An Analysis of Socioeconomic Differences in

Diet Composition and How This Influences Variations in Obesity

Among Women

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Abstract

Obesity is a multi-factorial entity which tends to be resistant to intervention, pointing to the need for prevention. Obesity is more prevalent in lower socioeconomic status (SES) groups than in higher SES groups. This inverse relationship has been well-documented in women, and to a lesser degree, in men. Fewer studies have investigated the behavioural factors which may contribute to the different prevalence in obesity.

This study has three purposes: 1) to investigate SES differences in intake of total energy, fat, carbohydrate, total, insoluble and soluble non-starch polysaccharide (NSP), and fruit and vegetables; 2) to examine SES and intake of dietary variables above while considering rural/urban differences, cigarette smoking status, obesity, under-reporting of dietary intake and physical activity 3) to assess whether SES differences in diet contribute to the differential prevalence of obesity by SES.

Data from the Heart Health Intervention Evaluation baseline study (1992-93) was used to provide data on women between 18-74 years old. Three-day food diaries were used to gather nutrient information, which were analyzed using, for nutrients, the NUTS database and, for NSP, CarbCount. A supplementary questionnaire, given to those who completed the 3-day diary, was used to assess physical activity.

All analyses were age-stratified. For the 18-34 year group, there were socioeconomic differences in the percent energy from fat, percent energy from carbohydrate, grams of total, insoluble and soluble NSP, and total, insoluble and soluble NSP densities (g/1000kcal). SES groups did not differ in intake of total energy or in grams of fruit and vegetables. In the 35-54 year group, there were socioeconomic differences in grams of total, insoluble and soluble NSP, and total, insoluble and soluble NSP densities, and grams of fruit and vegetables, but not in percent energy from fat or carbohydrate, or in total energy. In the 55-74 year group, there were no SES differences in intake of dietary variables evaluated.

There was no evidence of effect modification of the SES-diet relationships by rural/urban status, cigarette smoking status, under-reporting, obesity or physical activity, although the power to detect these differences was low.

Multi-variate logistic regression analysis revealed that the best independent predictors of obesity varied as a function of age. In the 18-34 year group, the following variables were significant unconfounded predictors of the presence of obesity: having a diet with $\geq$ 35% energy from fat, being an ex-smoker, under-reporting and low educational attainment. Education differences in fat intake may predict the presence of obesity. In the 35-54 year group, the following conditions were significant predictors of being obese: under-reporting, and the joint combination of being an ex-smoker and consuming a diet of < 50% energy from carbohydrate. High education was less likely to be obese than those of low education. Dietary differences in the education groups did not predict the presence of obesity. In the 55-74 year group, under-reporting and the joint combination of being a present smoker and consuming a diet $\geq$ 35% energy from fat significantly predicted the presence of obesity. There were no education differences in diet, and thus they could not predict the presence of obesity.

SES had the strongest relationship with dietary variables in the 18-34 year group, to a lesser extent in the 35-54 year group, and no effect in the 55-74 year group. Since the magnitude of dietary differences with SES were small, the issue of statistical versus clinical significance, in terms of their relationship to obesity, is raised. Education may not be a sensitive indicator of SES in the 55-74 year group. These findings have implications for health promotion by identifying an area of focus for nutrition education and community programs. Research should move forward into understanding why there are SES differences in diet. From this understanding, health promotion efforts may be targeted more appropriately at specific groups.

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Dedication

This work is dedicated to my mentors - my parents, John and Diana Sokolowski who have helped me attain dreams I did not think were possible, and for always encouraging me to reach for the stars!

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Chapter 1

Introduction

1.1 Statement of the Problem

Socioeconomic status (SES) is inversely related to many diseases and conditions, including obesity. Obesity predisposes one to many chronic disorders including hypertension, an atherogenic lipid profile, and diabetes mellitus (Flegal, Carroll, Kuszmarski and Johnson, 1998). Obesity was defined using the body mass index (BMI) for which there are many cut-points used to define obesity. These cut-points vary between countries. In Canada, a value of $\geq$ 27 kg/m^2 indicates obesity (Health and Welfare Canada, 1988), while in Europe, a value 30 kg/m^2 is used (Seidell, 1995). In the USA, values of 25, 27.3, 27.8 and 30 kg/m^2 have all been used to indicate obesity (James, 1996; Flegal, Carroll, Kuczmarski and Johnson, 1998). In Canada, the prevalence of obesity is about 27% for women and 35% for men (Macdonald et al, 1997). Once obesity has developed, it is difficult to eliminate, which points to the need for prevention.

In industrialized countries among women, obesity is more prevalent in lower SES than higher SES groups, regardless of the indicator of SES, be it education, income or occupation (Miller, & Wigle, 1986; Sobal and Stunkard, 1989; Winkleby, Fortmann, and Barrett, 1990; Marmot et al 1991; Bolton-Smith, Smith, Woodward and Tunstall-Pedoe, 1991; Popkin, Siega-Riz, and Haines, 1996). In the last 15 years, research has begun to examine possible mechanisms for why lower SES groups have a higher prevalence of obesity than higher SES groups. Behavioural differences between SES groups, including differences in dietary intake, are one area explored with this objective in mind. Variations in diet for different SES groups may be an important contributor to the differences in prevalence of obesity among SES groups. Few studies in Canada have examined the relationship between SES and diet, and how these relate to obesity in adults. Thus the present study is needed.

1.2 Purpose of the Study

The purpose of the present study is to examine socioeconomic differences in diet composition, and how these differences predict the presence or absence of obesity in a sample of 396 women from one of 4 regions in Saskatchewan (Saskatoon, Regina, Coteau Hills and Census District 11), aged 18-74 years.

1.3 Research Objectives

The objectives of the present study are:

1) To describe and compare SES differences in diet composition in the following three age groups: 18-34, 35-54, and 55-74 years. Specifically, to examine SES differences in dietary variables that have been shown to be related to obesity or associated with a diet conducive to weight loss, namely total energy intake (kcal/day), fat (% of total energy intake), carbohydrate (% of total energy intake), total, soluble, and insoluble non-starch polysaccharide (NSP) (g/day and g/1000 kcal), and fruit (g/day) and vegetables (d/day).

To address the first objective, MANOVA and ANOVA were performed. MANOVA allows the simultaneous consideration of multiple variables which are likely to be related all at once, and therefore helps to control Type I error, or error due to falsely rejecting the null hypothesis when it is true (Hair, Anderson, Tatham and Black , 1995). The alpha level was set at 0.05. As well, the distributions of the dietary variables among the SES groups were explored to illustrate where there were differences. Cut-points for dietary variables were chosen using Nutrition Recommendations for Canadians (Health Canada, 1990) and the World Health Organization's recommendations (WHO Study Group, 1990) as a guide.

2) To analyze the SES-diet relationship while taking into account the following variables: rural/urban status, cigarette smoking status, obesity, under-reporting of dietary intake, and physical activity.

To address the second objective, a stratified analysis was performed. Dietary variables were divided into 2 groups: low and high, by using cut-offs based on Nutrition Recommendations and WHO's recommendations, and were compared to SES, with low SES being the reference group (allowing comparisons of low-middle SES and low-high SES). These relationships were then assessed taking into account these variables: rural/urban, smoker/never smoked, ex-smoker/never smoked, under-reporting, and physical activity (for total energy only). Stratified analysis is beneficial because it allows for the calculation of Odds Ratios (OR) and allows for the assessment of effect modification and confounding. Ninety-five percent confidence intervals were calculated to indicate significance.

3) To assess whether SES differences in diet contribute to the differential prevalence of obesity by SES. To address this objective, a multi-variate logistic regression model with obesity as the dependent variable was performed. Independent variables to be considered are dietary variables that differ among SES groups, along with cigarette smoking, rural/urban differences, under-reporting, and physical activity. This allows multiple variables to be considered simultaneously, thereby determining the independent importance of each variable in predicting the presence of obesity.

Understanding SES differences in diet composition can provide clues as to what inequalities exist, and can therefore provide direction for developing health promotion strategies to reduce inequalities in the prevalence of obesity, and perhaps to reduce in the overall prevalence of obesity, and associated diseases and conditions.

1.4 Use of the term SES

There are many different indicators used for SES, such as income, occupation, and education. In the present study, education was used as the measure of SES. When the results and discussion are described, "education" is used, rather than SES since education only captures part of SES, which is a much broader concept. It is not the education, *per se*, that contributes to differences in disease and conditions, but rather something deeper and broader, of which education seems to be a good marker. As well, the terms SES and social class seem to be used inter-changeably in the literature, and are related to the country of publication. Although there is evidence that they may not be measuring the exact same entity (Wohlfarth, 1997), whenever studies are described in the present report, the term the author(s) used (SES or social class) is what is reported.

Chapter 2

Literature Review

Obesity is defined as an excessive amount of body fat (Lachance, 1994; Cummings, Goodrick and Foreyt, 1997; Michels, Greenland and Rosner, 1998). There is a range of what is considered an acceptable body weight, what is overweight and what is obese, with obesity being a greater degree of overweight. Obesity is often measured in terms of excessive weight, but strictly speaking, it is an excess of body fat, which often yields excess body weight. The difficulty with using a "greater degree of overweight" and obesity inter-changeably is that someone may weigh more because they have more lean body mass, which weighs more than fat. In the literature, overweight and obesity seem to be used inter-changeably, even though they are different.

Obesity is a multi-factorial entity, associated with an increased risk of many health adversities such as hypertension, diabetes mellitus, an atherogenic lipid profile, coronary heart disease, certain types of cancer, stroke, obstructive sleep apnea, osteo-arthritis, impaired psycho-social functioning, reduced physical agility and increased risk to discrimination and prejudice (Reeder, Angel, Ledoux, Rabkin, Young, and Sweet, 1992; Stefanick, 1993; Lachance, 1994; Elizabeth, 1995; Foreyt, Brunner, Goodrick, St. Jeor, & Miller, 1995).

There are many methods for estimating a person's body fat content such as under-water weighing, bio-electrical impedance, and skinfold calipers (Wang, Thornton, Russell, Burastero, Hevinsfield and Pierson, 1994; James, 1996). These methods are time-consuming to calculate and are not practical for larger epidemiological studies. For such studies, weight relative to height has become a popular method for estimating body fat. A practical definition of obesity and its assessment for health risk has been defined using the body mass index (BMI), which is a person's weight in kilograms divided by their height in metres squared. BMI is thought to be an adequate measure of adiposity (Lee and Nieman, 1996; Michels et al, 1998). It is simple and inexpensive to calculate, making it an attractive indicator of obesity for large studies.

A working definition of obesity necessitates choosing a cut-off point, below which people are not considered obese, and above which they are, making any particular cut-point somewhat arbitrary (Lachance, 1994). A healthy weight is considered a BMI of 19-25 kg/m^2, overweight is considered 25-27 kg/m^2 (St. Jeor, 1997), and obesity is considered greater than or equal to 27 kg/m^2 (Health and Welfare Canada, 1988; Reeder et al, 1992; St. Jeor, 1997). There are many different cut-points used to indicate obesity. In Europe, a BMI $\geq$ 30 kg/m^2 is considered obese (Seidell, 1995). In the USA after a 1985 National Institute of Health Consensus Conference, obesity was defined as BMI $\geq$27.8 kg/m^2 for men and $\geq$ 27.3 kg/m^2 for women, while in 1995, a World Health Organization (WHO) expert committee decided on BMI cut-points of 25, 30 and 40 kg/m^2 for grade I, II and III overweight, respectively (reported in Flegal, Carroll, Kuczmarski and Johnson, 1998). James (1996) wrote about overweight or Grade I obesity being a BMI between 25-29 kg/m^2, Grade II being a BMI between 30-39 kg/m^2 and extreme obesity or Grade III being $\geq$ 40 kg/m^2. As can be seen, there are many different indicators of obesity as well as different terms used ("overweight" and "obesity") for the same indicator, making comparisons on the prevalence of obesity between studies and different countries difficult.

Using a BMI cut-off of 27 kg/m^2, the prevalence of obesity in Canada is approximately 35% in men and 27% in women (Macdonald et al, 1997). This prevalence was determined from data gathered between 1986 and 1992 on 29,855 men and women from 10 Canadian provinces. Of these same people, two-thirds of obese women and less than one-half of obese men were trying to lose weight (Green et al, 1997). Unfortunately, research has shown that the long-term maintenance of weight loss is dismal, with the majority of people regaining all of the lost weight within 3-5 years after a lifestyle intervention (such as an energy-reduced diet; fat-modified diet; exercise; behaviour modification) and within 1 year of termination of pharmacotherapy (Cummings, Goodrick and Foreyt, 1997). Despite billions of dollars spent to treat it, obesity continues to increase (Goodrick, 1991), pointing to the need for prevention.

Many factors, both modifiable and non-modifiable, are associated with the development of obesity, including demographic factors such as age, gender and socioeconomic status (SES), personal characteristics such as obesity in other family members, childhood obesity, physical inactivity, and diet, and genetic factors involved in weight regulation such as hormones and peptides, which may influence weight by affecting the amount of food consumed as well as the body's ability to burn fat. (Lachance, 1994; Cummings et al, 1997; Schwartz and Seeley, 1997). It is clear that many factors contribute to obesity, each exerting its own relative importance. Changes in genetic influences would seem unlikely to account for the increased prevalence which has occurred in a short period of time (Seidell, 1995; Cummings et al, 1997; Flegal et al, 1998). This would seem to point to environmental determinants exerting powerful influences on the development and maintenance of obesity. This seems reasonable in current societies in countries like Canada, with an overabundance of food choices, decreased opportunities and motivation for physical activity and technological advancements (Pi-Sunyer, 1994; Cummings et al, 1997).

This review will first describe obesity and the evidence for dietary factors in its etiology and maintenance. This will set the stage for discussing SES differences in the prevalence of obesity, and the dietary factors that may possibly have an influence.

2.1. Assessment of Diet

Assessing people's diets allows examination of diet-disease relationships and tracking of nutrition trends. Before discussing evidence about diet and obesity, and SES and obesity, it is important to understand how diet may be assessed, and the errors that may arise in assessment. There are several methods to assess diet, each with its strengths and limitations. Often there is a trade-off between the depth of nutrient information obtained and subject burden, and cost of the method. The most common methods reported in the literature include food diary (food record), weighed food records, Food Frequency Questionnaires (FFQ) and dietary recalls.

2.1.1. Estimated Three-day Food Diary

The estimated three-day food diary has the advantage of approximating habitual eating patterns without too much subject-burden as compared to assessing the diet for longer time periods such as 7 days, or asking subjects to weigh their food. The participant is asked to record, at the time of consumption, all foods, beverages, and snacks eaten for a specified time period. Detailed descriptions of foods and beverages consumed, including the method of preparation and cooking are recorded. Portion sizes are estimated in household measures such as cups and spoons, and when possible, measured with a ruler for meat and cake, and counts for bread slices and eggs. Nutrient intakes are calculated using food composition data (Gibson, 1990).

There is random day-to-day variation, up to 20-30%, in people's eating habits (Schoeller, 1990). Assessing more than one day accounts for this random variation, and allows for a better approximation of usual intake (Schoeller, 1990; Gibson, 1990). The day of the week assessed may also be a source of variation in dietary assessment. Dietary intakes may vary between weekdays and the weekend. This effect can be accounted for by proportionally including a weekend day in the assessment (Gibson, 1990).

2.1.2 Weighed Food Records

In this method, all food consumed over a defined period is weighed by the participants. Details of methods of food preparation, description of foods and brand names should also be recorded. Food eaten away from home should be recorded, and this often presents logistic difficulties. This method is the most precise method available for estimating usual food and/or nutrient intake of individuals, but is time consuming and requires access to a weight scale (Gibson, 1990).

2.1.3 Food Frequency Questionnaire (FFQ)

The FFQ provides qualitative, descriptive information about usual food consumption by assessing the frequency with which certain food items or food groups are consumed during a certain time period. This information can then be used to predict intakes of nutrients or non-nutrients (Gibson, 1990).

Ursin, Ziegler, Subar, Graubard, Haile and Hoover (1993) identified foods associated with fat intake in the general American population, and found that percent energy from fat was positively related to intake of fat and oils, high-fat dairy products, fried potatoes and desserts, and was negatively related to intake of fruits, vegetables, cold and hot breakfast cereals, whole-grains and alcohol. These trends were similar across all age and socioeconomic groups. This study showed that data from FFQ can provide a relatively good indication of the fat content of the diet.

Sometimes FFQ's are used to quantify usual portion sizes of the foods, yielding a semi-quantitative FFQ. Nutrient scores can then be computed by multiplying the relative frequency that each food item is consumed by the nutrient content of the average portion size specified. The nutrient content is then obtained from a food composition table (Gibson, 1990). The method is rapid with low respondent burden, facilitating higher response rates, with the tradeoff of lower accuracy compared to other methods.

2.1.4 Dietary Recalls

The most common dietary recall period is 24-hours, in which a trained interviewer asks the participant to recall all food and beverage intake for the previous 24 hours. Quantities are estimated in household measures using food models to aid with recall and with estimating portions. This method is not appropriate for estimating the usual intake of an individual, but may approximate the usual intake of a population. It can approximate the usual intake of individuals if multiple replicates (4 recalls within a 1-year period) of 24-hour recalls are used. There is low respondent burden as compared to the other methods. However, the method relies on memory, and thus is inappropriate for children and for the elderly (Gibson, 1990).

2.1.5. Problem of Under-Reporting Food Intake

When assessing self-reported food intake, researchers assume that all consumed foods are being reported. The validity of this assumption has been questioned for many years. Although it was suspected that under-reporting of dietary intake was common, only in the last 10 years with the advent of the doubly-labelled water (DLW) technique, has under-reporting been quantified. DLW is a non-invasive technique for assessing total energy expenditure (TEE). If people are in energy balance but report eating less than the TEE as measured by DLW, under-reporting is said to have occurred (Schoeller, 1990).

Under-reporting is assessed by comparing reported energy intake to basal metabolic rate (BMR). BMR is the minimum amount of energy needed to sustain life (breathing, maintaining body heat, metabolic functions of organ tissues), and comprises the greatest proportion of total energy expended per day. It may be measured most