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ORIGINAL RESEARCH

Frequency of Dietary Recalls, Nutritional Assessment, and Body Composition Assessment in Men With Chronic Spinal Cord Injury

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Abstract

Objectives: To assess different frequencies of dietary recalls while evaluating caloric intake and the percentage of macronutrients in men with spinal cord injury (SCI) and to examine the relations between caloric intake or percentage of macronutrients and assessment of whole and regional body composition using dual-energy x-ray absorptiometry.

Design: Cross-sectional and longitudinal.

Setting: Laboratory and hospital.

Participants: Men with chronic (>1y postinjury) motor complete SCI (N=16).

Interventions: Participants were asked to turn in a 5-day dietary recall on a weekly basis for 4 weeks. The averages of 5-, 3-, and 1-day dietary recalls for caloric intake and percentage of macronutrients (carbohydrates, fat, protein) were calculated. Body composition was evaluated using whole-body dual-energy x-ray absorptiometry. After overnight fast, basal metabolic rate (BMR) was evaluated using indirect calorimetry and total energy expenditure (TEE) was estimated.

Main Outcome Measures: Caloric intake, percentage of macronutrients, BMR, and body composition.

Results: Caloric intake and percentage of macronutrients were not different after using 5-, 3-, and 1-day dietary recalls ($P>.05$). Caloric intake was significantly lower than TEE ($P<.05$). The percentage of fat accounted for 29% to 34% of the whole and regional body fat mass ($P=.037$ and $P=.022$). The percentage of carbohydrates was positively related to the percentage of whole-body lean mass ($r=.54$; $P=.037$) and negatively related to the percentage of fat mass.

Conclusions: The frequency of dietary recalls does not vary while evaluating caloric intake and macronutrients. Total caloric intake was significantly lower than the measured BMR and TEE. Percentages of dietary fat and carbohydrates are related to changes in body composition after SCI.

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Metabolic dysfunction after spinal cord injury (SCI) is the product of sequential factors including reduced level of physical activity, altered body composition, and diminished anabolic hormones.[1-5] Several studies have clearly documented that individuals with SCI are at increased risk of developing chronic obesity–associated disorders including hypertension, cardiovascular disease (228%), and diabetes mellitus (50%–75%) than are their age- and weight-matched able-bodied counterparts.[2-5] The prevalence of hypertension may exceed 45% in persons with tetraplegia and 64% in those with paraplegia.[6] Moreover, improvements in medical interventions increase the survival rate and are likely to lead to a significant

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increase in chronic disorders with time since injury and level of SCI.[4,6] Therefore, studying the factors that lead to the associated body composition and metabolic disorders is of paramount importance to improve the quality of life and reduce socioeconomic burdens on caregivers, families, and individuals with SCI.[1,2]

To date, there are no established dietary guidelines available for persons with SCI.[7-9] The paucity of information on the appropriate dietary recommendations stemmed from failure to accurately quantify the caloric needs for persons with chronic SCI relevant to the changes in body composition. A basic untested rationale is that persons with chronic SCI consume high caloric intake accompanied by reduced basal metabolic rate (BMR) and level of physical activity,[5] which results in an imbalance between caloric intake and expenditure.[5] This imbalance will lead to increase in fat mass (FM) and cause adverse changes in body composition. However, this rationale is not supported by the findings that individuals with SCI consume caloric intake below the recommended level.[9] Therefore, measuring BMR or total energy expenditure (TEE), rather than estimating, may accurately refute or confirm this claim. Cox et al[10] showed that BMR and TEE were 19.5 and 23.4kcal/(kg•d), respectively, after overnight fast. The same study estimated that total caloric intake was 1774Kcal/d or 27.4kcal/(kg•d) in a hospitalized group. This result indicated a positive energy balance of 4kcal/(kg•d). The study used a 1-day dietary recall that may have overestimated the caloric intake.[10] Contrary to these findings, the prevalence of malnutrition was ~44% in newly admitted adults with SCI in a multicenter trial.[11] Another study[12] showed that athletes with SCI have high cognitive dietary restraints to regulate their caloric intake. The low caloric intake may be explained by the fact that energy requirements are often considerably less than expected based on body mass and physical activity level in adults with SCI.[13,14]

Food consumption has been evaluated using different strategies including dietary recalls.[7-10] There is no agreement on the appropriate frequency of dietary recalls that can be used to accurately capture daily caloric intake and evaluate macronutrients. Seven days of dietary recalls over the course of 12 weeks have previously been used to quantify caloric intake and determine the percentage of macronutrients during a resistance training program.[15] Others have used 4 days or 1 day of dietary recalls to measure caloric intake.[8,10] The discrepancy in the frequency of dietary recalls is likely to cause either overestimation or underestimation of caloric intake. Seven-day dietary recalls appear to be a logistic strategy; however, the processes of data entry and data analysis are laborious and need extensive commitment, especially in a longitudinal study.[15] Moreover, the macronutrient data from the 7-day recall study were in agreement with those of the 4-day dietary recall study.[7,10] Both studies agreed that the percentage of carbohydrates ranged between 45% and 47%, percentage of fat between 34% and 37%, and percentage of protein between 17% and 19%.[9] However, caloric intake in the 7-day recall study (1512−1817kcal/d) over 12 weeks was lower than that in the 4-day recall study (2580kcal/d) and close to what has been reported by others.[8,10,15]

List of abbreviations:

BMI	**body mass index**
BMR	**basal metabolic rate**
DXA	**dual-energy x-ray absorptiometry**
FM	**fat mass**
SCI	**spinal cord injury**
TEE	**total energy expenditure**

The purpose of the present study was to investigate the effects of the frequency (5, 3, and 1d) of capturing dietary recalls on measuring caloric intake and percentage of macronutrients over a 4-week period in persons with chronic motor complete SCI. Moreover, the balance between BMR, TEE, and caloric intake was evaluated in persons with chronic SCI. We have also evaluated the relations between caloric intake, percentage of macronutrients, and body composition variables as well as BMR. On the basis of previous findings,[9,11,12] we hypothesized that total caloric intake will be lower than BMR and TEE. Percentages of fat and carbohydrates may explain body composition variables.

Methods

Sixteen individuals with motor complete SCI (C5-T10; mean age, 38±9y; mean weight, 84±14kg; mean height, 1.8±0.07m; mean body mass index [BMI], 25.7±4.3kg/m^2) were enrolled as a part of a national study investigating the effects of exercise and testosterone on body composition and metabolic profile after SCI. The study was conducted at the McGuire VA Medical Center in collaboration with the Clinical Research Unit at Virginia Commonwealth University Medical Center. All participants were asked to read and sign consent forms that were approved by the local ethical committee. All study procedures were conducted according to the Declaration of Helsinki.

Inclusion and exclusion criteria

Participants were included if they had motor complete SCI (C5-L2; American Spinal Injury Association Impairment Scale classification A and B) and >1-year duration to ensure a homogeneous sample, were between 18 and 50 years of age, and were responsive to electrical stimulation.[15] Participants with preexisting medical conditions (uncontrolled hypertension, uncontrolled hyperglycemia or a hemoglobin A_{1c} level >7.0%, chronic arterial diseases, recent deep vein thrombosis, uncontrolled autonomic dysreflexia, severe spasticity, fractures, pressure ulcers greater than grade II, documented osteoporosis, uncompensated hypothyroidism, renal disease) were excluded from the study.

Measurements

Each participant was asked to void his bladder and then to propel onto a wheelchair weighing scale (PW-630U[a]). After weighing the participant and his wheelchair (in kg; component 1), participants were helped to transfer to an adjustable mat and their wheelchairs were weighed empty (in kg; component 2). The weight (in kg) of each participant was determined by subtracting component 2 from component 1. The height of each participant was determined at the left side in the supine position after transferring to the mat and properly aligning the head, trunk, and the legs. Two smooth wooden boards were placed on the participant's head and heels, and the distance between them correspond to the height in nearest centimeter. Every effort was made to maintain the knees in an extended position. The BMI (in kg/m^2) was calculated as the weight (in kg) divided by the height (in m^2).[16-20]

Dual-energy x-ray absorptiometry

Dual-energy x-ray absorptiometry (DXA) was used to measure body composition in individuals with SCI, specifically regional and