Review Article

What's in your hands? A systematic review of dietary assessment methods and estimation of food sizes in a Primary Care Clinic

ABSTRACT

Introduction: Many patients with noncommunicable diseases such as obesity are attended to in Family Practice Clinics where quick dietary assessment along with estimation of food sizes as part of lifestyle modification and appropriate intervention could be offered. We performed a systematic review to determine the dietary assessment methods with the best evidence that can be employed in a Family Practice Clinic. **Methods:** Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) guidelines were used to conduct a systematic review of PubMed, Google, and Google Scholar databases from 1992 to 2017. **Results:** We found 730 original research articles, case–control studies, review articles, proceedings, transactions, and textbooks. Thirty-seven articles were selected out of which two were secondary data, 12 were review articles, 10 were descriptive surveys, and one was a prospective cohort study. There were two randomized controlled trials, two mixed study designs, one working paper, and seven guides. Food portion size estimation using household objects and the hand guide, then the food pyramid guide along with the food-sized plate intervention was documented. **Conclusion:** In view of the busy nature of Family Practice Clinics in several countries, in performing dietary assessment, food portions can be estimated using household measures and the hand portion guide. The pyramid guide and the portion-sized plate can then be used for intervention.

Keywords: Dietary assessment methods, Family Practice Clinics, food portion, hand portion guide, serving sizes

INTRODUCTION

Patients from all walks of life with a myriad of medical conditions, varying from noncommunicable diseases (NCDs), such as obesity, hypertension, and diabetes mellitus, to communicable diseases, such as malaria and typhoid fever, are attended to in first-contact settings such as Family Practice Clinics. As of 2017, World Health Organization (WHO) documented that out of the 56 million deaths globally, 38 million (68%) deaths were due to NCDs,[1] as compared to a decade ago, when NCDs led to about 35 million deaths.[2] Worldwide, this accounted for over half of all the deaths with majority of mortality from NCDs arising from low and middle-income countries.[2] In Africa, NCD deaths per millions was 2.5, whereas total deaths per millions was 10.8.[2]

Behavioral risk factors of most NCDs include unhealthy diet and sedentary lifestyle that contribute to obesity and dyslipidemia.[2] There is a need to emphasize lifestyle modification to reduce the morbidity and mortality from obesity and its health complications. Lifestyle modification can be taught to physicians using pneumonics such as WASHED.[3] **W** refers to weight control, **A** means alcohol reduction, **S** is for smoking cessation, **H** depicts health education, **E** means exercise, whereas **D** stands for diet. The dietary component of this pneumonic includes dietary

Adetola M. Ogunbode[1], Mayowa O. Owolabi[2], Olayinka O. Ogunbode[3], Adesola Ogunniyi[2]

[1]Department of Family Medicine, University College Hospital, Ibadan, Oyo State, Nigeria, [2]Department of Medicine, College of Medicine, University of Ibadan, Oyo State, Nigeria, [3]Department of Obstetrics and Gynaecology, College of Medicine, University of Ibadan, Oyo State, Nigeria

Address for correspondence: Adetola M. Ogunbode, Department of Family Medicine, University College Hospital, Ibadan, Oyo State, Nigeria.
E-mail: tolaogunbode@yahoo.co.uk

Access this article online	
Website: www.jmedtropics.org	Quick Response Code
DOI: 10.4103/jomt.jomt_22_18	

How to cite this article: Ogunbode AM, Owolabi MO, Ogunbode OO, Ogunniyi A. What's in your hands? A systematic review of dietary assessment methods and estimation of food sizes in a Primary Care Clinic. J Med Trop 2018;20:93-103.

assessment and advice and is one of the bedrocks of obesity management.

A study was performed in a first-contact setting, a primary care clinic to find out how primary care physicians give dietary advice to patients with obesity who presented to them.[4] The barriers to obesity management included provider, system and patient level barriers, and having poor education in school or during residency about obesity and its management.[4] To address the provider-level barriers, there are several methods that can be used to teach and to introduce simple quick methods of dietary assessment to physicians working in a busy clinic such as the hand portion guide, food photographs,[5] as well as household measures and objects.[6] Counseling and intervention can then be done using pictorials of food pyramids and plate-sized portions.[7]

The aim of this review was to identify dietary assessment methods and counseling methods/interventions that can be used by physicians in a busy Family Practice Clinic.

METHODS

Review design

The systematic review design was used with literature records that included original research articles, case–control studies, review articles, proceedings, transactions, and textbooks being assessed. This review was part of a bigger study on predictors of weight reduction within a 25-year span, from 1992 to 2017.

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) guidelines was used being a user-friendly guide [Figure 1]. The inclusion criterion was studies on obesity among adults. Obesity was defined as body mass index more than or equal to 30 kg/m^2. The primary search item was dietary assessment whereas the secondary search assessment was dietary intervention. Full texts were checked using the exclusion criterion which was not mentioning dietary assessment techniques.

List of databases searched for extraction and synthesis

Internet search engines were employed such as Google and Google Scholar to extract information. Hand searching of key journals in dietary assessment was done to supplement the electronic search.

Language

The language of the studies reviewed was English.

Search outcome

Seven hundred twenty records were from databases whereas 10 others were from extra sources such as textbooks and monographs. Out of the 730 articles identified, 620 were excluded because of the absence of information on various dietary assessment methods. One hundred ten full texts were found eligible and of these 73 were again excluded.

Analysis process

The remaining 37 articles selected were critically appraised in line with the set objective. Each article was read repeatedly ensuring that all the concepts involving dietary assessment were integrated and that any relationships between food intake and the hand portion guide with household measures were explored. Following the dietary assessment, interventions using the pyramid guide and the portion-sized plate were discussed.

RESULTS

Reports were taken, globally, from both developed and developing nations. Various study designs were used and analyzed. Out of the 37 studies that were documented, two used secondary data, 12 were review articles, 10 were descriptive surveys, whereas one was a prospective cohort study. Two were randomized controlled trials, two were mixed study designs, one was a working paper, whereas seven were instruments or guides. These are depicted in Tables 1 and 2. There are several dietary assessment methods available with the level of evidence.[8] This is shown in Table 3. The precise weighed individual inventory can be used for specific measurements of quantity of food consumed, but it is costly and was reviewed in four articles. The interview methods included diet recall and diet history methods that are quick and easy to administer but are prone to variations and recall bias. The diet recall was the method most commonly mentioned as it was discussed in 11 out of the 37 publications whereas the diet history was used in four of the 37 articles. The food frequency method gives specific details about food consumed and was discussed in seven of the articles. Two of the articles that were about food habit questionnaires and food records, which was the second highest dietary assessment method used, were mentioned in 10 documents. Food habit questionnaires and food records are useful for collecting large data. Food composite analysis is useful for research and was reviewed in six articles. Group methods such as food balance sheets and food accounts are good for planning for the country and were discussed in four of the publications.

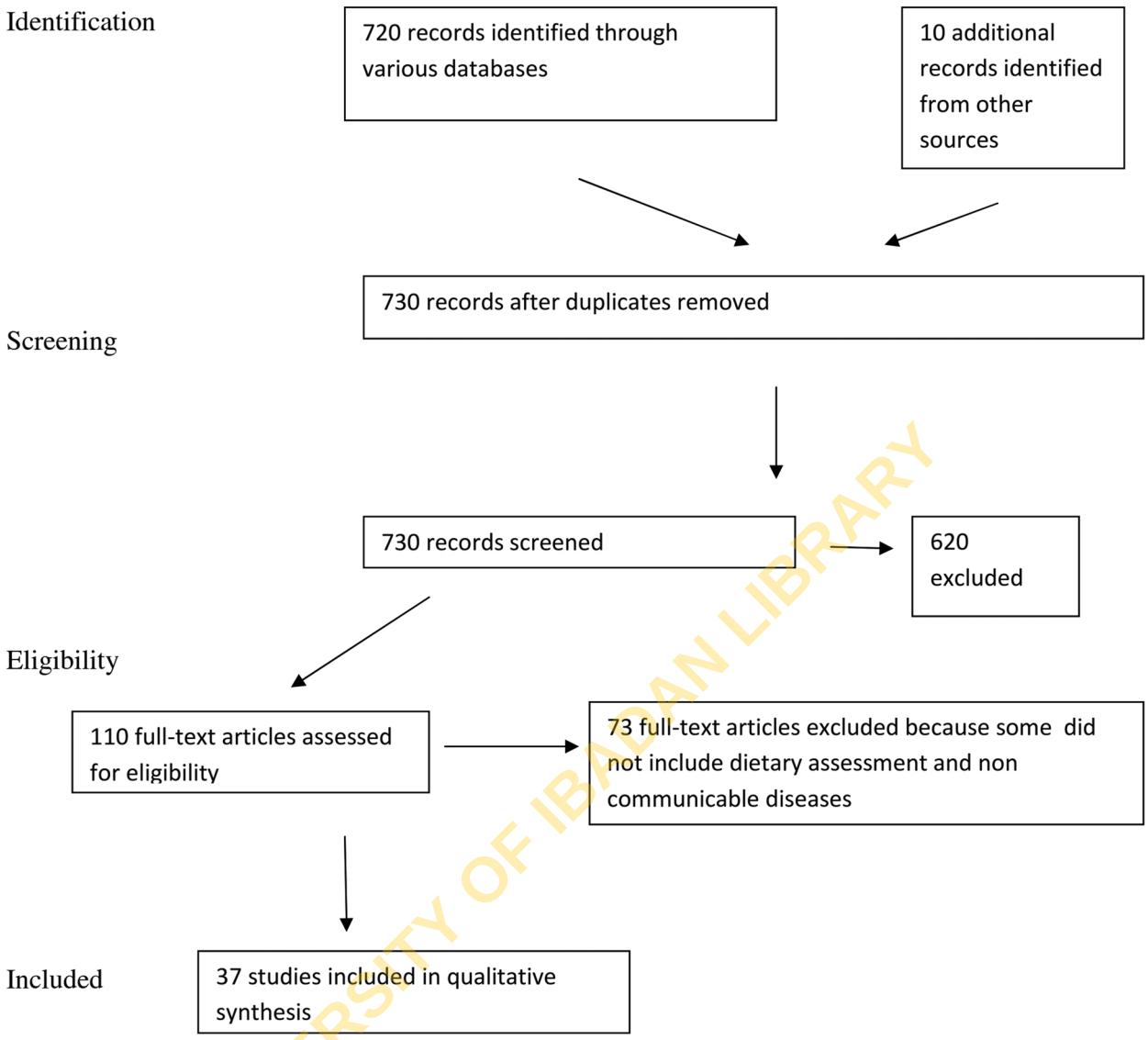

Figure 1: The Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) flow chart.

DISCUSSION

Several methods have been used to assess dietary assessment,[9] and the two classifications used are the individual method and the group method.[10] The individual methods of dietary assessment include the precise weighed individual inventory method, the interview methods (which is subdivided into two: diet recall and diet history), and the food frequency methods. Other individual methods of assessing dietary assessment include the questionnaire method such as food habit questionnaires, food records, and the food composite analysis. The group methods of dietary assessment are composed of the food balance sheet and food accounts.

In the precise weighed individual inventory method, a food inventory is taken at the beginning and end of the process. Weight of food consumed is recorded as well as food wasted. Nutritive value of meals is then calculated from classic food tables.[10]

Interview techniques are another type of method used for individual assessment; these include diet recall and diet history. These are also known as rapid assessment procedure (RAP) and involve interview techniques used to assess the patient's meal in the shortest time.[9] The 24-h-dietary recall can be done face-to-face or via the telephone.[9] The diet recall is also called the 24-h recall method, where the person remembers details of food consumed as well as timing in the previous 24 h.[11,12]

A report documented three 24-h recalls in which data collectors were taught to obtain information from dietary

Table 1: Study designs of the selected studies from high-income countries

Serial no.	First author/guide	Year of study	Site/Country	Study design
1	United States Department of Agriculture (USDA)	1992	Center for Nutrition Policy and Promotion	Food Pyramid Guide
2	Martinez *et al*.	1999	USA	Survey/Primary data
3	Shaw *et al*.	2001	USA	Review
4	Kim *et al*.	2003	Korea	Survey/Primary data
5	Texas Department of State Health Services	2004	Texas, USA	Diet History Form- Instrument
6	Food Agricultural Organization (FAO)	2005	FAO	Guide
7	Patrick *et al*.	2006	Primary care clinics and home/USA	Randomized Controlled Trial
8	Forman-Hoffman *et al*.	2006	UK	Survey/Primary data and Focus Group Discussions
9	Gibson *et al*.	2016	Australia	Survey/Primary data
10	Deans *et al*.	2009	UK	Prospective Cohort
11	Family Matters, Familyand Consumer Sciences,Colorado State UniversityExtension and Zander	2010	USA	Guide
12	Burns *et al*.	2011	USA	Systematic Review
13	Dary and Imhoff-Kunsch	2012	USA	Review
14	Hedrick *et al*.	2012	USA	Review
15	National Institute of Diabetes and Digestive and Kidney disease.	2012	National Institute of Health, USA	Short Review
16	Zelman	2012	UK	Guide
17	Precision Nutrition	2013	USA	Rainbow Portion – Guide
18	Smith *et al*.	2014	USA	Working Paper
19	Eat Right Ontario	2015	Canada	Canada's Hand Portions Guide
20	Harray *et al*.	2015	Australia	Randomized Controlled Trial
21	Martinez-Victoria *et al*.	2015	Spain	Review
22	Kirkpatrick and Collins	2016	Canada	Review
23	Howes *et al*.	2017	USA	Survey/Primary data

Table 2: Study designs of the selected studies from low and middle-income countries

Serial no.	First author	Year of study	Site/Country	Study design
1	Smith and Ojofeitimi	1995	Nigeria	Secondary data
2	Srivastava	2008	India	Secondary data
3	Adu *et al*.	2009	Nigeria	Survey/Primary data
4	Fadupin	2009	Nigeria	Survey/Primary data
5	Ajani	2010	Nigeria	Survey/Primary data
6	WHO PEN	2010	WHO	Review/Interventions
7	Fadupin and Olawale	2010	Nigeria	Survey/Primary data
8	Sanusi and Olurin	2012	Nigeria	Survey/Primary data
9	Korkalo *et al*.	2012	Mozambique	Survey/Primary data
10	Adebisi	2013	Nigeria	Survey/Primary data and secondary data
11	Lano-maduagu *et al*.	2013	Nigeria	Survey/Primary data
12	Ogunbode *et al*.	2015	Nigeria	Short Review
13	Bello *et al*.	2016	Nigeria	Survey/Primary data
14	WHO	2017	WHO	Short Review

recalls for 2 days during the week and for one weekend day using the University of Minnesota Nutrition Data System for Research software.[13] Food models that were three-dimensional were shown to the participants to demonstrate food portion sizes, whereas two-dimensional food models were given to them to take home.[13] The first visit was face-to-face, which was also corroborated by another report, whereas subsequent visits were via telephone interviews.[14] The average nutrient variables from fat (total and saturated) and grams of fiber) were

Table 3: Dietary assessment methods

Authors	Dietary assessment method recommended	Level of evidence	Advantages and disadvantages
Srivastava, 2008 Fadupin, 2009 Gibson *et al*., 2016 Korkalo *et al*., 2012	Precise weighed individual inventory	Level V	Documentation of exact quantities consumed. Self-collection of information. Expensive.Sample size is not representative and it does not represent normal eating patterns.
Patrick *et al*., 2006 FAO Adebisi, 2013 Adu *et al*., 2009 Ajani, 2010 Bello *et al*., 2016 Lano-maduagu *et al*., 2013 Srivastava, 2008 Diet History Form, 2004 Sanusi and Olurin, 2012 Kirkpatrick and Collins, 2016	Interview methods: Diet recall and diet history	Level II	Good for quick recall of diet and helps to show variations. Difficulties come in estimation because of the variations, a day's recall is not representative and the clients may not remember all they consumed.
Bello *et al*., 2016 Kim *et al*., 2003 Srivastava, 2008 FAO Martinez *et al*., 1999 Kirkpatrick and Collins, 2016 Dary and Imhoff-Kunsch, 2012	**Food frequency method**	**Level IV**	**Gives information about relationship with diet rather than certain nutrients and is good when exact details are needed. However, the frequency data obtained is more limited than other quantitative data.**
Deans *et al*., 2009 FAO Srivastava, 2008 Lano-maduagu *et al*., 2013 Martinez *et al*., 1999 Harray *et al*., 2015 Dary and Imhoff-Kunsch, 2012 Kim *et al*., 2003 Kirkpatrick and Collins, 2016 Howes *et al*., 2017	Questionnaire method: Food records andfood habit questionnaires	Level II	Data from big samples can be collected over a short time with a limited budget. However, random sampling cannot be done.
Martinez-Victoria *et al*., 2015 Srivastava, 2008 FAO Lano-maduagu *et al*., 2013 Fadupin, 2009 Sanusi and Olurin, 2012	**Food composite analysis**	**Level III**	**Mostly for research.**
Dary and Imhoff-Kunsch, 2012 Smith *et al*., 2014 Srivastava, 2008 FAO	Group methods: food balance sheets and food accounts	Level V Level V	Good for an overview of the countries' food supplies and food habits, useful for planning.

calculated from these three 24-h recalls.[13] The dietary recall is a fast technique in which well-known measures are used. A 7-day dietary recall can also be done as was performed in a research study to find out the nutritional status of Nigerian undergraduates.[15]

The meal-based diet history estimates a person's normal intake in which every food and beverage consumed at each meal is documented over time.[9] Diet history is what is most useful in epidemiological studies, to get details about the common dietary patterns and not their present pattern.[10] There is a record of daily meals, snack timings, and what each meal consists of.[10] The amount of servings and their portion sizes are used to estimate the quality and amount of foodstuffs. It is a simple and affordable method to use.[10] An example of the diet history form is that from the Texas

Department of state health services.[16] In Family Practice Clinics, which are busy clinic settings, the most feasible RAP would be the diet history.

In epidemiological studies, another tool that is commonly used is the food frequency questionnaire (FFQ).[17] FFQs are sometimes referred to as a "list-based diet history" and the participant should estimate the frequency of consumption based on frequency categories that indicate the number of times the food is usually consumed per day, week, month, or year. FFQs may be unquantified, semiquantified, or completely quantified based on the addition of serving sizes. The FFQ was administered to each participant in a study to determine the normal pattern of consumption and the food size using standardized food models.[17] In the food frequency method, the frequency of intake of food items consumed is documented. It is useful for identifying dietary patterns and when looking for dietary associations.[10] Another study combined self-administered FFQs and dietary records. In addition, a study in schools in Lagos, Nigeria, used interviewer-administered questionnaires to assess the dietary history/pattern as well as the food frequency.[18,19]

Food habit questionnaires are used to document details such as beliefs about food, food preferences, meal preparation techniques, and the circumstances around the meal. All these methods constitute examples of RAP to help accumulate better dietary data during dietary assessment. Food records are also called food diaries or dietary records. The individual documents all foods and beverages consumed for a period between 1 to 7 days.[9] A report had food diaries that included all the food and drinks consumed, documented, and collected over 3 days, a weekend inclusive.[20] Participants can also estimate the amount consumed by using common household measures (e.g., spoons, cups, glasses, and plates) or by using portion size estimation aides.[21]

In the food composite analysis for laboratory estimate, food items are checked at meal times and analyzed.[10] Food composition tables are used to change this intake into actual nutrient intake by the individual or from FFQs by multiplying the frequency of use by the nutrient composition for the portion size specified for each item. These food composition tables may be paper based or electronic.[22] Computerized software programs can be used to calculate nutrient intake by multiplying the reported frequency of each food by the amount of nutrient in a serving of that food.

The group methods for dietary assessment include the food balance sheet and food accounts. The food balance sheet is used to extrapolate the overall food stores of a country and is used to plan food programs.[10,23] The food balance sheet is also able to track trends in the nation's food supply and changes in the dietary patterns.[24] The meticulous documentation of meals consumed over time by the family, group, or organization is known as a food account.[10]

In estimating the food size during dietary assessment, a portion is the amount of food an individual decides to eat as a meal or snack, whereas a serving is what is shown on the food label.[25] Several household measures can be used to estimate meals instead of kitchen scales that several Nigerian homes do not have access to.[26,27] A study was done in a community in Nigeria among 413 participants, using 24-h dietary recall and estimated food portion sizes with measuring guides (household measures) and food models.[28] These household measures included teaspoons, table spoons, cups, and milk tins.[26-28]

Sanusi and Olurin[28] in 2012 determined that among the cereals and grains, one serving was equivalent to 1.3 slices of bread, 1.3 heaped table spoons of joll of rice, 1.75 heaped table spoons of white rice, one small wrap of "Eko" (maize mold), or a 500-mL cup of fermented maize meal/maize pap "ogi." One-eighth of a wrap of semolina, one-third of a wrap of pounded yam, 1.75 thin slices of boiled yam, two-third of a small wrap of yam flour "amala," one-third of a small wrap of cassava flour "Lafun" or cassava flour "Fufu" were also described as a serving.[28] Two-thirds of a milk tin of Cassava flakes "Garri," 2.5 table spoons of freshly prepared cassava "eba," or 8.3 medium slices of fried plantain were equal to a serving size.[28]

For the legumes, 1.5 heaped table spoons of boiled beans, a small bean cake "akara," 1.5 times the size of a small wrap of cowpea pudding "moinmoin," or three-fourth of a tin cup of cowpea pudding "moinmoin" constituted a serving.[28] For soups and stews, a serving was two-fifth serving spoon vegetable and melon "egusi and efo," two-third serving spoon of vegetable soup without melon "eforiro," 3.5 of draw soup "ewedu," three-fourth of draw soup "ogbonna," and for stews a serving was 1.3 serving spoons of vegetable oil stew and two-third serving spoon of palm oil stew.[28] For fruits, one small orange or 1.25 banana were a serving, whereas for protein, one small egg or one small piece of meat constituted a serving.[28] Other household materials that can be used to estimate the size of food consumed include an audio tape cassette to estimate a slice of bread or an electric bulb equal to half a cup.[29] This is shown in Figure 2.

In addition, a convenient method that can be used in the clinic for estimating food sizes is comparing the food consumed to

Figure 2: Hand guide.

the size of the fist or palm excluding the fingers as well as the thumb size, this could be done in comparison to household objects such as a cup.[21,30,31] Protein is measured with the size of the palm excluding the fingers[30] or a full cup or one fist size for a cup of beverage or legumes such as beans.[31] A carbohydrate serving is a fist size, for example, for cereal,

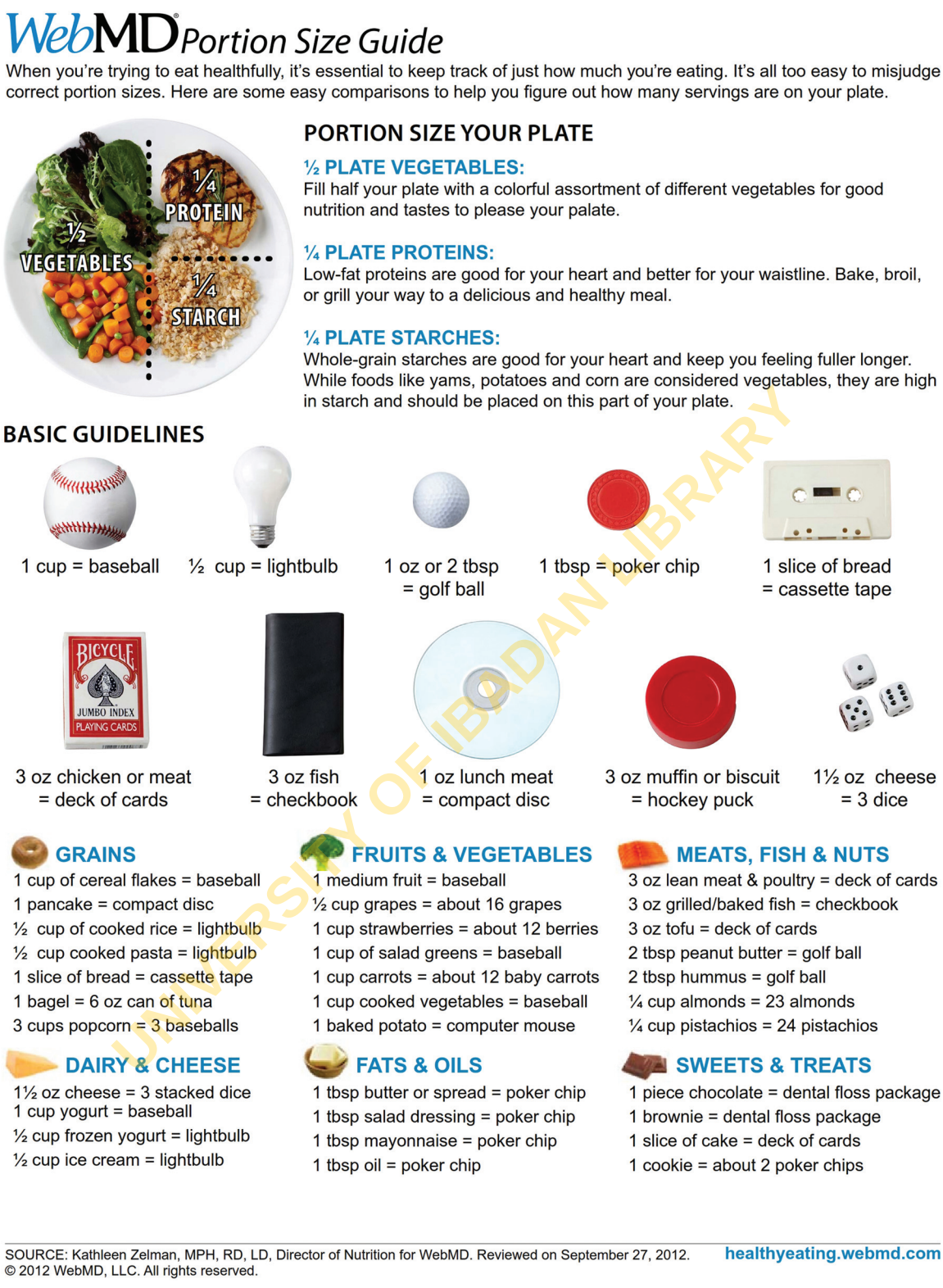

Figure 3: Objects and portion-sized plate.

but half a fist size or half of a cup if it is rice or pasta.[31] The size of the thumb represents a portion of fat.[30] Vegetable servings are equivalent to half cup or half fist of canned vegetables or full cup or one fist of leafy vegetables, whereas a fruit serving is equal to half a cup of fruit juice or half a fist of canned fruit or one medium fruit, for example, a whole orange[31] or one fist size.[30] A handful of nuts is a portion.[31] This is depicted in Figure 2.

Table 4: Strengths and limitations of the dietary assessment methods[8]

Type of method	Major strengths	Major limitations
Interview: 24-h dietary recall	- Little respondent burden	- Relies on memory
	- No literacy requirement	- Depends on skilled interviewer
	- Does not change consumption pattern	- Difficulty to estimate quantities
Interview: Diet history (meal-based)	- No literacy needed	- Depends on recall
	- Does not change consumption pattern	- Needs well-trained interviewer
	- Open-ended	- Difficulty to estimate amounts
Food frequency questionnaire	- Inexpensive	- Depends on memory
	- Preferable method for nutrients with day variability	- Needs difficult calculations
Questionnaire: Food habit	- Rapid and low cost	- Depends on recall
	- Does not change consumption pattern	- Needs a trained interviewer
	- Open-ended	
Questionnaire: Food record	- Does not depend on memory	- High participation burden
	- Easy to measure quantities	- Needs literacy
	- Open-ended	- Changes consumption pattern

Intervention following the dietary assessment can be done using the pyramid guide or the portion-sized plate. The pyramid guide is a pictorial that depicts the healthy way food should be combined before eating a meal. It shows different levels of each food group and how much should be consumed.[7] The grains and carbohydrates are at the base, followed by the vegetables and fruits at the middle level, then protein, and finally fats and oils are at the tip of the pyramid.[7] The pyramid guide can be used as a means of intervention initially.

Using the pyramid guide to daily food choices, examples of a serving for carbohydrates are one slice of bread, a biscuit, a small roll, five to six small or three to four large crackers, half cup cooked cereal or rice, and one ounce ready-to-eat cereal.[32] Carbohydrates such as bread are measured comparing each slice to an audio cassette or the size of a woman's palm stacked 1 inch high.[33] A fist is equal to a cup.[33] Other examples of carbohydrates consumed include bread, boiled yam, boiled plantain flour, "amala," and boiled cassava flakes, "eba."

For fruits, a serving is a medium banana, orange, apple, grapefruit, half a melon wedge, three-fourth cup juice, half cup chopped, cooked, or canned fruit, and one-fourth cup dried fruit.[32] Half cup cooked vegetables, half cup chopped raw vegetables, and one cup leafy raw vegetables, such as lettuce or spinach, constitute a serving of vegetables.[32] Cooked lean meat, poultry without skin, or fish a day should total 5 to 7 ounces a day. An egg or half cup cooked beans is equivalent to 1 ounce of meat.[32] A cup of milk, 8 ounces of yogurt, 1 to 1/2 ounces natural cheese, and 2 ounces processed cheese is equal to one serving.[32]

The plate can be portion sized and is another useful method to help people determine the quantity of servings per plate. It is used for dietary intervention.[29] To portion size a plate, the plate could be divided into four: half would be vegetables and fruits whereas a quarter could be starch or carbohydrate or protein especially low-fat protein respectively. This is seen in Figure 3.

These dietary assessment methods are useful in different settings and particularly in a Family Practice Clinic; the RAP can be a quick interview method. The methods, however, have their strengths and limitations that are depicted in Table 4.

Future dietary assessments of dietary habits and behavior will include mobile food records using a mobile device of all meals consumed before and after the meal.[34] In a study, pictures of food images were taken using mobile phones and 247 participants were recruited into a randomized controlled trial study that was to be used for validation of a new instrument. Six months later, there was a repeat of these pictures taken. Some authors in this cross-sectional study on image-based dietary assessment tried to find out the ability of dietetics interns and students to perform dietary assessment and concluded that more training could improve identification of food via images.[35] Biomarkers and web-based 24-h recall are methods that could also be useful in dietary assessment.[36,37]

CONCLUSION

In view of the busy nature of Family Practice Clinics, in performing dietary assessment, simple, quick to administer, and cost-effective methods should be adopted. Estimation

of food sizes should be done using household objects and the hand portion guide. The pyramid guide and the portion-sized plate can then be used for intervention.

Financial support and sponsorship

Nil

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. World Health Organization. Global Health Observatory (GHO). (2017). Available at http://www.who.int/gho/ncd/mortality_morbidity/en/. [Accessed January 30, 2017].
2. World Health Organization. Package of Essential Noncommunicable Disease Interventions for Primary Health Care in Low Resource Settings. Available at www.who.int>nmh>publications>essential. [Accessed May 18, 2016].
3. Ogunbode AM, Owolabi MO, Ogunbode OO, Ogunniyi O. "Weight control, alcohol reduction, smoking cessation, health promotion, exercise, and diet (WASHED)": a mnemonic for lifestyle modification in obesity. Nig J Clin Pract 2015;18:831-2.
4. Forman-Hoffman V, Little A, Wahls T. Barriers to obesity management: a pilot study of primary care clinicians. BMC Fam Prac 2006;7:35.
5. Korkalo L, Erkkola M, Figalgo L, Nevalainen J, Mutanen M. Food photographs in portion size estimation among adolescent Mozambican girls. Public Health Nutr 2012;16:1558-64.
6. Fadupin GT, Olawale Y. Weight and household measures of cooked Nigerian staple foods according to calories. Afr J Diabetes Med 2010;18:20-2.
7. United States Department of Agriculture (USDA). Center for Nutrition Policy and promotion. The food guide pyramid. Home Garden Bull 1992;252:1-29.
8. Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. Plast Reconstr Surg 2011;128:305-10.
9. FAO Corporate Document Repository. Preparation and use of food based dietary-guidelines. Methods of monitoring food and nutrient intake. Produced by Agricultural and consumer protection. Available at http://www.fao.org/DOCREP/x0243e05.htm. [Accessed May 3, 2013].
10. Srivastava M. Assessment of Nutritional status in Basics of Clinical Nutrition. In: Yoshi YK, editor. New Delhi, India: Jaypee Brothers Medical Publishers; 2008. pp. 30-43.
11. Ajani SR. An assessment of dietary diversity in six Nigerian states. Afr J Biomed Res 2010;13:161-7.
12. Lano-maduagu AT, Abiola OM, Akorede QJ, Tunrayo EB. Assessment of socio-economic, dietary intake, hygienicpractice and anthropometric indices in determining the nutritional status of mothers in Akure south local government, Ondo state. IJRRAS 2013;15:158-67.
13. Patrick K, Calfas KJ, Norman GJ, Zabinski MF, Sallis JF, Rupp J, *et al.* Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors. PACE for adolescents. Arch Pediatr Adolesc Med 2006;160:128-36.
14. Adebisi TT. Assessment of nutritional status of diabetic patients in Ogun State,Nigeria. Am J Hum Ecol 2013;2:120-6.
15. Adu OB, Falade AM, Nwalutu EJ, Elemo BO, Magbagbeola OA. Nutritional status of undergraduates in a Nigerian university in south-west Nigeria. Int J Med Med Sci 2009;1:318-24.
16. Texas Department of State Health Services. Diet history form. 2004. Available at www.dshs.state.tx.us/rls/nursing/forms/core4a.pdf. [Accessed January 22, 2013].
17. Kim J, Ahn Y, Paik H, Hamajima N, Inoue M, Tajima K. Calibration of a food frequency questionnaire in Koreans. Asia Pacific J Clin Nutr 2003;12:251-6.
18. Martinez ME, Marshall JR, Graver E, Whitacre RC, Woolf K, Ritenbaugh C, *et al.* Reliability and validity of a self administered food frequency questionnaire in a chemoprevention trial of adenoma recurrence. Cancer Epidemiol Biomarkers Prev 1999;8:941-6.
19. Bello B, Ekekezie O, Afolabi OT. Dietary pattern and nutritional status of primary school pupils in a South Western Nigerian state: a rural urban comparison. Afr J Food Sci 2016;10:203-12.
20. Deans DAC, Tan BH, Wigmore SJ, Ross JA, de Beaux AC, Paterson-Brown S, *et al.* The influence of systemic inflammation, dietary intake and stage of disease on rate of weight loss in patients with gastro-oesophageal cancer. Br J Cancer 2009;100:63-9.
21. Gibson AA, Hsu MSH, Rangan AM, Seimon RV, Lee CMY, Das A, *et al.* Accuracy of hands v. household measures as portion size estimation aids. J Nutr Sci 2016;5:e29.
22. Martinez-Victoria E, Martinez de Victoria I, Martinez-Burgos MA. Intake of energy and nutrients; harmonization of Food Composition Databases. Nutr Hosp 2015;31(Suppl. 3):168-76.
23. Dary O, Imhoff-Kunsch B. Measurement of food consumption to inform food fortification and other nutrition programs: an introduction to methods and their application. Food Nutr Bull 2012;33:S141-5.
24. Smith LC, Dupriez O, Troubat N. Assessment of the reliability and relevance of the food data collected in National Household Consumption and Expenditure Surveys. IHSN Working Paper No. 008, 2014.
25. National Institute of Diabetes and Digestive and Kidney Disease. National Institute of Health. Just enough for you. About food portions. Weight-control information network. Publication No. 09-5287.1-18. March 2012. Available at https://www.niddk.nih.gov/health-information/health-topics/weight-control/just-enough/Documents/justenough.pdf. [Accessed September 29, 2016].
26. Smith IF, Ojofeitimi EO. Nutrition and Diet Therapy for Health Care Professionals. Associated Bookmakers Nigeria Ltd; 1995. pp. 89-93.
27. Fadupin GT. Food exchange lists of local foods in Nigeria. Afr J Diabetes Med 2009;D1-419:15-8.
28. Sanusi RA, Olurin A. Portion and serving sizes of commonly consumed foods, in Ibadan,Southwestern Nigeria. Afr J Biomed Res 2012;15:149-58.
29. Zelman K. WebMD Portion Size Guide. 2012. Available at img.webmd.com/dtmcms/live/webmd/consumer_assets/site_images/media/pdf/diet/portion-control-guide.pdf. [Accessed July 4, 2013].
30. Precision Nutrition. Eat the Rainbow Portion Size Guide. 2013. Available at http://www.precisionnutrition.com/wordpress/wp-content/uploads/2013/07/EatRainbow_PortionGuide.pdf. [Accessed September 29, 2016].
31. Eat Right Ontario. Handy Guide to Serving Sizes. Canada's Food Guide Serving Sizes. 2015. Available at http://www.eatrightontario.ca/getmedia/255dbbe6-23cd-4adf-9aba-f18310f09e3d/Handy-Servings-Guide-English-for-web-FINAL-October-2015.aspx. [Accessed September 29, 2016]
32. Shaw A, Fulton L, Davis C, Hogbin M. Using the food guide pyramid: a resource for nutrition educators. U.S. Department of Agriculture Food, Nutrition, and Consumer Services Center for Nutrition Policy and

Promotion; 2001. pp. 1-126. Available at www.nal.usda.gov/fnic/fpyr/guide.pdf. [Accessed July 4, 2013]

33. Family Matters, Family and Consumer Sciences, Colorado State University Extension and Zander A. Portion size vs serving size: What's the difference? Colorado State University Family Matters Newsletter. Family Matters, Family and Consumer Sciences, Colorado State University Extension. 2010. Available at www.ext.colostate.edu/pubs/fammatrs/fm1003e.pdf. [Accessed July 4, 2013].
34. Harray AJ, Boushey CJ, Pollard CM, Delp EJ, Ahmad Z, Satvinder S, *et al.* A novel dietary assessment method to measure a healthy and sustainable diet using the mobile food record: protocol and methodology. Nutrients 2015;7:5375-95.
35. Howes E, Boushey CJ, Kerr DA, Tomayko EJ, Cluskey M. Image-based dietary assessment ability of dietetics students and interns. Nutrients 2017;9:114.
36. Hedrick VE, Dietrich AM, Estabrooks PA, Savla J, Serrano E, Davy BM. Dietary biomarkers: advances, limitations and future directions. Nutr J 2012;11:109.
37. Kirkpatrick S, Collins CE. Assessment of nutrient intakes: introduction to the special issue. Nutrients 2016;8:184.