

## Article

# Energy Intake Evaluation by a Learning Approach Using the Number of Food Portions and Body Weight

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**Abstract:** An accurate quantification of energy intake is critical; however, under-reporting is frequent. The aim of this study was to develop an indirect statistical method of the total energy intake estimation based on gender, weight, and the number of portions. The energy intake prediction was developed and evaluated for validity using energy expenditure. Subjects with various BMIs were recruited and assigned either in the training or the test group. The mean energy provided by a portion was evaluated by linear regression models from the training group. The absolute values of the error between the energy intake estimation and the energy expenditure measurement were calculated for each subject, by subgroup and for the whole group. The performance of the models was determined using the test dataset. As the number of portions is the only variable used in the model, the error was 26.5%. After adding body weight in the model, the error decreased to 8.8% and 10.8% for the normal-weight women and men, respectively, and 11.7% and 12.8% for the overweight women and men, respectively. The results prove that a statistical approach and knowledge of the usual number of portions and body weight is effective and sufficient to obtain a precise evaluation of energy intake after a simple and brief enquiry.

**Keywords:** prediction of energy intake; total number of food portions; body mass index; energy expenditure; dietary apps



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## 1. Introduction

The evaluation of energy intake is commonly performed using the 24-h dietary recall or frequency questionnaire, or 3- to 7-day reported food intake [1,2]. Doubly labelled water (DLW) is used as a reference method to measure total energy intake (TEE) in free-living conditions and to validate reported energy intake in many studies, including [3,4]. This reference methodology is based on the fundamental principle of energy balance, meaning that total energy expenditure (TEE) is equal to energy intake when the body weight is stable (in the absence of a significant weight change) [5]. Many authors found a positive correlation between TEE measured by DLW and body weight, but a flat slope between TEE and reported energy intake [6–8]. According to these authors, the underestimation of energy intake concurrent with increasing weight may be due to the imitation error of the food reported by the general population. That means that food intake is reported in the same way, regardless of the body weight range. This is confirmed by Novotny et al. (2003), who found an overall underreporting of 294 kcal/d energy intake [9]. This underestimation of energy intake was higher in women than in men: 85% of women underreported their food intake by 621 kcal/d, whereas 61% of men underreported theirs by 581 kcal/d. In