Food and Agriculture Organization
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Narrative review of data collection modalities for Minimum Dietary Diversity for Women: strengths, limitations and mechanisms

Project report

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Output for the project GCP/GLO/1027/GER: Advancing and Expanding the Uptake of Minimum Dietary Diversity for Women Indicator: Capacity Development on collection, interpretation and its use to inform food system transformative policies and programmes.

Activity 1.1.2: Conduct exploratory studies on different modalities for data collection

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Abbreviations and acronyms

24HR	24-hour dietary recall
CAPI	computer assisted personal interview
CATI	computer assisted telephone interview
CAWI	computer assisted website interview
LMIC	low- and middle-income country
MAD	minimum acceptable diet for children aged 6–23 months old
MDD-W	Minimum Dietary Diversity for Women aged 15–49 years
ODK	open data kit
PAPI	pen and paper interview

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Summary

The purpose of this activity was to conduct a narrative literature review on some key technology-supported modalities for dietary data collection used globally, with a view to promoting the use of convenient and reliable tools to support data collection through the for the Minimum Dietary Diversity for Women (MDD-W) indicator.

We reviewed three main technology-based data collection methods – computer assisted personal interview (CAPI), computer assisted telephone interview (CATI) and computer assisted website interview (CAWI) – exploring their advantages and disadvantages and considering real-life examples of where they have been applied to MDD-W. Each of these methods has strengths and weaknesses depending on the objectives of the research, the resources available to collect new data, and the contextual conditions under which the data collection is undertaken.

Despite their limitations, the technology-based data collection methods identified provide a promising alternative to traditional data collection using pen-and-paper questionnaires followed by manual data entry and cleaning. Technology-based data collection is more flexible and allows immediate verification of inconsistencies and a reduction of missing data. Appropriate use of technology-based tools can improve the quality of the dietary data collected for MDD-W and therefore support the optimal use of this indicator in order to inform action and ultimately improve nutrition.

Purpose, scope and project context

This activity was carried out as part of the project, *Advancing and Expanding the Uptake of Minimum Dietary Diversity for Women (MDD-W) Indicator: Capacity Development on collection, interpretation and its use to inform food system transformative policies and programmes,* supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) through the German Development Cooperation Agency (GIZ) - Knowledge for nutrition (K4N). The overall aims of the project include to strengthen capacities for collection, analysis and interpretation of MDD-W (capacity development component), and expand and advance of the use of MDD-W (evidence generation component).

The purpose of this activity was to review the literature in order to collect and synthesize evidence on the strengths and weaknesses of different data collection methods that could be applied to MDD-W enumeration. It is intended that this review will a) directly inform programme managers

and survey planners of the merits and limitations of available methods, and b) provide a foundation for further work to develop recommendations on data collection methods for MDD-W and/or the creation of supportive tools, such as ODK templates. It is hoped that this work will assist in the selection of the best methods for specific contexts, and lead to better data collection and ultimately more informed action.

This review focused on technology-based data collection tools that could replace traditional pen-and-paper methods for the collection of MDD-W data. The focus of the review was on data collection modalities that are applicable to, or have already been used for, non-quantitative food group-based dietary assessments. Dietary assessment approaches designed for quantitative dietary data collection or other types of non-dietary data collection were not considered.

1. Introduction

Individual-level dietary intake data is commonly collected by dietary assessment methods such as 24-hour dietary recall (24HR), food frequency questionnaires or diet records/diaries (Thompson & Byers, 1994). Since quantitative dietary intake assessments are often resource intensive (e.g. time, cost) and require highly specialized skills, shorter dietary assessment instruments (e.g. screeners, list-based recall) and proxy dietary indicators (including simple food group indicators such as MDD-W) have been developed and validated for situations that do not require assessment of the total diet (National Cancer Institute 2022; Verger et al 2019).

Several interviewing methods exist to capture food consumption in dietary surveys. The oldest method is the Pen and Paper Interview (PAPI), where data is collected face-to-face and recorded on paper. Survey data collection using PAPI typically involves several consecutive steps, such as: data collection using paper questionnaires followed by data entry, cleaning and analysis. The advantages of this traditional method are that it requires almost no technical expertise or advanced programming skills for implementation; it does not rely on hardware, software or internet connection, making it especially useful in rural or remote locations or when respondents are less familiar with new technologies (e.g. elderly); and it allows for great flexibility in the implementation of the survey design.

However, recent technological innovations have provided new opportunities that offer the potential to reduce the cost and time of data collection and the inconvenience of paper transport and storage, which can increase the risk of data loss (ABD, 2019). These new methods also offer the opportunity to lessen the cognitive burden (defined as the amount of working memory used) placed on the interviewer and respondent due to, for example, shortening the length of the interview, facilitating (standardized) coding and data analysis, and improving participation and data quality (ABD, 2019; Amoutzopoulos et al., 2018; Caeyers et al. 2012; Rahija et al., 2016).

Three key innovative interviewing methods are the focus of this review. Despite the variety of names given to them, they are identified by their most commonly used acronyms throughout this report: Computer Assisted Personal Interview (CAPI), Computer Assisted Telephone Interview (CATI) and Computer Assisted Website Interview (CAWI). Each of these methods presents advantages and disadvantages depending on the research objective, the resources available to collect new data and the contextual conditions in which the data collection is carried out.

2. Literature review methodology

A non-systematic review of the literature was conducted between August and September 2022 to identify articles pertaining to the three data collection methods for dietary intake assessment that were the focus of this review: CATI, CAPI and CAWI. PubMed and Google Scholar databases were searched using search terms relating to dietary or nutrition surveys, data collection methods, PAPI, CAPI, CATI, CAWI, face-to-face interviews, nutrition/dietary assessment, and technology-based data collection methods. Articles were selected for review if they were in English and contained sufficient information to evaluate tool features, functions and uses.

Thirty-two references were finally included in the narrative review. Articles were published between 1994 and 2022, with the majority published after 2009.

3. Computer assisted personal interview

3.1 How do computer assisted personal interviews work?

CAPI is the direct technological evolution of PAPI, and is characterized by an interviewer reading questions to the respondent from the screen of a handheld device, such as a tablet, pre-loaded with a dietary questionnaire or survey template. The respondent's answers are immediately entered into the device and ideally sent to a server in real time. For MDD-W data collection, CAPI is more suitable when the list-based method is used, as open recall is more challenging to programme into CAPI applications (ABD, 2019; FAO, 2021).

CAPI has been used to collect large-scale survey data, such as the Demographic and Health Surveys (AASA Consulting, 2019; Mercader et al., 2017; Paudel et al., 2013) and to collect dietary data for research studies (e.g. Global Diet Quality Score (GDQS), MDD-W, Minimum Acceptable Diet (MAD) for children 6–23 months old etc.) (AASA Consulting, 2019; Moursi et al., 2021; Shumayla et al., 2022).

Several software programmes have been developed to facilitate CAPI surveys, for example ODK, which has previously been used to collect MDD-W data (Hanley-Cook et al., 2020). Additional examples, including details on the developer and their estimated costs, are listed in **Table 1**

Table 1. Software used for computer assisted personal interviews, by developer and cost

SOFTWARE	DEVELOPED BY	COST (SEPTEMBER 2022)
OPEN DATA KIT (ODK)	University of Washington's Department of Computer Science and Engineering	Starts from USD 169/month (Unlimited forms, users, 10k monthly submissions, 10GB total storage, 1 project space, standard support, standard response time)
SURVEYCTO	Dobility, Inc., USA	USD 198/month (Unlimited storage, users, forms, devices, 24x7 access to professional support, 10,000 monthly submissions)
CBS BLAISE	CBS (Statistics Netherlands)	*Not found*
CSPRO	United States Census Bureau	Free
SURVEYTOGO	Dooblo, Israel	No license costs. Pay only for interviews
SURVEYBE	EDI Global, Tanzania	USD 50 /month
SURVEYSOLUTIONS	The World Bank	Free
EPI INFO	Centers for Disease Control and Prevention	Free
QUALTRICS	Qualtrics International Inc.	USD 1500–5000/year
KOBOTOOLBOX	Harvard Humanitarian Initiative	Free

Source: Authors' own elaboration from various sources.

Only five studies identified researched the acceptance of CAPI by respondents or assessed its cost-effectiveness, data quality, enumeration time and data collection efficiency, as compared to other methods (ABD, 2019; Amoutzopoulos et al., 2018; Caeyers e al. 2012; Rahija et al., 2016; Paudel et al., 2013; Thriemer et al., 2012). These studies focused, in particular, on low-and middle-income countries (LMICs), where the transition from PAPI to CAPI is likely to be more challenging with regard to logistics and respondent's acceptance (ABD, 2019; Mercader et al., 2017).

3.2 Strengths of the computer assisted personal interview data collection method

Respondent's acceptance of CAPI *vs* PAPI: Two studies tested respondents' perception of CAPI reported a high level of acceptance (Mercader et al., 2017; Paudel et al., 2013). The study by Paudel et al. elucidates the successful use of tablets and wireless technologies during the 2011 Demographic and Health Survey in Nepal. The authors reported that questionnaires administered in this way stimulated feelings of curiosity and respect among respondents who perceived the surveys as more important, increasing the desire to participate. Furthermore, similarly to other studies reviewed by the authors, a proportion of participants felt that the electronic survey was more confidential than PAPI forms, as the electronic versions could not be easily seen by others (Mercader et al., 2017; Paudel et al., 2013). However, cases of skepticism have also been reported due to the fear of being recorded (Mercader et al., 2017; Paudel et al., 2013; Van Heerden et al., 2013).

Respondent engagement: CAPI also allows enumerators to increase respondent engagement through images or other forms of sensory stimulus (e.g. video or sounds) to support questions compared to PAPI or other non-face-to-face interview methods. Like PAPI surveys, CAPI forms can allow multiple-choice and written responses, but they can also capture GPS location, take photos, record audio or video, perform calculations, allow respondents to draw onto photos, etc. Furthermore, as opposed to CATI or CAWI, during face-to-face interviews, enumerators can observe the local context and glean additional information. For example, when collecting MDD-W data through the open recall method, enumerators could see the types of vegetables in the garden/kitchen/market and assist the respondent to recall her diet through probing.

Cost-effectiveness: CAPI has emerged as a more economically viable option for larger surveys than PAPI (Adams et al., 2022; Mercader et al., 2017, Paudel et al., 2013). In general, CAPI has higher fixed costs than PAPI, including initial expenses for software development and purchase of hardware. However, many of the variable costs (per interview) sustained for PAPI, such as printing, data entry and data cleaning are eliminated or reduced with CAPI, especially for large surveys (Adams et al., 2022; Caeyers et al. 2012; Mercader et al., 2017; Sobhani & Zinab, 2017; Thriemer et al., 2012). In other words, as the sample size increases, fixed costs are offset by a decrease in variable costs (Rahija et al., 2016).

Time and data collection efficiency: As compared to PAPI, the direct export of collected data to an electronic database saves time during the subsequent data entry and cleaning phases (Krishna, 2016; Rahija et al., 2016; Sobhani & Zinab, 2017).

Enumerator monitoring: CAPI enables more efficient interview monitoring by automatically recording the start time, end time and GPS position of each interview. This makes it easy for supervisors to check whether an enumerator has actually conducted a given interview or not, by comparing the time and GPS data with those of other interviews during which a supervisor was present (Rahija et al., 2016).

Data quality: CAPI was found to improve data quality, through consistency checks that help avoid or eliminate data entry errors (Caeyers et al. 2012; Krishna, 2016; Paudel et al., 2013; Sobhani & Zinab, 2017; The World Bank, 2022; Yu et al., 2009). Usually, the use of CAPI applications minimizes missing information (FAO, 2021). CAPI software allows survey designers to programme validation conditions that detect erroneous data and display a warning message to the enumerator. They can also include skip patterns that can be programmed into the structure of the questionnaire and automatically enforced, eliminating routing errors. Additionally, as the data is immediately digitized during the interview, potential data entry errors during transcription from the paper to a database are eliminated (Caeyers et al. 2012; Rahija et al., 2016).

3.3 Limitations of the computer assisted personal interview data collection method

Shifting from PAPI to CAPI entails potential obstacles, particularly in LMICs (Mercader et al., 2017).

Logistics: CAPI relies on electricity, Wi-Fi connection and tablets, making the infrastructure and safety conditions in certain locations non-ideal for CAPI use (King et al., 2013; Paudel et al., 2013, The World Bank, 2022). Additional limitations of CAPI include technical problems during data collection (Sobhani & Zinab, 2017), and challenges related to the storage and transport of electronic devices in certain field settings (Mercader et al., 2017: Paudel et al., 2013).

Privacy and acceptance: In terms of acceptance of this method, the most frequently encountered concern of participants is that of being recorded or overheard (Mercader et al., 2017; Paudel et al., 2013; Van Heerden et al., 2013). Since screens are often difficult to read outside, especially in bright sunlight, some studies have revealed difficulties in finding private interview spaces indoors that would make the respondents comfortable when using CAPI (Mercader et al., 2017; Paudel et al., 2013).

Box 1. MDD-W collected via computer assisted personal interviews: the case of Haryana in India

In 2021, a community-based cross-sectional study was conducted among 1 236 lactating women aged between 18–35 years in selected villages in Haryana state, India. The study aimed to assess the prevalence of MDD-W and associated factors among lactating women.

MDD-W data was collected via CAPI. All tools were translated into the local language, Hindi, and a two-day training was conducted with enumerators on topics including handling the application, interview techniques, ethical considerations, participant rights, maintaining anonymity, reading and understanding the questions, and techniques to reduce under or over reporting. A pre-tested structured interview schedule was used to collect information on knowledge and practices on nutrition and maternal health, including MDD-W, basic socio-demographic variables, and service utilization. Timely monitoring was conducted for maintaining the quality of the data, and supervisors were assigned to randomly back-check and spot-check 10 percent of all forms.

The study found that three quarters of lactating women in Haryana attained MDD-W, which was linked to age, education and knowledge of nutrition (Shumayla et al., 2022).

4. Computer assisted telephone interview

4.1 How do computer assisted telephone interviews work?

Data collection is carried out through telephone interviews, where the interviewer reads questions to the respondent and records the answers on a computer, using a software application.

The Gallup World Poll is an example of a CATI application, where phone interviews are used to track important issues worldwide, such as food access, employment, leadership performance and well-being (Gallup, 2022). In the case of the Gallup World Poll, respondents' phone numbers are randomly generated with the random-digit-dial method, used mainly when a list of phone numbers to be called by interviewers is not available. However this method might produce non-existent phone numbers and waste time. Machine learning algorithms, based on a small subset of verified existing numbers, have been recently

used to create new numbers that are more likely to be true phone numbers. In most cases, however, respondents' phone numbers are accessed when sampling project participants.

4.2 Strengths of the computer assisted telephone interview data collection method

Cost-effectiveness: Some studies advocate for the economic advantage of CATI compared to face-to-face interviews, as it eliminates the need for field visits (ICRC, 2020; Lamanna et al., 2019; WFP, 2016).

Respondent engagement: The degree of sociality or anonymity of the interview process can also introduce bias in survey data, with both possible positive and negative effects. If, on one hand, as mentioned among CAPI's strengths, more accurate answers can be obtained when the enumerators are aware of the local context, on the other hand, respondents may be more reluctant to give answers that they feel are socially undesirable, due to the physical or verbal presence of the survey administrator. Therefore, surveys conducted by telephone may be less prone to social desirability or apprehension bias than those conducted through face-to-face interviews (Lamanna et al., 2019).

Time and data collection efficiency: Research in rural Ethiopia suggested that CATI can reduce recall cognitive bias compared to in-person 24HRs since telephone interviews offer the possibility to split the recall period into shorter chunks with more frequent phone calls (Assefa et al., 2022).

4.3 Limitations of the computer assisted telephone interview data collection method

Potential non-coverage bias: Data from September 2022 from Statista (Bankmycell, 2022) report that 83.4 percent of the world's population uses cell phones. In addition, voice calls are the most common use of cell phones in LMICs, making CATI a promising method of dietary data collection (Lamanna et al., 2019; WFP, 2016). However, although more and more people have access to mobile phones worldwide, cost and socioeconomic factors (e.g. gender norms or age) may still be barriers to smartphone penetration, especially in LMICs (OECD, 2018). Therefore, a potential non-coverage or selection bias may result from the exclusion of those without access to mobile devices or networks. This can be particularly counterproductive when measuring dietary indicators at the population level, as the segment of the population that does not own or use a cell phone is likely to consist mostly of the most economically disadvantaged people, who are also more likely to be nutritionally vulnerable (Lamanna et al., 2019).

Network coverage: Poor network coverage was reported to be the main limiting factor in the case study in Kenya by the World Food Programme, which assessed whether the use of CATI among women was both as feasible and effective as face-to-face interviews for collecting accurate data on MAD and MDD-W (Lamanna et al., 2019).

Trust and gender dynamics: In studies seeking to collect women's dietary data, limiting factors included concerns about receiving phone calls from unknown numbers as well as issues related to gender dynamics in some households, such as women needing to ask their husbands' permission to use the phone and participate in the study (Lipps & Lutz 2017; WFP, 2016).

Box 2. MDD-W collected via computer assisted telephone interviews: the case of Kenya

In 2019, CATI was used to collect MDD-W and MAD for children 6–23 months old, using a one-week test-retest study, in 1 821 households in Kenya (Lamanna et al., 2019). The study aimed at assessing the accuracy, feasibility and biases of collecting dietary data via CATI. Accuracy and bias were assessed by comparing individual scores and population prevalence of undernutrition collected via CATI with data collected via face-to-face surveys (i.e. PAPI or CAPI). Through CATI, ~75 percent (*n*=1 366) of the study participants were reached. Results showed that while MDD-W data was independent of the survey modality, children's nutrition scores were significantly higher when measured using CATI, both for dietary diversity (mean increase of 0.5 food groups, 95 percent confidence interval 0.3–0.6) and meal frequency (mean increase of 0.8 meals per day, 95 percent confidence interval 0.5–1.0), both components of MAD. Thus, using CATI led to a 17 percent higher reported prevalence of MAD among infants and young children. The authors argue that this result may depend on the social desirability factor. Indeed, caregivers may experience a stronger social desirability bias when speaking about their child's diet and breastfeeding practices, as compared their own eating habits.

Moreover, the researchers reported that women without mobile phone access were younger and had fewer assets than women with access, but had only marginally lower dietary diversity scores, resulting in a small non-coverage bias of 1–7 percent due to the exclusion of participants without mobile phones. Thus, the study concluded that collecting nutrition data from rural women in Africa with mobile phones may result in no change to as much as 25 percent higher dietary diversity estimates as compared to collecting the information via face-to-face interviews (i.e. CAPI or PAPI).

5. Computer assisted website interview

5.1 How do computer assisted website interviews work?

Recently there has been a proliferation of new tools to collect dietary data, as evaluated by Eldridge et al. (2018). Web surveys or online questionnaires, also known as CAWI, are among the methods suitable for 24HR data collection (Eldridge et al., 2018). CAWI consists of a survey or questionnaire provided to the respondent via a link, in a panel or on a website and therefore does not require the involvement of enumerators that personally engage with the respondent.

Multiple examples of such surveys now exist, although most examples found in this review were from high-income settings. Two examples are the NutriNet-Santé cohort study in France (Hercberg et al., 2010) and myfood24 (myfood24, 2022), a web-based 24HR where users enter their consumed foods on a website by searching food items in the underlying database. Features like portion size options, images and pop-up windows are implemented to guide the user through the self-administered recall (myfood24, 2022). A German study by Kock et al. (2021) validated this method by comparing its performance with a weighed food record and biomarkers. The study found that myfood24-Germany provided short-term intake estimates for energy and a range of nutrients that were comparable to a weighed food records. Both methods showed a similar extent of measurement error as compared to biomarkers. The authors concluded that myfood24-Germany was of comparable validity to more costly and time-consuming traditional dietary assessment methods (Koch et al., 2021).

As far as the authors are aware, there have been no cases of MDD-W data collected by the CAWI method.

5.2 Strengths of the computer assisted website interview data collection method

Unlike the other methods, online surveys are self-administered, therefore removing the costs related to enumerator training, remuneration and travel. CAWI allows survey conductors to reach a large number of respondents in a very short time (Tassinari, 2021), is less invasive than other survey methods, and may contribute to more standardized dietary assessment since it does not rely on enumerators (Eldridge et al., 2018).

5.3 Limitations of the computer assisted website interview data collection method

Since online surveys are self-administered, probing on the part of enumerators is not possible (Eldridge et al., 2018; Thompson et al., 2010). In fact, people may not pay attention to the foods they have eaten, may not remember everything, often do not know the contents of the foods consumed, and are unable to accurately estimate the portion sizes leading to inaccurate data (Thompson et al., 2010). This can also result in dietary under-reporting, which may be conscious or unconscious (especially prevalent among adolescents and overweight respondents) and may seriously influence observed diet-disease relationships (Ambrosini et al., 2018). While this may be relevant to all approaches described in this report, it is expected that CAWI, without the benefit of enumerator intervention, is most likely to be affected.

Coverage bias may also be a concern with CAWI, as it will have limited use in settings where smartphones and personal computers are not widely available (Eldridge et al., 2018). There is also the risk of abandonment by the respondent without having completed the interview (Tassinari, 2021). Other aspects should be considered with CAWI, such as the significant cost of developing the software, the need to adapt the questionnaire with a food list relevant to the local context and the possibility to use appropriate photos to assist the respondent with portion size estimation.

6. Additional considerations

6.1 Mixed mode surveys

Software solutions that combine two or three of these data collection modalities (CAPI, CATI and CAWI) in a single survey, such as IdSurvey, are increasingly common (Martin & Lynn, 2011). These so-called 'mixed-mode' approaches can result in more agile data collection since they provide researchers and participants with flexibility, increasing response rates (CFR, 2021; Martin & Lynn, 2011). For example, interviews may start by telephone and be completed online, or participants may be given the option to choose which modality they prefer (Martin & Lynn, 2011). However, standardizing such approaches is difficult, given that a recall predominantly based on CAWI might yield very different results than CAPI or CATI. There is also no evidence yet regarding over- and underreporting (Martin & Lynn, 2011). Like the

single modalities, appropriateness of the mixed mode will depend on many factors specific to the context in which the data is to be collected.

6.2 Data security

One important consideration of electronic data collection relates to data security. While this literature review does not cover data security aspects in detail, the authors recognize the importance of considering data security, including potential misuse, when collecting electronic data.

Collecting, processing and analyzing electronic data pose specific data security risks (e.g. sensitive information disclosure, risk of data being stolen, network exploits etc.)[1], for example when data is transferred from mobile devices to a server and/or stored on a server (ADB, 2019; UNSD, 2019). Therefore, encryption, at both the device level and during transmission, and preparing a data management plan to ensure data privacy can greatly mitigate such security risks. This could include storing and backing up anonymized data on network drives, storage services (e.g. SharePoint), or clouds; and 'preserving data' on a data repository (e.g. OSF-Open Science Framework).

Electronic data collection systems typically need to support multiple security objectives, namely:

- confidentiality (i.e. ensuring that data is properly protected from unauthorized disclosure both when stored on a mobile device and/or when transferred to the server);
- integrity (i.e. ensuring that data will not be modified (intentionally or unintentionally) or corrupted during storage and/or in the transmission process from the field to a server); and
- availability (i.e. ensuring the information system is functional and that authorized users can access data and services when needed) (UNSD, 2019).

The report, *Guidelines on the Use of Electronic Data Collection Technologies in Population and Housing Censuses,* prepared by the United Nations Statistics Division (UNSD), Department of Economic and Social Affairs (DESA), covers more details on security threats and vulnerabilities and provides recommendations on how to protect electronic data (UNSD, 2019).

[1] For a more detailed list of the major security concerns (threats and vulnerabilities) in the mobile data collection process, refer to page 70 of the report, *Guidelines on the use of electronic data collection technologies in population and housing censuses* (UNSD, 2019).

Summary of findings

Advantages and disadvantages of each analyzed method are summarized in **Table 2**.

Table 2. Summary of strengths and limitations of the different data collection methods

Method	Strengths	Limitations
PAPI	- Traditional method, high acceptance - Requires almost no technical expertise - Great flexibility in the implementation of the survey design - Suitable for populations less familiar with technology (e.g. elderly)	- Data entry and quality control are time consuming and subject to human error - Costs of printing and inconvenience with paper transport and storage - Greater risk of data loss
CAPI	- High acceptance - Higher cost-effectiveness compared to PAPI - Higher respondent engagement compared to PAPI - Higher time and data collection efficiency compared to PAPI - Better enumerator monitoring compared to PAPI - Higher data quality compared to PAPI	- May encounter some issues in terms of logistics, privacy and acceptance, especially in LMICs
CATI	- Relatively low cost compared to CATI and PAPI - Allows respondents greater freedom to engage at the level they wish - Efficient if repeated interviews are used	- Potential non-coverage bias - Network coverage - May be limited by trust and gender dynamics
CAWI	- Low costs associated with interview time - Less invasive for respondents	- Low reliability of self-reported data - Requires internet connection - Potential non-coverage bias - High costs associated with development

Source: Authors' own elaboration.

Conclusion

From this literature review, it can be concluded that each of the technology-supported data collection modalities reviewed have advantages and disadvantages, and that selection of the method should be made by assessing the specific context, needs and available resources.

Technology-assisted tools may offer benefits to the collection of MDD-W data in terms of cost, efficiency and data quality, and some evidence has emerged on the validity of data on MDD-W collected via CAPI and CATI. However, at present, the authors proceed with caution in recommending CAWI specifically for MDD-W, as no research on the validity of this method was identified. Recommendations for technology-based data collection include adapting the tools to the local context, piloting and refining the questionnaire, avoiding power outages or coverage problems by securing back-up solutions for power and internet connection. Moreover it is advisable to pay attention to issues such as GPS location and synchronization, particularly in contexts with poor internet connectivity and to carefully consider data protection and security by ensuring that ownership, possession, storage and utilization of data collected and transmitted are clearly planned and executed.

References

AASA Consulting (Pvt) Limited, Pakistan. 2019. *Baseline Survey of Implementation of the Nutrition-Sensitive Component (ER3) of the Programmeme for Improved Nutrition in Sindh (PINS).* Final Report. AASA Consulting (Pvt) Limited, Pakistan

Adams, K. P., Bell, W., Somé, J. W., Colaiezzi, B., Wafa, S., Rogers, B., & Coates, J. 2022. The cost and cost efficiency of conducting a 24-h dietary recall using INDDEX24, a mobile dietary assessment platform, compared with pen-and-paper interview in Viet Nam and Burkina Faso. *British Journal of Nutrition,* 1-15.

Ambrosini, G. L., Hurworth, M., Giglia, R., Trapp, G., & Strauss, P. 2018. Feasibility of a commercial smartphone application for dietary assessment in epidemiological research and comparison with 24-h dietary recalls. *Nutrition Journal,* 17(1), 1-10.

Amoutzopoulos, B., Steer,T., Roberts, C., Cade, J.E., Boushey, C.J., Collins, C.E., Trolle, E., de Boer, E.J., Ziauddeen, N., van Rossum, C., Buurma, E., Coyle, D., & Page, P. 2018. Traditional methods v. new technologies–dilemmas for dietary assessment in large-scale nutrition surveys and studies: a report following an international panel discussion at the 9th International Conference on Diet and Activity Methods (ICDAM9*)*.Brisbane, 3 September 2015. *Journal of Nutritional Science*, 7, e11.

Asian Development Bank (ADB). 2019. *The CAPI effect boosting survey data through mobile technology. A Special Supplement of the Key Indicators for Asia and the Pacific 2019*. Asian Development Bank

Assefa, T. W., McCullough, E., & McGavock, T. 2022. Measuring dietary diversity: evaluating a novel cell phone method to extend the reference period without increasing the cognitive burden on respondents in Ethiopia*. AgEcon Search*

Bankmycell. 2022. *How many smartphones are in the world?* In: *Bankmycell*. Cited 18 November 2022. https://www.bankmycell.com/blog/how-many-phones-are-in-the-world

Bromage, S., Batis, C., Bhupathiraju, S.N., Fawzi, W.W., Fung, T.T., Li, Y., Deitchler, M., Angulo, E., Birk, N., Castellanos-Gutiérrez, A., He, Y., Fang, Y., Matsuzaki, M., Zhang, Y., Moursi, M., Gicevic, S., Holmes, M.D., Isanaka, S., Kinra, S., Sachs, S.E., Stampfer, M.J., Stern, D., & Willett, W.C. 2021. Development and validation of a novel food-based Global Diet Quality Score (GDQS). *The Journal of Nutrition,* 151(Supplement_2), 75S-92S.

Caeyers, B., Chalmers, N., & De Weerdt, J. 2012. Improving consumption measurement and other survey data through CAPI: Evidence from a randomized experiment. *Journal of Development Economics*, 98(1), 19-33.

COMUNICATION FOR RESEARCH (CFR). 2021. Benefits of Mixed-Mode Surveys. In: *Communication for research- Market Research Blog.* Cited 13 January 2023. https://www.cfrinc.net/cfrblog/benefits-of-mixed-mode-surveys

Eldridge, A. L., Piernas, C., Illner, A. K., Gibney, M. J., Gurinović, M. A., De Vries, J. H., & Cade, J. E. 2018. Evaluation of new technology-based tools for dietary intake assessment—an ILSI Europe Dietary Intake and Exposure Task Force evaluation. *Nutrients*, 11(1), 55.

FAO. 2021. *Minimum dietary diversity for women.* Rome. https://doi.org/10.4060/cb3434en

Gallup. 2022. Methodology: How Does the Gallup World Poll Work*?* In: *Gallup. USA*. Cited 18 November 2022. https://www.gallup.com/178667/gallup-world-poll-work.aspx

Gicevic, S. 2018. *Dietary diversity, dietary quality and sustainable dietary surveillance*. Cambridge, Massachusetts, Harvard University. PhD dissertation.

Hanley-Cook, G.T., Tung, J.Y.A., Sattamini, I.F., Marinda, P.A., Thong, K., Zerfu, D., Kolsteren, P.W., Tuazon, M.A.G., & Lachat, C.K. 2020. Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) data collection: validity of the list-based and open recall methods as compared to weighed food record*. Nutrients,* 12(7), 2039.

Hercberg, S., Castetbon, K., Czernichow, S., Malon, A., Mejean, C., Kesse, E., Touvier, M., & Galan, P. 2010. The Nutrinet-Santé Study: a web-based prospective study on the relationship between nutrition and health and determinants of dietary patterns and nutritional status. *BMC Public Health*, 10(1), pp.1-6.

King, J.D., Buolamwini,J., Cromwell, E.A., Panfel, A., Teferi, T., Zerihun, M., Melak, B., Watson, J., Tadesse, Z., Vienneau, D., Ngondi, J., Utzinger, J., Odermatt, P., & Emerson, P.M. 2013. A novel electronic data collection system for large-scale surveys of neglected tropical diseases. *PloS One*, 8(9), e74570.

Koch, S. A., Conrad, J., Cade, J. E., Weinhold, L., Alexy, U., & Nöthlings, U. 2021. Validation of the web-based self-administered 24-h dietary recall myfood24-Germany: comparison with a weighed dietary record and biomarkers. *European Journal of Nutrition,* 60(7), 4069-4082.

Krishna, V. 2016. From Paper to Tablet-Based Surveys: An Introduction to Computer-Assisted Personal Interviews (CAPI). *Georg-August University of Göttingen. 10.13140/RG.2.1.3312.2808.*

Kurniawan, N. B. 2018. A systematic literature review on survey data collection system. In: *2018 International Conference on Information Technology Systems and Innovation (ICITSI)* (pp. 177-181). IEEE.

ICRC (International Committee of the Red Cross). 2020. *Remote data collection for food security and economic vulnerability*. Part 2 – implementation guidelines.

Lamanna, C., Hachhethu, K., Chesterman, S., Singhal, G., Mwongela, B., Ng'endo, M., Passeri, S., Farhikhtah, A., Kadiyala, S., Bauer, J.M., Rosenstock, T.S. 2019. Strengths and limitations of computer assisted telephone interviews (CATI) for nutrition data collection in rural Kenya. *PloS One*, 14(1), e0210050.

Lipps, O., & Lutz, G. 2017. Gender of interviewer effects in a multitopic centralized CATI panel survey. *Methods, data, analyses: a journal for quantitative methods and survey methodology (mda*), 11(1), 67-86.

Martin, P. & Lynn, P. 2011. *The effects of mixed mode survey designs on simple and complex analyses*.(No. 2011-28). ISER Working Paper Series.

Mercader, H. F. G., Kabakyenga, J., Katuruba, D. T., Hobbs, A. J., & Brenner, J. L. 2017. Female respondent acceptance of computer-assisted personal interviewing (CAPI) for maternal, newborn and child health coverage surveys in rural Uganda. *International journal of medical informatics*, 98, 41-46.

Moursi, M., Bromage, S., Fung, T.T., Isanaka, S., Matsuzaki, M., Batis, C., Castellanos-Gutiérrez, A., Angulo, E., Birk, N., Bhupathiraju, S.N. & He, Y., 2021. There's an app for that: Development of an application to operationalize the Global Diet Quality Score. *The Journal of Nutrition,* 151(Supplement_2), pp.176S-184S.

Myfood24. 2022. About myfood24. In*: Myfood24.* Cited 19 November 2022. myfood24® | About myfood24

National Cancer Institute. 2022. Short Dietary Assessment Instruments. *In: National Cancer Institute. Division of Cancer Control & Population Science.* USA. Cited 18 November 2022. https://epi.grants.cancer.gov/diet/screeners/

Nguyen, P.H., Tran, L.M., Hoang, N.T., Trương, D.T.T., Tran, T.H.T., Huynh, P.N., Koch, B., McCloskey, P., Gangupantulu, R., Folson, G., Bannerman, B., Arrieta, A., Braga, B.C., Arsenault, J., Kehs, A., Doyle, F., Hughes, D., & Gelli, A. 2022. Relative validity of a mobile AI-technology assisted dietary assessment in adolescent females in Vietnam. *The American Journal of Clinical Nutrition*, 116(4), 992-1001.

Organization for Economic Co-operation and Development (OECD). 2018. *Bridging the digital gender divide: include, upskill, innovate.* OECD.

Paudel, D., Ahmed, M., Pradhan, A., & Dangol, R. L. 2013. Successful use of tablet personal computers and wireless technologies for the 2011 Nepal Demographic and Health Survey. *Global Health: Science and Practice*, 1(2), 277-284.

Rahija, M., Mwisomba, T., Kamwe, M.A., Muwonge, J.& Pica-Ciamarra, U. 2016. Are CAPI based surveys a cost-effective and viable alternative to PAPI surveys? Evidence from agricultural surveys in Tanzania and Uganda*. Seventh International Conference on Agricultural Statistics.* Rome.

Shumayla, S., Irfan, E.M., Kathuria, N., Rathi, S.K., Srivastava, S., Mehra, S. 2022. Minimum dietary diversity and associated factors among lactating mothers in Haryana, India: a community based cross-sectional study. *BMC Pediatrics* 22, 525.

Sobhani, S. R., & Zinab, H. E. 2017. *De*velopment of a Computer Assisted Personal Interview (CAPI) tool for food and nutritional surveys using Food Frequency Questionnaire (FFQ) in Iran. *Journal of Nutritional Sciences and Dietetics*, 31-34.

Tassinari, D., Giassi, C. L. A., Giovanelli, A., De Santis, E., Boveri, S., & Asteria, C. 2021. *Italian Survey on Perception of Obesity and Bariatric and Metabolic surgery: a comparison between general practitioners and obese patients*.

Thompson, F. E., Subar, A. F., Loria, C. M., Reedy, J. L., & Baranowski, T. 2010. Need for technological innovation in dietary assessment*. Journal of the American Dietetic Association*, 110(1), 48.

Thompson, F. E., & Byers, T. 1994. Dietary assessment resource manual*. The Journal of Nutrition*, 124(suppl_11), 2245s-2317s.

Thriemer, K., Ley, B., Ame, S.M., Puri, M.K., Hashim, R., Chang, N.Y., Salim, L.A., Ochiai, R.L., Wierzba, T.F., Clemens, J.D., von Seidlein, L., Deen, J.L., Ali, S.M., & Ali, M. 2012. Replacing paper data collection forms with electronic data entry in the field: findings from a study of community-acquired bloodstream infections in Pemba, Zanzibar*. BMC Research Notes*, 5(1), 1-7.

United Nations Statistics Division (UNSD). 2019. *The Guidelines on the Use of Electronic Data Collection Technologies in Population and Housing Censuses.* United Nations, New York, NY 10017. USA.

Van Heerden, A., Norris, S., Tollman, S., Richter, L., & Rotheram-Borus, M. J. 2013. Collecting maternal health information from HIV-positive pregnant women using mobile phone-assisted face-to-face interviews in Southern Africa. *Journal of Medical Internet Research*, 15(6), e2207.

Verger, E. O., Ballard, T. J., Dop, M. C., & Martin-Prevel, Y. 2019. Systematic review of use and interpretation of dietary diversity indicators in nutrition-sensitive agriculture literature. *Global Food Security,* 20, 156-169.

WFP.2016. *mVAM for Nutrition Kenya Case Study*. Nairobi. https://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp291938.pdf

Yu, P., de Courten, M., Pan, E., Galea, G., & Pryor, J. 2009. The development and evaluation of a PDA-based method for public health surveillance data collection in developing countries. *International Journal of Medical Informatics,* 78(8), 532-542.

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