Available online at www.sciencedirect.com

SCIENCE DIRECT

Preventive Medicine 41 (2005) 203–210

Preventive Medicine

www.elsevier.com/locate/ypmed

Comparison of energy and nutrient intakes among meals and snacks of adolescent males

Nancy K.A. Stockman, M.Sc., R.D., Tanja C. Schenkel, M.Sc., R.D., Jessica N. Brown, B.Sc., Alison M. Duncan, Ph.D., R.D.*

Department of Human Biology and Nutritional Sciences, University of Guelph, Guelph, Ontario, Canada N1G 2W1

Available online 10 December 2004

Abstract

Background. Eating behaviors developed during adolescence can have immediate health implications and influence future chronic disease risk. The objectives of this study were to determine and compare the distribution of energy and nutrient intakes among meals and snacks, and relate eating occasion frequency to body mass index (BMI) of adolescent males.

Methods. Healthy adolescent males (n = 180) completed 3-day food records. Following analysis for energy and nutrient intakes, 3-day averages and frequencies were computed for all meals and snacks.

Results. Dinner was the largest contributor of energy, macronutrients, cholesterol, dietary fiber, and sodium, whereas both dinner and breakfast were the largest contributors of calcium and iron. On average, subjects consumed 1.63 snacks/day, with 77% consuming ≥1 snack/day. BMI was significantly greater and energy intake was significantly lower in subjects having ≤3 eating occasions/day relative to 4 or ≥6 eating occasions/day. The 26% of subjects classified as inconsistent breakfast consumers had significantly higher BMIs and lower iron intakes relative to consistent breakfast consumers.

Conclusions. This study provides valuable information regarding eating occasion frequency and contribution of meals and snacks to energy and nutrient intakes in adolescent males. Such information could be used to improve nutrition education programs for adolescents aimed at chronic disease prevention.

Keywords: Adolescent males; Diet; Nutrient intakes; Meals; Breakfast; Snacks; Intake distribution; Eating frequency

Introduction

Adolescence is a period marked by rapid growth and development, creating increased demands for energy and nutrients [1,2]. It is a unique time as physiologic, psychosocial, and cognitive development is also occurring [1]. The profound changes that occur during this time create a life stage where individuals are nutritionally vulnerable [2]. Not only is there a greater demand for energy and nutrients, but there is also a change in lifestyle and eating habits that can affect both nutrient intakes and needs of the adolescent [2].

Several lifestyle changes occur during adolescence that may influence eating behaviors and subsequent nutrient intakes. There is a growing control over the food environment, food is often consumed away from home, ready-to-eat foods are easily accessible, there is an increased tendency to skip meals, and more frequent snacking occurs [3–8]. Furthermore, other factors such as peer pressure, body image, mass media, nutrition knowledge, and changes in activity patterns can also influence eating behaviors and nutrient intakes [3,8,9].

Eating behaviors developed during adolescence can have immediate effects on several health issues such as iron deficiency anemia, excess body weight, and dental caries [4,10]. Eating behaviors can also have long-term health effects on risk of chronic diseases including obesity [10–15], cardiovascular disease [10,11,14–16], osteoporosis

* Corresponding author. Fax: +1 519 763 5902.
E-mail address: amduncan@uoguelph.ca (A.M. Duncan).

0091-7435/$ - see front matter © 2004 Elsevier Inc. All rights reserved.
doi:10.1016/j.ypmed.2004.11.001

[10,14,15], and cancer [10,14,15]. The relation of adolescent eating behaviors and nutrient intakes to immediate and long-term health issues rationalizes the need for dietary assessment studies of this population group.

Although dietary assessment research has examined the nutritional adequacy of adolescent diets, fewer studies have examined the distribution of energy and nutrient intakes throughout the day. Nutrient intake at breakfast has received the most scientific attention, largely because it is the most frequently skipped meal among adolescents [5,17] and its omission has been associated with higher body mass index (BMI) [5], less nutrient-dense diets [18–21], and more nutrient inadequacies [18,19,21]. Snacks have also been researched due to their frequent occurrence in adolescence [6,22] and their relation to lower consumption of well-balanced meals [23] and improved nutritional quality of the diet [22,24].

In addition to specific eating occasions, there is interest in the number of daily eating occasions and its relation to BMI and energy intake. Increased eating frequency among adolescents has been associated with lower BMI in both epidemiological [25] and intervention [26] studies, suggesting that consuming food more frequently and distributing intake more evenly throughout the day are associated with leanness [25,26]. However, concerns have been raised that these results are vulnerable to methodological errors, specifically that any relationship between eating frequency and body weight regulation is likely mediated by changes in energy intake [27]. In view of the increasing prevalence of adolescents who are overweight [28,29], the relation of eating frequency to BMI and energy intake warrants further investigation.

More information is needed regarding the contribution of meals and snacks to energy and nutrient intakes and the relation of eating occasion frequency to BMI and energy intake, particularly in adolescent males. The current study was undertaken to determine and compare the distribution of energy and nutrient intakes among meals and snacks of adolescent males, as well as relate frequency of eating occasion to BMI and energy intake.

Methods

This research was approved by the Human Research Ethics Board of the University of Guelph and the Research Committees of local high schools.

Subject recruitment

Healthy adolescent males between 14 and 18 years old were recruited from local high schools and community groups. Following a review of the study information packet, written informed consent was provided by subjects as well as assent from their parent or legal guardian if they were younger than 18 years old.

Study orientation seminars

Study orientation seminars were arranged for small groups of subjects to explain all aspects of the study and provide training on the completion of accurate food records. Food models, food labels, standard measuring cups and spoons, as well as bowls and drinking glasses were used in an interactive demonstration to maximize understanding and comprehension of how to complete food records. Instruction was also provided on how to read food labels and how to record home-cooked recipes. The importance of detail, accuracy, and honesty was stressed and questions were encouraged.

Subjects were then provided with food record forms and instructed to record all food and drink consumed for 24 h on three consecutive days including two weekdays and one weekend day. Forms included areas to indicate the time, type, and quantity of food consumed and preparation method. In addition, subjects were instructed to self-report the type of every eating occasion as breakfast, lunch, dinner, or snack.

Individual follow-up meetings

Following completion of the 3-day food record, each subject attended a prescheduled individual follow-up meeting with a study coordinator. During this meeting, the study coordinator reviewed the 3-day food record with the subject and addressed any uncertainties, errors, or omissions. Height and body weight of each subject wearing light clothing and no shoes were measured using a standard measuring tape and a calibrated body weight scale.

Data and statistical analyses

In order to categorize subjects into body weight categories, calculated BMI along with age was plotted on the Centers for Disease Control and Prevention (CDC) Growth Charts for boys, 2–20 years old [30,31] for determination of BMI-for-age percentiles. Subjects were then classified according to the following body weight categories as outlined by the CDC [31]: underweight (<5th percentile), acceptable body weight (5th to <85th percentile), at risk for overweight (85th to <95th percentile), or overweight (≥95th percentile).

All food records were analyzed for energy, protein, carbohydrate, total fat, saturated fat, cholesterol, dietary fiber, calcium, iron, and sodium using NutriBase IV Clinical Edition™ 2001. This food database contains nutrient information for over 30,000 foods, including 6210 food items for up to 82 food components from the United States (U.S.) Department of Agriculture Standard Reference, Release 13 Nutrient Database, and 4668 food items for up to 115 food components from the Canadian Nutrient Files.

Intakes of energy and nutrients at breakfast, lunch, dinner, and snacks as well as daily totals were computed