.603	0.182	0.613	0.058	–0.026
4. Your grandmother	0.582	0.221	0.561	0.008	–0.094
5. Your sister-in-law	0.155	0.248	0.262	0.745	0.052
6. Your older sister	–0.007	0.293	0.088	0.824	–0.034
7. Your mother	0.506	0.191	0.395	0.435	0.022
8. Other mothers in the neighbourhood/village	0.089	0.266	0.796	0.113	–0.033
9. Neighbours	0.106	0.149	0.718	0.254	0.118
<i>Health workers/community agents</i>					
10. Your spouse/partner	0.584	0.425	0.116	0.162	0.117
11. Your mother-in-law	0.729	0.504	0.189	0.009	0.014
12. Your spouse's grandmother	0.721	0.473	0.224	0.022	–0.001
13. Your grandmother	0.580	0.596	0.038	0.131	–0.003
14. Your sister-in-law	0.199	0.753	0.105	0.305	–0.001
15. Your older sister	0.237	0.708	0.22	0.208	0.222
16. Your mother	0.654	0.497	0.096	0.131	0.109
17. Other mothers in the neighbourhood/village	0.168	0.746	0.319	0.098	0.02
18. Neighbours	0.106	0.78	0.168	0.195	–0.025
<i>Health workers/community agents</i>					
19. The most influential people in my family think I should not give water to my CU6M in addition to BM	0.741	0.082	0.160	0.168	0.213
20. If I did not give my CU6M of water ..., most influential people ... would think I should not give water to him ...	0.726	0.066	0.028	0.154	0.282
21. The most influential people in my family think it is correct not to give water to my CU6M in addition to BM	0.458	–0.237	–0.228	0.073	–0.369
Eigenvalues	9.41	1.98	1.62	1.40	1.25
% of variance SN (68.08)	40.92	8.61	7.05	6.07	5.43
<b>Perceived behavioural control</b>					
1. If I knew the benefits of exclusive breastfeeding (EBF)	0.121	0.050	0.684	0.253	0.31
2. If I knew the dangers of giving water	0.155	0.030	0.754	–0.039	0.355
3. If there is no heat	0.349	0.201	0.577	0.060	–0.387
4. If I do not have the financial means to buy the water (pack/bottle)	0.430	0.022	0.49	0.321	–0.226
5. If I knew that breast milk already contained water	0.108	–0.065	0.785	0.080	0.058
6. If I did not return to work	0.769	0.146	0.231	0.233	–0.038
7. If I do not leave it with someone at home	0.736	–0.039	0.039	0.062	0.313
8. If I didn't give him a syrup or any other medication	0.782	0.145	0.191	0.017	0.075
9. If I did not give him BM substitutes (BMS)	0.840	0.109	0.115	0.081	–0.019
10. Being sensitized about the benefits of EBF	0.179	0.732	0.217	0.022	0.256
11. Always staying with my CU6M	0.175	0.837	–0.021	0.027	0.115

(Continues)

TABLE 1 (Continued)

Constructs and items	Rotated factor loadings				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
12. Being able to ensure a good milk supply after childbirth	-0.086	0.778	0.054	0.176	0.117
13. The fact of having my mother ... who takes care of my CU6M	0.128	0.684	-0.15	0.183	-0.23
<u>14. For me, not giving water to my CU6M ... would be:</u>	-0.085	0.269	0.1	0.71	0.171
<u>15. How much control do you feel you have when you decide not to give water to your CU6M ...?</u>	0.154	0.03	0.031	0.837	0.171
<u>16. If I wanted to, I could easily decide not to give water to my CU6M ...</u>	0.323	0.087	0.175	0.582	0.057
<u>It is up to me not to give water to my CU6M ... if I have knowledge about the dangers of water</u>	0.149	0.197	0.166	0.364	0.568
<u>I feel able not to give water to my CU6M ... if I have knowledge of the dangers of water provision</u>	0.094	0.128	0.181	0.208	0.732
Eigenvalues	5.24	2.29	1.81	1.32	1.08
% of variance (65.23)	29.10	12.73	10.05	7.35	6.00
Environmental factor items					
1. Not having access to individual counseling sessions on EBF during antenatal care visits	0.810	-0.249	0.073		
2. Not having access to group education sessions on EBF during antenatal care visits	0.860	-0.159	0.123		
3. Not having access to individual counseling sessions on EBF during immunization visits	0.897	-0.132	0.038		
4. Not having access to group education sessions on EBF during immunization visits	0.878	-0.132	0.117		
5. Not having given birth in a health facility	0.746	-0.185	0.322		
6. Not to be assisted by qualified personnel to give birth	0.776	-0.084	0.342		
7. Not having received birth support at the hospital or health center to initiate EBF	0.641	0.033	0.421		
8. Not having benefited from maternity leave	0.158	-0.205	0.756		
9. Not being able to bring my CU6M to my workplace ... spend the day with him/her	0.461	-0.316	0.573		
10. Not having support from my family to encourage me not to give water ... to my CU6M	0.398	-0.320	0.623		
11. Having an occupation of any kind	-0.108	0.306	-0.531		
12. Having my child exposed to the sun at my work place or activity	-0.102	0.684	-0.285		
13. Having received a BMS donation at the health facility	-0.152	0.828	-0.152		
14. Having been exposed to BMS advertising	-0.152	0.786	-0.184		
15. Receiving information that encouraged me to give my child water ...	-0.240	0.774	0.022		
16. Having a place nearby to get good quality water	-0.088	0.811	-0.301		
17. Having the financial means to buy good quality water	-0.063	0.824	-0.261		
Eigenvalues	7.64	2.89	1.06		
% of variance (68.13)	44.92	16.99	6.22		

Abbreviations: CFA, confirmatory factor analysis; SN, subjective norm.

<sup>a</sup>Items in italic font were removed in CFA.

<sup>b</sup>Direct measurements of each individual construct were performed using the underlined items.



**TABLE 2** Fit indices of confirmatory factorial analysis for the attitude construct ( $N = 300$ )

Indices	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\chi^2$	1023.53	908.24	831.19	774.45	742.55	714.46	675.93
df	169	150	149	148	147	146	145
$p$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RMSEA	0.13	0.13	0.12	0.12	0.12	0.11	0.11
90% CI	0.12–0.14	0.12–0.14	0.12–0.13	0.11–0.13	0.11–0.13	0.11–0.12	0.10–0.12
$p$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CFI	0.93	0.93	0.94	0.95	0.95	0.95	0.95
TLI	0.92	0.93	0.93	0.94	0.94	0.94	0.95
SRMR	0.09	0.09	0.08	0.08	0.08	0.08	0.07

Abbreviations: CFI, comparative fit index; CI, confidence interval; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker–Lewis index;  $\chi^2$ , chi-squared test value.

was met, but the model fit was still not optimal. In Model 4, Item 12 ('Giving my CU6M water ... will cause abdominal pain') was added to Factor 2, whereas in Model 5, Item 15 ('CU6M should be given water when given medication') was also added to Factor 2. These two items were the lowest weighted variables on Factor 1, adding more reason to believe that these items did not only belong on Factor 1. For both models, still, only the CFI criteria were met. For the final model (Model 6), we added the correlation between the errors of Item 14 ('Giving my CU6M water ... will help prevent constipation') and Item 15 ('CU6M should be given water when given medication'). Fit indices met the recommended CFI and TLI levels, but the SRMR, chi-squared and RMSEA with its 90% CI criteria were unmet (Table 2). A decision was made to stop the modifications, as further modifications to the model would be unjustifiable from a theory standpoint. The final model is composed of 19 items, two cross-loadings and four correlations between errors.

For the SN construct, nine models were run. In the first model, 14 items were included, with one cross-loading with Item 16. This solution revealed that only criteria for the CFI and TLI were met (Table 3). In subsequent models (1 and 2), the correlation between the errors of pairs of items was added as follows: (a) Model 1: Item 17 ('Other mothers in the neighbourhood/village will agree/disagree if I give water ... to my CU6M') and Item 18 ('Neighbours will agree/disagree ...') and (b) Model 2: Items 11 and 12. In Models 3–5, Item 11 ('Your Mother-in-law ...'), Item 12 ('Your spouse's grandmother ...') and Item 13 were removed because they did not significantly load onto Factor 2. After Model 5, 11 items remain, and the required fit indices for CFI, TLI and SRMR were attained, which could be enough to stop the modifications and use Model 5 as the final model. However, as the RMSEA and its 90% CI were still relatively high, modifications were continued. In subsequent models (6 to 8), correlations between the errors of items were added: (a) Model 6: Item 12 ('Your spouse's grandmother ...') and Item 13 ('Your grandmother ...'); (b) Model 7: Item 11 ('Your mother-in-law ...') and Item 13; and (c) Model 8: Items 1 and 10 ('Your spouse ...'). Besides the chi-squared statistic, criteria for selected indices

were respected in Model 8. The final model included 11 items, one cross-loading from the first model and five correlations between errors.

Model 0 for PBC comprised the nine items that loaded significantly on the two main factors of the EFA, with no cross-loading. This model proved to be a good fit with the CFA data, as the criteria for the CFI, TLI and SRMR indices were attained (Table 4). The chi-squared and RMSEA indices did not meet the necessary criteria, but a decision was made to use Model 0 as the final model, as no modifications were theoretically justifiable.

A final CFA was conducted on items related to the environment. The initial model included only items with a loading coefficient in EFA above 0.4, which resulted in an initial model composed of 14 items with no cross-loadings. Results for the fit indices were unsatisfactory except for CFI and TLI (Table 5). Model 1 was run after removing the automatically postulated correlation between Factors 1 and 2, as they did not significantly correlate. After this modification, the criteria for all other indices but CFI and TLI were unmet. Models 2 and 3 were run in which the correlation between the errors of Item 16 ('Not having a place nearby to get good quality water could prevent me from providing water to my child') with Item 17 ('Not having the financial means to buy good quality water') and Item 5 ('Not having given birth in a health facility') with Item 6 ('Not being assisted by qualified personnel to give birth') was respectively added. Model 3, respecting all indices, except the chi-squared, was chosen as the final model. This model is composed of 14 items and two correlations between errors.

Hancock and Mueller's reliability coefficients for final models were either above 0.90 for each construct and their respective two factors: (a) ATT: 0.96 (Factor 1) and 0.94 (Factor 2); (b) SN: 0.93 (Factor 1) and 0.97 (Factor 2); (c) PBC: 0.90 (Factor 1) and 0.94 (Factor 2); and (d) environment: 0.98 (Factor 1) and 0.90 (Factor 2).

Results of frequency distributions of data show significant differences in answers between mothers of the two different samples (Table S3).

**TABLE 3** Fit indices of confirmation factorial analysis for the subjective norm construct (N = 300)

Indices	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
$\chi^2$	686.70	512.86	411.71	408.83	399.34	389.44	278.45	210.24	175.89
df	71	70	69	70	71	72	71	70	69
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RMSEA	0.17	0.15	0.13	0.13	0.12	0.12	0.10	0.08	0.07
90% CI	0.16–0.18	0.13–0.16	0.12–0.14	0.12–0.14	0.11–0.14	0.11–0.13	0.09–0.11	0.07–0.10	0.06–0.09
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CFI	0.97	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
TLI	0.96	0.97	0.97	0.98	0.98	0.98	0.99	0.99	0.99
SRMR	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03

Abbreviations: CFI, comparative fit index; CI, confidence interval; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker–Lewis index;  $\chi^2$ , chi-squared test value.

**TABLE 4** Fit indices of confirmation factorial analysis for the perceived control behavioural construct (N = 300)

Indices	Model 0
$\chi^2$	190.40
df	26
p	<0.001
RMSEA	0.15
90% CI	0.13–0.17
p	<0.001
CFI	0.96
TLI	0.95
SRMR	0.05

Abbreviations: CFI, comparative fit index; CI, confidence interval; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker–Lewis index;  $\chi^2$ , chi-squared test value.

## 4 | DISCUSSION

Using an extended version of the TPB framework, this study aims to develop and validate a questionnaire that could be used to investigate psychosocial and environmental factors to the provision of water in addition to breast milk among mothers of CU6M in two regions of the Republic of Guinea. FGDs and literature were used to identify salient beliefs associated with each construct of the eTPB that may impact the behaviour under study. Results from the qualitative analysis of FGDs were used to develop a questionnaire, which was then administered to two distinct populations of mothers of children. Subsequently, data were used for the questionnaire's validation process, which was performed through EFA and CFA. EFA results show that four to five factors fitted the data for each of the four constructs, but two explained above 65% of the variance. To further simplify the questionnaire, only items loading on the two factors were considered for CFA. The final questionnaire includes all items (56) that were initially loading on the two factors and whose factor loading's coefficients were above 0.4 as well as one item to measure the intention. Data for all indicators (chi-squared test, RMSEA, CFI, TLI and SRMR) and criteria used to assess the validity of the questionnaire were examined as well as that for the assessment of its reliability (Hancock and Mueller coefficients). For all the final four models, the chi-squared statistic criterion was unmet. Besides the RMSEA cut-off, criteria for CFI, TLI and SRMR were met for the ATT and PBC constructs. For the SN and the environmental constructs, criteria for RMSEA, CFI, TLI and SRMR were met.

For each construct, detailed information on mothers' beliefs and perceptions related to water provision has emerged during FGDs. As for ATT, data revealed several mothers' beliefs about the benefits of providing water in addition to breast milk, and for them, to prevent childhood illnesses, water should be given. Also, for mothers, child medication necessitates being accompanied by water. These negative beliefs have been reported in other studies (Chiabi et al., 2011; Cresswell et al., 2017; Nwankwo & Brieger, 2002; Ojofeitimi

**TABLE 5** Fit indices of confirmation factorial analysis for the environment-related construct ( $N = 300$ )

Indices	Model 0	Model 1	Model 2	Model 3
$\chi^2$	713.43	435.10	217.49	163.28
df	76	77	76	75
$p$	<0.001	<0.001	<0.001	<0.001
RMSEA	0.17	0.13	0.08	0.06
90% CI	0.16–0.18	0.11–0.14	0.07–0.09	0.05–0.08
$p$	<0.001	<0.001	<0.001	<0.056
CFI	0.98	0.99	0.99	0.99
TLI	0.98	0.99	0.99	0.99
SRMR	0.10	0.10	0.06	0.06

Abbreviations: CFI, comparative fit index; CI, confidence interval; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker–Lewis index;  $\chi^2$ , chi-squared test value.

et al., 1999; Semega-Janneh, 2001; Yotebieng et al., 2013). For instance, in the Democratic Republic of Congo, most mothers reported that water was needed for the proper digestion of human milk and because of the hot climate (Yotebieng et al., 2013). Similarly to our context, in Nigeria, mothers mentioned that their baby would be thirsty if not given water (Nwankwo & Brieger, 2002).

On the other hand, results on mothers' perceptions about people in their surroundings who will agree/disagree with the provision of water in addition to breast milk show that an important proportion of people, including their spouse, mothers-in-law or their mothers, grandmothers and even neighbours, will agree with the behaviour. Moreover, as observed in Nigeria (Peterside et al., 2013), mothers tend to act according to their expectations of people in their surroundings. The mother's environment plays an important role in influencing breastfeeding practices. The mother's decision to give only breast milk seems to be influenced by the most influential people in her social network. In a review of eight qualitative studies, grandmothers, husbands, fathers, friends and community members were identified as having an influential role in child feeding practices (Kavle et al., 2017).

Mothers perceive that if they do not have financial means or do not have to leave the baby with somebody for work or other reasons—which may also lead to breast milk substitutes (BMS) provision to their young child—they will not provide water to their child. They also perceived that if they know about the benefits of EBF, they will be able to ensure a good breast milk supply, stay with their baby and not have somebody else taking care of the child. Thus, it would be easier for them not to provide water in addition to breast milk. In fact, good knowledge about breastfeeding benefits has been associated with its practice (Cresswell et al., 2017; Peterside et al., 2013; Sinha et al., 2015).

Environmental factors that could hinder water provision to children were related to the above beliefs and perceptions. If mothers could access information to learn about the importance of EBF and not giving water through group or individual education sessions, receive support to initiate breastfeeding when giving birth in a hospital and could be able to bring the child with them at work, this may hinder the provision of water. Other environmental conditions, such

as having the child exposed under the sun, mothers receiving BMS and being exposed to their marketing, as well as mothers receiving encouragement from people in their surroundings to give water, may also lead a mother to offer water to their baby. Even though bottled water marketing might be an issue in the West Africa region, it was not mentioned during FGD. Our findings are supported by a systematic review of barriers related to EBF in LMICs, which reported that women attending any ANC and receiving counselling, as well as women not having full-time employment, are more likely to exclusively breastfeed (Kavle et al., 2017).

Interestingly, throughout the CFA analysis, adjustments performed to improve the goodness-of-fit of models relate mainly to the addition of correlations between two items' errors. In fact, the identical items with factor loading coefficients above 0.4 in EFA were maintained in the CFA final models. Moreover, for each construct, correlation terms added were in line with what one would expect from a theoretical perspective. For instance, concerning the ATT construct, a mother will likely answer in a similar way on items regarding water provision to avoid fatigue and prevent the throat from being dry. Also, mothers will likely want to prevent health problems by providing their child with medication and combining it with water for its uptake. For SN, responding in the same way to items related to the neighbourhood's mothers and neighbours, in general, is congruent too. For the construct on the environment, one could also expect having mothers respond in a similar way to items related to being assisted by qualified personnel at birth and received support as factors that could hinder the provision of water in addition to breast milk.

With 57 items, we can assert that the questionnaire has been simplified compared with its original version of 88 items. Interestingly, although the sociodemographic characteristics of the two populations involved in the validation process were different, for each construct, the structure factor that emerged from EFA was confirmed by CFA.

Even though the final questionnaire did not respect the chi-squared statistic criterion, one word of caution is warranted concerning its use to conclude about the goodness-of-fit of our final models. When noncontinuous data are used in CFA, as was the case in our study, the chi-squared statistic value tends to be

inflated (Flora & Curran, 2004; Li, 2016). For categorical variables, Maydeu-Olivares and Joe (2014) recommend using RMSEA and SRMR in tandem to assess the goodness-of-fit of models. Although the SN and the environment's final models met both indices' criterion, only the SRMR cut-off was respected for the ATT and PCB constructs. On the other hand, in their study conducted in Australia, Jansen et al. (2016) have used CFA (and similar indices to ours) to develop and validate a questionnaire to assess young children's feeding practices. They consider final models as good if criteria for all indices (RMSEA, CFI, TLI and SRMR) but the chi-squared statistics were met, and, as adequate, if at least, criteria for two to three indices were met. In our case, based on these assumptions, for ATT and PCB constructs, final models can be considered as satisfactory concerning their validity but good for SN and environmental constructs.

Based on the  $H$  coefficient, we can state that the questionnaire's reliability is good for all constructs; this means that it has a set of items representing the latent constructs.

Despite the aforementioned results, our study has some limitations that should be recognised. It has been tested in one unique context, and thus, it may limit its generalisation to other cultural and socio-economic settings. The tool also contains an important number of items that may be a constraint to its administration or integration into national surveys. Because of its length, the questionnaire may also lead to certain participant fatigue, and thus, it may have impacted the quality of responses. On the other hand, our research has several strengths that should be acknowledged. The first one is developing a valid and reliable questionnaire that could help assess psychosocial and environmental determinants of the water provision in addition to breast milk by mothers of CU6M. The tool was also shown as performing well among two distinct populations of mothers. Results from its use can be exploited by a social and behavioural change programme, which can adjust and refine their messages to address specific beliefs and perceptions of water provision among mothers of children under 6 months of age. The next step would be to use the questionnaire to investigate the relationship between the behaviour and its psychosocial and environmental determinants.

## 5 | CONCLUSION

This research offers a questionnaire that could be used to investigate psychosocial and environmental determinants of the provision of water in addition to breast milk among mothers of children under 6 months of age. Nevertheless, further validation in other contexts is required.

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## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## CONTRIBUTIONS

NRN and SB designed the research. NRN conducted the study. NRN, SB and JBD analysed and interpreted the data. NRN wrote the first draft of the manuscript and had the primary responsibility for the manuscript's final content. All authors critically revised the manuscript. All authors also contributed to and approved the final version of the manuscript.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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