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PERCEPTIONS OF HOUSEHOLD MEASURING UTENSILS AMONGST MMOPANE COMMUNITY IN BOTSWANA

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ABSTRACT

In assessing adults' dietary intakes, nutritionists and dietitians often rely on clients' reported food consumption, estimated in units of households measuring utensils (cups, tablespoons and teaspoons). However, it is yet to be established whether the public can accurately estimate the capacity of household utensils and the amount of food consumed in units of household measuring utensils. The purpose of the study was to examine conceptions of household measuring utensils and establish how well participants estimate the sizes of household measuring utensils comparing with metric sizes of 250 ml for a cup, 15 ml and 5 ml for a tablespoon and a teaspoon, respectively. The study used a cross-sectional survey design with a random sample of 253 participants aged between 18-60 years. Participants were asked to complete questionnaires by identifying a sample that best approximated their perception of a standard (metric) cup, tablespoon and teaspoon. The results revealed that most adults' perceptions of the utensils differed from the correct measurements (metric sizes) of household utensils. Fifty eight percent of participants identified a sample of 375 ml sample as the one that they thought best approximated a standard / metric cup while 19% identified a 330 ml sample as the one that best approximated a metric cup. Only 13% of participants correctly identified a standard cup. Pertaining to tablespoon and teaspoon sizes, only about 7% and 38% participants correctly identified a tablespoon and teaspoon, respectively. The weighted mean size of a cup as perceived by participants was estimated at 332 ml. The mean difference between what participant perceived best explained their understanding of a cup (332ml) from the metric size of 250 ml was statistically significant (significant one sample t-test; T = 20. 234, p< .001; df = 252). Similarly, the average size of a teaspoon as perceived by participants differed from standard/ metric size of a teaspoon ($T = -4.326, p< .001; n= 251$). Similarly, observations were made with regard to the difference between perceived size of tablespoon ($T = -51.20, p< .001; n = 252$) and metric size of a tablespoon. Lastly, participants' perception of sizes of household utensils was influenced by age, education and gender. The findings underscore the importance of establishing local notions of household measures before assessment methods that rely on their use are administered. Further, the findings suggest the need for clients' education on household measures prior to use of the same in dietary assessments.

Key words: Botswana, Dietary recall, Dietary assessment, Household measuring utensils

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INTRODUCTION

In using dietary assessment methods to evaluate clients' diets and nutrient intake, practitioners often expect / assume that clients have some knowledge of sizes of household measuring utensils such as cups and spoons. Thus, in the use of dietary records and food inventories, clients are asked to recall and / or record food consumed in units of household measuring utensils [1]. Not only is there a general expectation that clients have a fairly accurate perception of sizes of household measuring utensils but that any lapses in client's conceptions of household measuring utensils can be attenuated by the use of interview aids in the form of food models, sample cups and spoons or food photographs [2, 3]. Furthermore, amongst other methods, dietary recalls are preferred because it is believed that they do not have significant time burden on participants nor do they require clients to have high numeracy or literacy levels [4]. However, the significance of the burden likely varies by population groups or participants characteristics. Some population groups may experience more burden than others because of their particular socio-demographic characteristics. Populations with low numeracy and literacy skills may be burdened more than others at the instance of these dietary assessment methods. Thus, the relative weight of the burden may vary from one population group to another, thereby bringing to question the validity of the assumptions of dietary assessment methods across population groups. In a review of studies using dietary assessment methods in Africa, it was observed that participants had difficulty recalling food consumed and in estimating portion size [5].

The use of dietary recall methods across population groups assumes that participants have operational ability to estimate portions of food consumed in household measuring utensils. Furthermore, it is assumed that participants across population groups have comparable perceptions and /or understanding of the sizes of household measuring utensils such that the notion of a cup or a tablespoon as household measuring utensils is fairly universal. This notwithstanding, perceptions of sizes of household measuring utensils are likely to be influenced by many factors. Amongst such factors are cultural backgrounds, literacy and numeracy levels, formal training and / or employment in disciplines /sectors requiring regular usage of household measuring utensils. More accurate perceptions of sizes of household measuring utensils are expected in population groups, which use these utensils routinely to measure food. Such is likely in communities where written recipes are used routinely and thus people become more accurate at approximating the capacity of these utensils and the portions of food served using these household measuring utensils. The same is expected of communities where effort is taken during meal preparation to ensure that just enough food for members of the household is prepared. This is in contrast to practices in communities, which embrace the notion that there should always be leftover food at family meal times to cater for unexpected guests or for use as an additional meal of the day. In traditional Botswana setting, the latter practice is common. There is evidence that such practices also apply in other African population groups, as incidents where children have been fed leftover food have been reported in other communities [6, 7]. In such settings, therefore, there may be no incentive to measure food more precisely; after all leftover food is culturally acceptable, despite its risks if not re-heated properly [6, 7]. Societal and / or gender roles may also influence how well people estimate the sizes of measuring utensils at the household level.

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Where societal norms dictate that women and girls prepare meals for the family, they may have better appreciation of sizes of household measuring utensils than men and boys because of repeated use of these utensils [8].

There are many factors that may influence the awareness of sizes of household measuring utensils in any given population group. Environments that promote use of household measuring utensils, societal norms around food preparation, overall literacy and numeracy level and / or gender dynamics are some of the factors that may influence awareness of sizes of household measuring utensils. The predominance of these factors in one population group compared to another is likely to result in differing perceptions of household measuring utensils by population groups.

This study was carried out to examine conceptions of household measuring utensils of adults in Botswana communities, to describe participants' conception of household measuring utensils (cups, tablespoon and teaspoons) and how they compared to standard / metric sizes of these units of measures.

METHODOLOGY

Using a cross sectional survey design, data were collected from a random sample of 253 participants aged 18 to 60 years in Mmopane, a peri-urban community in Botswana. A week before the study commenced, the research team visited the study site to inform the village leadership about the study and also show them study approval documents from the ethics committee. Next, the research assistants walked through the village and systematically selected every third household for participation. The systematic random sampling procedure was selected because it is a practical procedure for field work and it also yields more information per unit cost than simple random sampling. In every third household, the team informed household members about the study and requested one adult member present to consent to participate in the study. The contact details of the consenting member of the household were collected into the study register. The consenting member was also invited to a central place in the Village - the Village Chief's Offices, for data collection the following week. A day before the data collection, consenting household members were called on their cellphones and reminded of the data collection day. On the data collection day, participants were checked against the register and given a consent form to complete. Follow- up calls were made to those who had failed to come and were asked to come the following day.

Participants were asked to complete the study questionnaire with the help of research assistants. Information requested in the questionnaire were mostly participant's demographic characteristics and information on variables that might influence appreciation of household measuring utensils as guided by the literature. Participants were also presented with labeled samples of spoons and cups whose sizes were established before the study and requested to identify a sample that best approximated the size/volume that a standard / metric cup, tablespoon and teaspoon should hold.

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CUPS AND SPOONS SIZES

The sizes, in units of cups, of the four samples presented to participants were established with a measuring cylinder to be 185 ml (3/4 Cup), 250 ml (1 Cup), 330 ml ($1^{1}/_{3}$ Cup) and 375 ml ($1^{1}/_{2}$ Cup) for samples A, B, C and D, respectively (Figure 1) [5]. In the case of tablespoons, however, there was a limited number of varying sizes of spoons that approximate a tablespoon in the market; therefore, participants were presented with 3 samples in units of Tablespoons measuring 10 ml or $^{2}/_{3}$ Tablespoon (Sample A) , 15 ml or 1 Tablespoon (Sample B) and 7.5 ml or $^{1}/_{2}$ Tablespoon (Sample C). Similarly, for units of teaspoons, participants were presented with four samples as Sample A: 1 teaspoon tsp or 5 ml, Sample B: $1^{1}/_{4}$ teaspoon or 6.25 ml, Sample C: 3/4 teaspoon or 3.75 ml, and Sample D: $^{2}/_{3}$ teaspoon or 3.5 ml.

Figure 1: Samples of cups presented to the participants

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Teaspoon Samples Tablespoon Samples

Figure 2: Samples of spoons presented to the participants

ETHICAL APPROVAL

The Ministry of Health Research and Development Division Board granted permission to carry out the study – Reference Number: PPME 13/18/1 IV (560). Protocol number HRDC00507. All study participants consented to the study and completed consent forms. All aspects of the project were carried out with adherence to the principles of ethical practice.

RESULTS

Participants' characteristics:

Of the 253 participants aged at least 18 years in this study, 64% were females while 35% and 21% had attained 8-10 and 11-12 years of formal education, respectively. Slightly over one in five participants either had over 12 years of formal education (22%) or less than 7 years of formal education (23). Half (50%) of the respondents prepared food for their families daily compared to 23% and 27% who prepared family meal three days per week or rarely, respectively.

Very few (n= 37) participants in the study were ever employed in sectors such as catering where household measuring utensils were used regularly. Other demographic characteristics of the sample are shown in Table 1.

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Perceived size of a standard cup, tablespoon and teaspoon

Participants' perceived sizes of a standard cup, tablespoon and teaspoon are shown in Tables 2 and 3. From the results, 58% participants identified sample D, with a capacity of 375 ml as the sample they thought best fits their perception of a standard metric cup, while 19% selected a sample with a capacity of 330 ml. Altogether, 77% of participants selected samples that were 1.3 and 1.5 times larger than a standard cup as the two that best fit their perceptions. Only 13% of participants correctly identified a metric cup as sample A. With respect to tablespoons, 73% of participants selected C (7.5 ml) while 20% selected A (10 ml) as the samples that best fit their perception of a tablespoon. Only 7% of participants correctly identified a metric tablespoon. Regarding teaspoons, most participants correctly identified sample A as the sample that best approximates the size of a standard (metric) teaspoon.

Mean variances of participant's conceptions and actual sizes of measuring utensils

In order to establish the mean sizes of a cup, tablespoon and teaspoon as perceived by all participants, weighted averages were computed. The computed mean sizes of household measuring utensils as perceived by respondents were then compared to actual volume of a cup (250 ml), tablespoon (15 ml) and teaspoon (5 ml) as derived from the basic metric standards [9]. Using the computed weighted mean, participants' perceptions of a cup was about 332 milliliters compared to metric size of 250 ml. The mean difference between the two was statistically significant (Significant one sample t-test; T = 20. 234, p< .001; df = 252). Similarly, participants perceptions of the size of a teaspoon ($T = -4.326$, $p < .001$; $n = 251$) and a tablespoon ($T = -51.20$, $p < .001$; $n = 252$) also differed significantly from the standard references of 5 ml and 15 ml, respectively (Figure 3). Participants tended to overestimate the size of a cup and teaspoon, but underestimated the size of a tablespoon. Participants' relative proportions of a teaspoon and tablespoon were also incorrect.

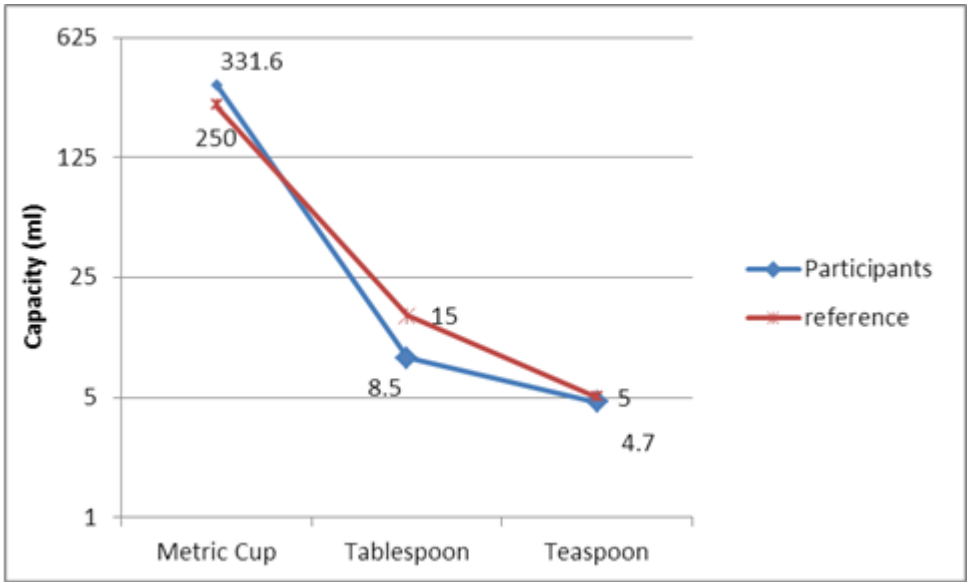

Figure 3: Capacity of household measuring utensil as perceived by Participants

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Proportion of participants correctly identifying sizes of household measuring utensils

There were some significant age, gender and education differences in participants who correctly selected samples of 250 ml, 15 ml and 5 ml as samples that best reflected their perception of a cup, tablespoons and teaspoon respectively. Altogether 13%, 38% and 7% of participants identified the correct sample for a cup, teaspoon and tablespoon, respectively. The participants, who correctly identified household's measuring utensils (Table 3), were more likely to be females, older (> 35 years) or have higher educational achievements (> 8 years of formal education). A higher proportion of females (14%) than males (11%) correctly identified a sample of the size of a cup. Similarly, a higher proportion of older participants (18%) identified the correct sample for a cup compared to younger participants (10%). However, perceptions of household measuring utensils were not influenced by participants' prior work in areas where the utensils were used frequently and / or the frequency with which the member prepared meals for their household.

DISCUSSIONS

Conceptions of household measuring utensils in Botswana

Observations in this study showed tremendous variations in adults' perceptions of the sizes of household measuring utensils. The perceived size of a standard cup was 1.3 - 1.5 times larger than the actual size of a metric cup. Surprisingly, the perceived size of a tablespoon was much smaller (½ the actual size) while the perceived size of a teaspoon (4.7 ml) did not differ much from a metric teaspoon (4.7 ml versus 5.0 ml). Our observations also suggest that there is a low sense of proportionality between these household measuring utensils in the population in the sense that while adults tended to think that a cup is much bigger than its actual size, their perceptions with respect to a tablespoon and teaspoon was different. Further, what was particularly striking in this study is that factors which were expected to consistently influence participants' perceptions of size or volume of household measuring utensils such as; age, level of educational achievements, gender, and prior work experience in food outlets had varying influence. Fewer men correctly identified a sample of a cup, teaspoon and tablespoon compared to women. Higher level of education was helpful in identifying the correct sample of a cup and tablespoon but not a teaspoon. Older age on the other hand proved helpful in identifying the correct sample of a cup and teaspoon but not a tablespoon. These inconsistencies suggest either that participant's sense of proportionality about these household utensils is low or that they do not have confidence on whatever informs their choice of samples.

While it has long been shown that errors in estimations of reported food dietary intake are influenced by the characteristics of food, the use of food models/photographic samples, observations in this study also suggest that the local perceptions of household measuring utensils, gender, education level and education level of participants are other important factors. It is important that communities' perfections of household measuring units are established before the units are used in dietary assessment methods.

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Gender has been observed to be an important factor in participant's ability to correctly identify the size of household measuring units (cups and tablespoon). This is possibly a result of the fact that 77% of the 124 participants who prepared meals for their households daily are women ($p < .0001$). Thus, unlike men who seldom prepared meals for their household, women had more opportunity to use household measuring utensils. Such an activity is likely to help improve women's ability to recognize correct sizes of household measuring utensil. This observation is not surprising because women play major roles in both the purchasing of household groceries and preparation of meals across many population groups [10]. Although research also reports the blending of household roles between men and women as more women work outside the home, women still tend to play a leading role in household meal preparation [11]. This has remained so despite women cooking less frequently than in yester years [10, 11]. From this view point, the observation that older women's perceptions about the size of cups, teaspoon and tablespoon matched the standard sizes of these household utensils is, therefore, not surprising because older women are more likely than younger women to be responsible for the running of the home.

In addition to the observed association between the participants' demographic factors and their ability to correctly estimate sizes of household utensils, the usage of these utensils may have also had some influence. The usage of these utensils, which can best be deduced from their names in local language, suggests they are not primarily used for measuring food. In contrast to some western cultures/ languages where a cup is generally more specifically described in terms of a unit of measurement (volume/ size), amongst the Botswana population, a cup is often described by its utility in functions other than measurement. Rather a cup takes prominence in that it is a container used for serving liquids with little reference to a specific volume (for example 250 ml). According to the Sapir – Whorf hypothesis as previously explained [9], languages greatly influence the way people perceive concepts. Further, languages portray concepts differently depending on their perceived importance in their culture. Thus, in a culture where precision in measuring food consumed is not considered important, the language may appear limited in related adjectives. The language is limited in adjectives that portray high levels of precision in measurements but not in other functions possibly because, as argued in the context of the Whorf Hypothesis, the latter function was considered more important. It is, therefore, not surprising that amongst the Botswana people there are many different types of cups. A few of these are "a tea cup" (*komoki)*, a "cup belonging to a child" (*kopi* ya ngwana), 'an enamel cup" (bikiri), or "a ceramic cup. All these "cups" are described by their common usage, ownership or the material from which they are made. These also make little reference to a cup as a unit of measurement.

On occasions when size is of importance, reference may be made to a large cup (*kopi e tona)* or a small cup (*kopi e nnye*). In both situations, however, size is not precisely described in terms of the actual differences in the proportion between a large cup and a small cup. Yet in dietary assessment methods, it is important that people appreciate how much larger a bigger cup is from a small cup in specific terms. Observations made earlier in this study with regard to Botswana perceptions of cups as household measuring utensils also applies to spoons. Compounding the low precision of adjectives used in household measuring utensils amongst Batswana adults is the availability of cups and

spoons of varying sizes and shapes. Thus, a cup and spoon that a given household appreciate is what they have, which may vary from one that the next household has. In more numerate population groups this problem is easily addressed by acquisition of sets of measuring cups and measuring spoons, a concept that is not common in households in Botswana.

With these observations, therefore, the uses of dietary assessment methods that assume that respondents attach similar importance to precision in size/capacity of household utensils in Botswana are likely to yield erroneous results. In addition to considerations for common measurement errors in dietary intake such as the normal day-to-day variations in individuals' dietary intake [12], psychological or behavioral factors [13], and methodological factors [14], efforts should be made to abet differences in local conceptions of households measuring utensils.

Variations in the performance of methods of dietary assessment are not uncommon [15, 16]. Some of the variations have also been documented across different population groups [17, 18]. In a study in South Africa, for example, the reproducibility of a Food Frequency Questionnaire was found to be lower in the Tswana speaking adolescents compared to others [19]. Reasons for such variation are diverse and may include local conceptions of household measuring utensils as is the case in this study, or the lack of standardized recipes for staples, the lack of shared meanings of portion size across cultures, the complexity of local dishes, or how food is served [20]. In one study in China, it was reported that the provision of meat and vegetable dishes in one serving bowl for all household members made it difficult for individuals and trained observers to establish the proportion of the food that each individual household member consumed [21]. The resulting error can be very significant particularly if the culture in which the food assessed is different from the culture that informed the development of the dietary assessment methods. It is for these reasons that a previous work recommended preliminary interactions with communities before dietary assessment methods are used [22]. The purpose of these interactions is to give researchers the opportunity to pre-test dietary assessment tools and methodology extensively and fine tune them to the specific food cultures of the community of interest. This, in addition to extensive knowledge of any given community's culture and practices around food and knowledge of tools for quantifying food will improve the quality of dietary assessment data [23,24]. Lately, food photographs have been used with some success to minimize portion size estimation errors; however, these tend to be culture specific because of the diversity of cultural foods [25].

IMPLICATIONS OF THE STUDY

Observations in this study raise important factors that may influence the accuracy of self-reported dietary information, which rely on participants' knowledge / perception of sizes of household measuring utensil. First, given that the appreciation of household measuring utensils differs by gender, age, level of education and perhaps cultural contexts, over or under reporting should be expected to differ by socio-demographic characteristics of participants. Based on the findings of this study, there is reason to believe that men and younger people may be less likely to provide accurate information because of their poorer

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appreciation of household utensils compared to women and older adults (35 years of age or older). Hence, efforts that minimize errors when dietary assessment methods that rely on household measuring utensils are used in men and younger adults need to be put in place.

Routine use of household measuring utensils, as might be expected in women who routinely prepare meals for their household, is likely to improve estimation of food measured by household utensils. For this reason, it may be beneficial to establish whether participants routinely prepare meals for their household. Such a question can serve as a pointer for discriminating between participants who are likely to provide more accurate information and those who are prone to making errors.

CONCLUSION

Taking into context the observations in this study and consistent with previous works in dietary assessment methods, the authors recommend the consideration of gender, age, education level and local perceptions of household measuring utensils amongst factors that may influence the performance of dietary assessment methods across cultures. Further, local conceptions of household measuring utensils should be established before dietary assessment methods that rely on their use are administered. Where communities' estimates of household measuring utensils differ from the actual metric standard, education should be provided before the assessment is undertaken.

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Table1: **Summary of demographic and other information among participants (n = 253)**

	Frequency	**%**
Gender		
Male	92	36
Female	161	64
Age (Years)	**N**	**%**
18 – 24	60	24
25 – 29	57	22
30 – 34	37	15
35 – 39	33	13
40 – 44	18	7
45 – 49	19	8
50 – 60	28	11
Years of Formal Education	**N**	**%**
0-7	58	23
8-10	88	35
11-12	52	20
> 12	55	22
How often do you prepare a family meal?	**N**	**%**
Daily	125	50
At least three times per week but not daily	59	23
Rarely (not more than once a month)	69	27
Ever worked in sectors requiring routine use of household measuring utensils?		
Yes	37	50
No	215	85
Do you usually buy groceries for your household		
Yes	210	83
No	42	17

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Table 2: Perceived sizes of standard cup, tablespoon or teaspoon by adult participants (n = 253)

	N (%)
Which Sample best approximates the size of a standard Cup	
Sample A : 3/4 Cup (185 ml) A	25 (10)
Sample B: 1 Cup (250 ml)	33 (13)
Sample C: 1 1/3 Cup (330 ml)	47 (19)
Sample D: 1 1/2 Cup (375 ml)	148 (58)
Which Sample best approximates the size of a standard Tablespoon	
Sample A : 2/3 Tbsp (10 ml)	52 (20)
Sample B: 1 Tbsp (15 ml)	17 (7)
Sample C: 1/2 Tbsp (7.5 ml)	184 (73)
Which Sample best approximates the size of a standard Teaspoon	
Sample A: 1 tsp (5 ml)	95 (38)
Sample B: 1 1/4 tsp (6.25 ml)	53 (21)
Sample C: 3/4 tsp (3.75 ml)	93 (36)
Sample D: 2/3 tsp (3.5 ml)	12 (5)

Table 3: Proportion of participants correctly identifying sizes of household measuring utensils (no.= 253)

	Gender		Age		Education (years)		% identifying utensil correctly
	Female	Male	18-34	≥ 35 years	≤ 7 years	≥ 8 years	
Correctly identified a cup	14%*	11%*	10%**	18%**	7%*	15%*	13.0%
Correctly identified a teaspoon	42%*	31%*	34%*	44%*	45%	35%	38%
Correctly identified a tablespoon	7%	5%	7%*	6%*	2%*	8%*	7%

** P< 5% *P < 10%

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