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Original Article

Availability of two self-administered diet history questionnaires for pregnant Japanese women: A validation study using 24-hour urinary markers

Mie Shiraishi [a, b, *], Megumi Haruna [a], Masayo Matsuzaki [a], Ryoko Murayama [c], Satoshi Sasaki [d]

[a] Department of Midwifery and Women's Health, Division of Health Sciences and Nursing, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
[b] Department of Children's and Women's Health, Division of Health Sciences, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan
[c] Department of Advanced Nursing Technology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
[d] Department of Social and Preventive Epidemiology, School of Public Health, The University of Tokyo, Tokyo, Japan

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ABSTRACT

Background: Accurate and easy dietary assessment methods that can be used during pregnancy are required in both epidemiological studies and clinical settings. To verify the utility of dietary assessment questionnaires in pregnancy, we examined the validity and reliability of a self-administered diet history questionnaire (DHQ) and a brief-type self-administered diet history questionnaire (BDHQ) to measure energy, protein, sodium, and potassium intake among pregnant Japanese women.

Methods: The research was conducted at a university hospital in Tokyo, Japan, between 2010 and 2011. The urinary urea nitrogen, sodium, and potassium levels were used as reference values in the validation study. For the reliability assessment, participants completed the questionnaires twice within a 4-week interval.

Results: For the DHQ (n = 115), the correlation coefficients between survey-assessed energy-adjusted intake and urinary protein, sodium, and potassium levels were 0.359, 0.341, and 0.368, respectively; for the BDHQ (n = 112), corresponding values were 0.302, 0.314, and 0.401, respectively. The DHQ-measured unadjusted protein and potassium intake levels were significantly correlated with the corresponding urinary levels ($r_s = 0.307$ and $r_s = 0.342$, respectively). The intra-class correlation coefficients for energy, protein, sodium, and potassium between the time 1 and time 2 DHQ (n = 58) and between the time 1 and time 2 BDHQ (n = 54) ranged from 0.505 to 0.796.

Conclusions: Both the DHQ and the BDHQ were valid and reliable questionnaires for assessing the energy-adjusted intake of protein, sodium, and potassium during pregnancy. In addition, given the observed validity of unadjusted protein and potassium intake measures, the DHQ can be a useful tool to estimate energy intake of pregnant Japanese women.

Introduction

Maternal nutrition is a significant factor for the well-being of both mother and fetus.[1–3] Deficiencies in energy and protein during pregnancy have been associated with low birth weight,[4] and the pathogeneses of preeclampsia and gestational diabetes mellitus (GDM) have been associated with excess energy and fat intake, as well as vitamin and mineral deficiencies.[1,2,5] The recent increase in the incidence of low birth weight and GDM in Japan[6,7] emphasizes the importance of adequate nutritional status. Therefore, accurate

* Corresponding author. Department of Children's and Women's Health, Division of Health Sciences, Graduate School of Medicine, Osaka University, 1-7, Yamadaoka, Suita, Osaka 565-0871, Japan.
E-mail address: mi-shi@umin.ac.jp (M. Shiraishi).
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assessment of dietary intake, especially energy intake, is required to estimate the risk of pregnancy complications. Nonetheless, no validated questionnaires for assessing energy intake, which is an indirect indicator of the overall quantity and quality of dietary intake, exist for pregnant Japanese women.

Dietary questionnaires, including diet history questionnaires (DHQs) and food frequency questionnaires, are often used in large epidemiological studies because they are less burdensome for participants and less costly than other dietary assessment methods. A self-administered DHQ and a brief-type self-administered diet history questionnaire (BDHQ) have already been validated for assessing energy intake and the intake of most nutrients using the dietary record, 24-hour urine collection, and doubly-labeled water methods in the non-pregnant, adult Japanese population.[8–11] The DHQ is a semi-quantitative questionnaire that assesses dietary intake for a total of 150 food and beverage items in the previous 1 month based on the following categories: the reported consumption frequency and portion size, usual cooking methods, and general dietary behavior.[8–11] The DHQ takes about 40 min to complete. On the other hand, the BDHQ is a fixed-portion questionnaire that assesses dietary intake for a total of 58 food and beverage items based on the reported consumption frequency, usual cooking methods, and general dietary behavior.[8] The BDHQ takes 10–15 min to complete. To identify the utility of the DHQ and the BDHQ as assessment tools for energy intake during pregnancy, validation studies with pregnant women are necessary.

Other studies in non-pregnant women have used energy expenditures derived from the doubly-labeled water method, human calorimeters, accelerometer or heart-rate monitoring to assess the validity of estimated energy intake.[12] Of these, the doubly-labeled water method has been regarded as the gold standard. However, this method cannot be applied to pregnant women because safety during pregnancy has not been verified. The other objective methods also have implementation problems: large-scale equipment is needed, the estimation of energy expenditure is difficult during pregnancy, or the value is easily affected by psychological status.[13] On the other hand, 24-hour dietary recalls and dietary records are often used as reference methods. However, these subjective methods have the possibility of reporting bias.

Protein and potassium intake are used as alternative markers to explore the validity of overall dietary intake because these nutrients are present in a variety of foods.[14–17] For example, protein is primarily found in meat, fish, beans, and cereals, while potassium is present in fruits, vegetables, beans, and potatoes. Protein and potassium intake measures are frequently validated using a 24-hour urinary excretion test. The 24-hour urine collection method is acceptable even for pregnant women because it is not a physically invasive procedure. In addition, the intake of sodium, which can be validated using a 24-hour urinary sodium level test, may be helpful for assessing energy intake[18] because it also reflects the consumption of a wide range of foods, including fish, shellfish, and processed foods.[19] Previous studies have indicated that the reporting accuracy of sodium intake, as well as those of protein and potassium intake, had a significant positive correlation with the reporting accuracy of energy intake,[20] and that the degree of misreporting did not greatly differ among energy, protein, sodium, and potassium intakes.[21] Protein, sodium, and potassium intake might complement each other as alternative markers of energy intake owing to their different sources. Thus, we assessed the indirect validity of energy intake by carefully interpreting the availability of these nutrients. It is also important to evaluate the validity and the reliability of protein, sodium, and potassium intake measures themselves during pregnancy, since an excess or deficiency of these nutrients affects fetal growth and may result in pregnancy complications.[22–24]

The present study was designed 1) to assess the validity of the DHQ and the BDHQ for estimating protein, sodium, and potassium intake levels using the 24-hour urinary markers; 2) to assess the validity of the DHQ and the BDHQ for estimating energy intake levels using unadjusted intake of protein, sodium, and potassium as alternative indicators; and 3) to investigate the reliability of the DHQ and the BDHQ via comparing the dietary intake levels estimated using repeated administrations of the questionnaires.

Methods

Overview of the recruitment criteria and study design

Validation study

The present study was conducted at a university hospital in Tokyo, Japan. The BDHQ was administered between June and December 2010, while the DHQ was administered between January and June 2011. Thus, participants of the DHQ validation study and those of the BDHQ validation study were recruited separately. Healthy Japanese women with singleton pregnancies were recruited at 15–19 weeks of gestation. Those with diabetes, hypertension, and psychological diseases, as well as those who were less than 20 years of age and those who had a low Japanese literacy level, were excluded from the study. These inclusion and exclusion criteria were the same in validation studies for both the DHQ and BDHQ. Each participant received written and verbal information about the study protocol before providing written informed consent. The research ethics committee of the Graduate School of Medicine at the University of Tokyo approved the study procedures and protocol.

The participants responded to the questionnaires while waiting for their pregnancy checkup at 19–23 weeks of gestation. Participants received instructions on how to complete the DHQ and the BDHQ before answering them. The participants who did not have sufficient time to complete the questionnaires in the hospital filled them out after returning home (within 7 days) and submitted them via mail. We resolved missing or unclear data face-to-face or through a telephone interview.

Twenty-four-hour urine collection was conducted within the 5 days preceding the pregnancy checkup at 19–23 weeks of gestation.

Reliability study

To assess the reliability of the BDHQ and the DHQ, pregnant women at 15–19 weeks of gestation were recruited between October and December 2010 and between January and March 2011, respectively. The participants were a subsample from each validation study. The first measurement (time 1) was completed upon recruitment, and participants were later asked to complete the questionnaire a second time. The second measurement (time 2) was completed 4 weeks after the time 1 survey.

Diet history questionnaire

The DHQ was designed to assess the dietary intake of Japanese adults over the previous month[8–11] and has been previously validated for some fatty acids and vitamins in pregnant Japanese women.[25–28] Estimates of dietary intake for a total of 150 food and beverage items were calculated using an *ad hoc* computer algorithm, which included weighting factors for the DHQ. The estimates were based on consumption frequency and portion size of selected food and beverage items, daily intake of staple foods (rice, other grains, bread, noodles, and other wheat products), soup for noodles, and miso soup; usual cooking methods for fish, meat, eggs, and vegetables; and general dietary behavior, such as seasoning