



Measurement of Fruit and Vegetable Consumption: Research Informing Practice

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Abstract - A working party from the Goulburn Valley Primary Care Partnership, located in rural Victoria, Australia, explored the literature for methods of measuring fruit and vegetable consumption, as part of a government funded initiative. Members of the working party are dispersed in various locations. The aim was to utilise the findings to inform the development of a survey and methodology to accurately measure baseline fruit and vegetable consumption in children, in each location of the working party members. Determining fruit and vegetable consumption of any population relies on accurate measurement methods. Eligibility criteria of the literature review was determined by the aims of the survey. Two members of the working party conducted the initial search of electronic databases, with the assistance of a librarian. The working party shared, reviewed, summarized and critiqued representative studies through electronic communication. The initial literature review yielded 176 articles. After de-duplication, 67 met the eligibility criteria. Peer review reduced this to 14 most relevant articles to inform survey development and project methodology. Self reporting of fruit and vegetable consumption is complicated by the subjective understanding of respondents, resulting in over and under estimation. There is evidence that inclusion of photographs of serving size overcomes this limitation and improves accuracy. There were many other methodological confounders, such as seasonal variation of consumption, which had not been previously considered. The literature review provided valuable information for the development of a local survey. Previous research identified important pitfalls. The systematic and rigorous literature review conducted will ensure that our project avoids methodologies which result in inaccurate baseline data of fruit and vegetable consumption.

Keywords - Fruit and vegetable (F&V) consumption, Literature review, Survey development, Accurate measurement of F&V

1. Introduction

In 2012, the Goulburn Valley Primary Care Partnership (GVPCP) committed to working collaboratively on one Integrated Health Promotion (IHP) Plan, as part of the Hume Region Regional Health Promotion Strategy (Department of Health Hume Region, 2011). The Regional Health Promotion Strategy requires agencies to work in partnership to plan, implement and evaluate initiatives that address identified priority areas. The GVPCP catchment area has five IHP-funded agencies, spread over a diverse area in rural Victoria, Australia, who selected Healthy Eating as the regional health promotion priority. The target population of children 0-12 years was chosen. Data indicates that only low proportions of children consume the daily recommended amount of fruit and vegetables necessary for healthy growth and protection from chronic disease later in life (Department of Health, 2010). The objective is to increase the number of

serves of fruit and vegetables consumed by children aged 0-12 in the GVPCP catchment.

The first aim for the GVPCP working party was to conduct a literature review of best practice methods for accurately measuring fruit and vegetable (F&V) consumption, which would inform survey development and a methodology for establishing accurate baseline data. Information collected would further aid in developing interventions that are targeted based on results. The methodology to be used by the working party in practice had not been pre determined, so the accuracy of both traditional methods and validated tools was to be explored through the literature review.

A literature review is considered the most efficient way to access a body of information and is a reliable basis for decision making, if the selection is unbiased, relevant and critically appraised (Monash University, 2013). Key features of a good literature review are a clearly stated aim, pre-defined eligibility criteria, reproducible methodology, a

systematic search, assessment of the included studies and presentation of the findings (Monash University, 2013).

2. Methods

Two members of the working party, assisted by a librarian, conducted an electronic search of data bases, including CINAHL, AustHealth and Cochrane Library. These data bases were chosen due to their link to public health. Search term headings included fruit, vegetables, food intake and nutritional assessment with keywords measur*, evaluat*, food* or fruit* or vegetable*, intake or portion* or serv*. Eligibility criteria of articles included; post 2001, English language, relevance of the article to the target age group and identification of the measurement method.

Children were not listed in the eligibility criteria, as the working party felt that this may limit the inclusion of useful tools. In addition the targeted age group necessitated parental involvement. The articles accessed were divided among the working party, with twelve staff reviewing articles and completing summaries using a template. The template was intended to focus the group on the review purpose of developing a data collection tool.

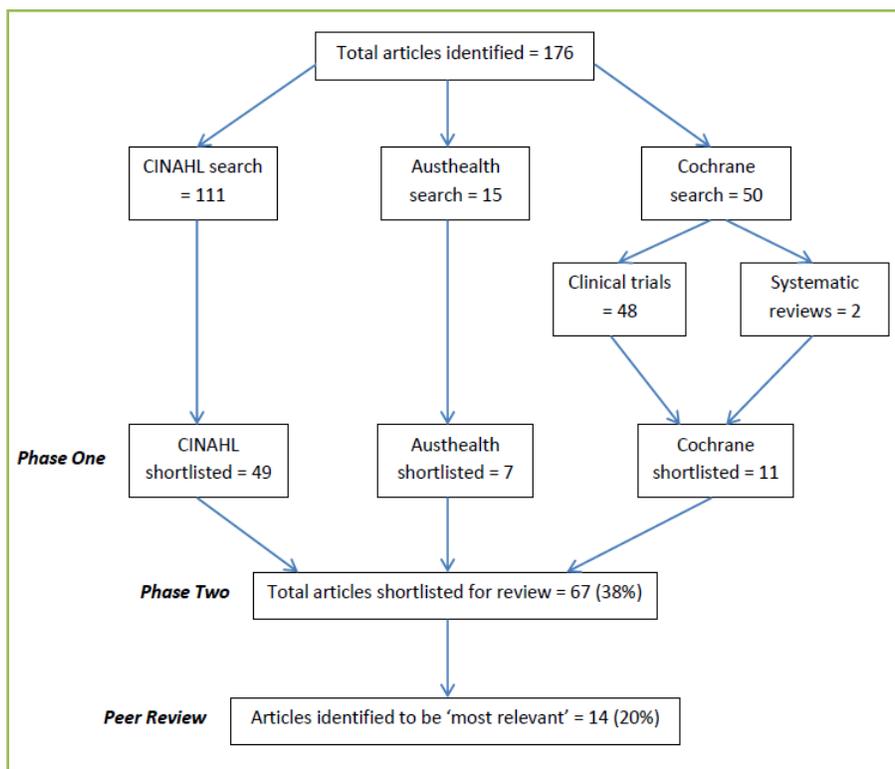
One staff member completed the initial review and articles were then exchanged between agencies for cross checking. Following this process, fourteen studies were identified to best meet the criteria of informing the group of accurate measurement tools for F&V consumption. Reasons for exclusion included articles that focused on monitoring environmental changes in settings, evaluations that did not measure F&V consumption, studies that did not align with the target group or methods that included an obviously high financial or human resource requirement.

The final 14 articles targeted adults, but given that our target group was 0-12 years, parental surveys were likely and therefore considered appropriate. Measurement of dietary intake in children aged 8 years and under relies on parental recall as children are unable to recall food intake and conceptualize time.

3. Results

From the electronic data bases an initial 176 articles were identified, mostly from CINAHL. Further short listing and review process is shown in Figure 1.

Figure 1. Electronic literature search and review process



Many of the final 14 articles were subjected to whole working party analysis. The articles, concepts and criteria are shown in Table 1. There were a variety of measurement tools

used in the studies from various countries. Each of the studies explicitly stated limitations and important findings.

Table 1. Analysis of final articles

Article	Population	Measurement tool used	Context	Ethical approval	Could it be easily replicated for our study?	Is it affordable?	Major finding
Thoradeniya T, de silva A, Arambepola C, Atukorala S & Lanerolle P 2012, 'Portion size estimation aids for Asian foods', <i>Journal of Human Nutrition and Dietetics</i>, 25, pp. 497–504	Schoolchildren aged 10-16 years	Photographic representation and line drawings of portion sizes compared to household measuring utensils	Sri Lankan children's estimation of Asian food portions	x	✓	✓	Portion size estimation aids improve accuracy of dietary recall
Cade JE, Frear L & Greenwood DC 2006, 'Assessment of diet in young children with an emphasis on fruit and vegetable intake: using CADET – Child and Diet Evaluation Tool', <i>Public Health Nutrition</i>, 9(4), pp. 501-508	Children aged 3-7 years	24hr food tick list compared to 24hr semi weighed food diary	Primary schools in the UK – utilizing food measures by non specialists	✓	x	x	Rapid collection of food and nutrient information – over estimation but better than food diaries
Thompson F, Subar, A., Smith, A., Midthune, D., Radimer, K., Kahle, L. & Kipnis, V. 2002. 'Fruit and vegetable assessment: performance of 2 new short instruments and a food frequency questionnaire'. <i>Journal of the American Dietetic Association</i>. ;102. pp 1764-1772.	Adults	24hr dietary recall, food frequency questionnaire and self administered all day food screeners, and by meal food screeners	4 telephone surveys of adults in the US	x	x	✓	There were substantial errors in survey wording, respondents understanding and estimation
Kim, D., Holowaty, E. 2003, 'Brief, validated survey instruments for the measurement of fruit and vegetable intakes in adults: a review'. <i>Preventative Medicine</i>,36, pp440-447	NA	Comparison of 10 brief survey instruments measuring fruit and vegetable intake	Systematic review of the literature from 1980 - 2002	NA	NA	NA	Greater validity of surveys which include questions on portion size and consumption. Surveys useful to evaluate interventions
Gaston, G., Belanger-Gravel, A., Paradis, A., Vohl, M., Perusse, L. 2008, 'A simple method to assess fruit and vegetable intake among obese and non-obese individuals'. <i>Canadian Journal of Public Health</i>.99, pp 494-498	Adults	Comparison of 6 item, 7 day period questionnaire (FV-Q)of food consumption to an interviewer administered food frequency questionnaire	Obese and non obese French Canadian adults	✓	x	x	The FV-Q can identify people who require nutritional counselling
Prochaska, J., Sallis, J. 2004, 'Reliability and Validity of a fruit and vegetable screening measure for adolescence'. <i>Journal of Adolescent Health</i>.34 pp163-165	Adolescents	2 item self administered measure of fruit and vegetable consumption, over 3 days at the time of eating compared to a food diary	US secondary school children	✓	x	✓	Over estimation of consumption when compared to a food diary
Traynor, M., Holowaty, P., Reid, D., Gray-Donald, K. 2006, 'Vegetable and Fruit food frequency questionnaire serves as a proxy for quantified intake'. <i>Canadian Journal of Public Health</i>, 97. pp286-290	Adults	Telephone administered 24hr recall compared to a food frequency questionnaire (FFQ)	Dietician administered to Canadian adults	x	x	x	The FFQ is a good proxy measure, however results were biased to high income, highly educated females
Prelop, M., Thai, C., Erausquin, J., Slusser, W. 2011, 'Improving low-income parents' fruit and vegetable	Parents of school aged children	Self administered questionnaires on knowledge, attitudes, behaviour and	Multi ethnic US school based intervention	✓	x	x	Positive changes in parent food knowledge and

intake and their potential to impact childrens' nutrition', <i>Heath Education</i> .111 pp 391-411		consumption	for low income parents. Controlled repeated measure used				behaviour from a robust, well designed intervention
Locke, E., Coronado, G., Thompson, B., Kuniyuki, A. 2009, ' Seasonal variation in fruit and vegetable consumption in a rural agricultural community'. <i>Journal of American Dietetic Association</i> . 109. pp45-51	Adults	Longitudinal interview administered questionnaire on monthly consumption of fruit and vegetables	Measurement of seasonal consumption of fruit and vegetables of Hispanic farm worker and non farm worker families in the US	x	x	x	There was a large seasonal variation in consumption patterns in the agricultural community, particularly among farm workers
Sirikulchayanonta C, Iedsee K, Shuaytong P, Srisorrachatr S. 2010'Using food experience, multimedia and role models for promoting fruit and vegetable consumption in Bangkok kindergarten children'. <i>Nutrition & Dietetics</i> .67 pp97-101	Kindergarten children	Before and after questionnaire of habits, preferences and consumption of fruit and vegetables.	A multimedia and role model intervention in Thai kindergartens	✓	x	x	Increased fruit and vegetable consumption occurred after the intervention
Oosthuizen D, Oldewage-Theron WH, Napier C. 2011. 'The impact of a nutrition programme on the dietary intake patterns of primary school children'. <i>South African Journal of Clinical Nutrition</i> 24, pp75-81	School children aged 9-13 years	24hr recall questionnaire of food consumption with a food model for portion sizes and nutrition knowledge questionnaire	Low income South African community with poor access to safe food and water	✓	x	✓	Knowledge improved but without improved consumption of fruit and vegetables
Mangunkusumo RT, Maisterhout JS, de Graaf N, Maarsingh EJ, de Koning HJ, Raat H.2006.' Internet versus paper mode of health and health behavior questionnaires in elementary schools: asthma and fruit as examples'. <i>Journal of School Health</i> 76.pp 80-86	School children aged 10-12 years	Paper based and electronic based FFQ to assess fruit intake	Comparison of the same tool administered differently to Dutch elementary school children	✓	x	✓	Electronic administration of surveys is accepted and preferred by children and yields similar responses
Huddy AD, Adams JK, Holden L, Newell SA, Van Beurden E, Dietrich UC. 2003.'Fruits and vegies in lunchboxes – accuracy of a prospective 24-hour food record for primary school children'. <i>Health Promotion Journal of Australia</i> 14. pp 141-143	Primary school children, year 4 and older	A prospective food record (TFV) compared to lunch box auditing of fruit and vegetable consumption	Australian school children from 16 geographically dispersed schools	✓	x	x	The TFV accurately measured fruit and vegetable in lunchboxes. Overall accuracy unknown
Worsley, A., Crawford, D. 2003. 'Some questions to consider in assessing dietary intake'. <i>Australasian Epidemiologist</i> 10. pp 16-18	NA	NA	An opinion piece on assessing dietary intake	NA	✓	NA	Dietary assessment is a highly specialised area with multi factorial confounders to accuracy, validity and reliability

4. Discussion

The articles were reviewed to achieve our aims; to inform survey development and methodology to accurately measure F&V consumption. We were aware that our study could not compare survey responses using a traditional/gold standard

dietary assessment such as weighed dietary records, due to limited human resources. Although the included studies would not necessarily be valid in our setting, we noted studies which did include reliability and validity measures.

Three of the studies (Godin; Prochaska, 2004; Thompson, 2002) reported over estimation or under estimation of serving sizes when using Food Frequency Questionnaires (FFQ) and

24-hour food recall. Another study (Traynor, 2006) identified the inability to assess this indicator with a FFQ. Accurate reporting of serving size is fundamental to understanding F&V consumption rates in populations. The inclusion of photographs demonstrating serving size was shown to improve accuracy (Thoradeniya, 2012) when using self reported questionnaires.

Electronic surveys for measuring F&V consumption demonstrate reliability, acceptance and in some instances preferability (Mangunkusumo, 2006), however, participation is limited to those with internet access. Previous studies report poor F&V consumption in low socioeconomic groups and those with limited education (Oosthuizen, 2011), which also likely to be the same groups without internet access. There is also evidence that groups with higher income and education are likely to be over represented (Traynor, 2006). A true representation of F&V consumption in a population requires inclusion of both groups. A method which increases accessibility is essential to promote response rates, especially for under- represented groups.

One study reported wide seasonal variation in F&V consumption (Locke, 2009), which had not previously been considered, but would be vital if the study has repeated measures. Projects with repeated measures, such as controlled before and after studies, were able to demonstrate a relationship between the intervention and changes to F&V consumption, knowledge or behavior (Huddy, 2003; Oosthuizen, 2011; Sirikulchayanonta, 2010).

Many previous studies report parental influence on childhood F&V consumption (Cade, 2006; Oosthuizen, 2011; Prelip, 2011; Sirikulchayanonta, 2010), thus parental behaviour, attitudes and beliefs are important to capture in a survey to understand environmental influences on children's food consumption. Some of the studies reviewed included F&V measurements, such as lunch box audits (Cade, 2006; Huddy, 2003; Kim, 2003; Oosthuizen, 2011; Prelip, 2011; Sirikulchayanonta, 2010) which our study could not resource or replicate due to financial constraints and capacity of working party. Despite this, they frequently provided valuable information.

Worsley and Crawford's article gives advice about assessing dietary intake and the importance of survey structure and expert advice to ensure that the data collected was meaningful and reliable (Worsley, 2003).

5. Conclusion

A comprehensive literature review was essential to ensure our study of F&V consumption in children utilized a measurement tool and methodology to maximize accuracy. No suitable tool was clearly identified therefore the learnings from previous studies informed development of local survey targeted at parents to determine F&V consumption of children 0-12 years. Although the survey was to be self developed for the local context, it was heavily informed by the findings from

the literature review. Previous studies revealed errors and confounding factors which could reduce the validity and reliability of the data collected. In addition this exercise prompted consideration of context, concepts and resource allocation regarding potential interventions which may be introduced as a result of the survey.

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