

**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!

## Table of Contents

Chapter	Title	Page Number
	PERMISSION TO USE	i
	ABSTRACT	ii
	ACKNOWLEDGEMENTS	iv
	DEDICATION	v
	TABLE OF CONTENTS	vi
	LIST OF TABLES	ix
	LIST OF FIGURES	xiii
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Statement of the Problem	1
	1.2 Purpose of the Study	2
	1.3 Research Objectives	2
	1.4 Use of the term SES	3
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>4</b>
	2.1 Assessment of Diet	6
	2.1.1 Estimated Three-Day Food Diary	6
	2.1.2 Weighed Food Records	7
	2.1.3 Food Frequency Questionnaire	7
	2.1.4 Dietary Recalls	8
	2.1.5 Problem of Under-Reporting Food Intake	8
	2.1.6 Errors in Dietary Assessment	11
	2.2 Evidence Supporting the Relationship between Obesity and Diet Composition	11
	2.2.1 Cross-Sectional Studies of Diet Composition and Obesity	12
	2.2.2 Diet and Energy Compensation	14
	2.2.3 Weight-Loss Studies	15
	2.2.4 Fruit and Vegetables	17
	2.3 Socioeconomic Status (SES)	18
	2.3.1 Measurement of SES	19
	2.3.2 SES and Health	20
	2.3.3 SES and Obesity	22
	2.3.4 SES and Obesity in Developed versus Developing Countries	24
	2.4 SES and Diet	25
	2.4.1 Historical Aspects	25
	2.4.2 SES and Diet in Developed versus Developing Countries	26
	2.4.3 SES and Diet as Assessed by Food Frequency Questionnaires	26

Chapter	Title	Page Number
	2.4.4 SES and Diet as Assessed by Either Weighted Food Records, Estimated Diet Records or Dietary Recall	28
	2.5 SES Differences in Self-Report Data	32
	2.5.1 Dietary Information	33
	2.5.2 Height and Weight	33
	2.5.3 Physical Activity	34
	2.6 Additional Variables to Consider	35
	2.6.1 Physical Activity	35
	2.6.2 Cigarette Smoking	37
	2.6.3 Rural versus Urban	38
	2.7 Cross-Sectional Studies in the Assessment of Diet-Related Relationships	39
	2.8 Implications of Diet for SES Inequalities in Obesity	40
<b>3</b>	<b>METHODS</b>	<b>41</b>
	3.1 Heart Health Intervention Evaluation	41
	3.1.1 Administration	41
	3.1.2 Regions of Study	42
	3.1.3 Participants	43
	3.2 Data Collection Procedures	43
	3.2.1 Diet Diaries	43
	3.2.2 Demographic Information	44
	3.2.3 Questionnaire	44
	3.3 Analysis of Diet Diaries	44
	3.3.1 Coding of the Diet Diaries	45
	3.3.2 Coding Assumptions	45
	3.3.3 Nutritional Analysis	45
	3.4 Measurement of Variables	46
	3.4.1 Assessment of Under-Reporting	48
	3.4.2 Rationale for Use of Women	48
	3.5 Statistical Analysis	48
<b>4</b>	<b>RESULTS</b>	<b>53</b>
	4.1 Response	53
	4.2 Demographic Information, Mean Values and Distribution of BMI by Age and Education, and Relation of Age and Education	55
	4.3 Comparison of Dietary Variables Among Educational Groups	63
	4.3.1 Dietary Results in the 18-34 Year Group	69
	4.3.2 Dietary Results in the 35-54 Year Group	71
	4.3.3 Dietary Results in the 55-74 Year Group	73
	4.3.4 Alcohol by Educational Group	73
	4.3.5 Analysis of Fruit and Vegetables	75
	4.3.6 Distribution of Dietary Variables by Education and Age	81
	4.4 Stratified Analysis	93



Chapter	Title	Page Number
	4.4.1 Relationship Between Education, Obesity and Third Variables	100
	4.4.1.1 Assessment of Effect Modification	100
	4.4.1.2 Assessment of Confounding	100
	4.5 Education and Under-Reporting	101
	4.6 Obesity and Dietary Variables	102
	4.7 Multi-Variate Logistic Regression of Education and Obesity	109
5	DISCUSSION	115
	5.1 Comparisons with the Nova Scotia Nutrition Survey	116
	5.2 Evidence for Confounding and Possible Effect Modification by Age	118
	5.3 Results of Comparing Education, Obesity and Diet	119
	5.3.1 Results in the 18-34 Year Group	119
	5.3.2 Results in the 35-54 Year Group	124
	5.3.3 Results in the 55-74 Year Group	128
	5.4 Stratified Analysis	132
	5.4.1 SES and Diet in Relation to Third Factors	132
	5.4.2 Effect Modification and Confounding of the SES-Obesity Relationship	136
	5.5 Do SES Differences in Diet Reflect Differences in Obesity?	140
	5.6 Biases and Limitations	144
	5.7 SES Differences in Barriers to Preventing Obesity	148
	5.7.1 Cost of a Healthy Diet	149
	5.7.2 Other Reasons for Socioeconomic Differences in Diet	150
	5.7.3 Additional SES Differences in Barriers to Preventing Obesity	151
	5.8 Summary and Conclusions	152
6	REFERENCES	157
7	APPENDICES	174
	Appendix A: Physical activity section of Knowledge and Attitudes Questionnaire	174
	Appendix B: A sample of the diet diary sent to participants	175
	Appendix C: Sample calculations for BMI and power	181
	Appendix D: List of coding assumptions used in dietary analysis	183
	Appendix E: Example of a NUTS printout used in dietary analysis	195
	Appendix F: Example of a CarbCount printout used in dietary analysis	196
	Appendix G: Formulae for test of heterogeneity, calculation of a Mantel-Haensel OR, G-statistic and Wolfe Confidence intervals	197
	Appendix H: Tables from stratified analysis	198

## LIST OF TABLES

Table Number	Title	Page Number
2.1	Excess Disease Rates in Lower Socioeconomic Classes and their Relation to Diet in Britain	29
4.1	Women in the Heart Health Intervention Evaluation who completed dietary intake diary	54
4.2	Final sample included in the study by region and age	56
4.3	Representativeness of the present sample to the general Saskatchewan population, subdivided by age group	57
4.4	Average BMI ( $\pm$ SD) by age	57
4.5	Relationship between education and age	58
4.6	Average BMI by educational level (low/middle/high), Subdivided by age group	60
4.7	Distribution of BMI by age and education	61
4.8	Distribution of obesity by education, subdivided by age	62
4.9	Dietary intake of selected nutrients (Means $\pm$ SD) for all age and education groups	64
4.10	Dietary intake of selected nutrients (Mean $\pm$ SEM) by education level for all age groups	65
4.11	Dietary intake of selected nutrients (Mean $\pm$ SEM) for the low education group, subdivided by age	66
4.12	Dietary intake of selected nutrients (Mean $\pm$ SEM) for the middle education group, subdivided by age	67
4.13	Dietary intake of selected nutrients (Mean $\pm$ SEM) for the high education group, subdivided by age	68
4.14	Dietary intake of selected nutrients (Mean $\pm$ SEM) subdivided by education for 18-34 year group	70
4.15	Dietary intake of selected nutrients (Mean $\pm$ SEM) subdivided by education for 35-54 year group	72
4.16	Dietary intake of selected nutrients (Mean $\pm$ SEM) subdivided by education for 55-74 year group	74
4.17	Proportion of those who consumed alcohol by education group	76
4.18	Comparison of g and % energy from alcohol in 18-34 year age group among education groups among only those who did consume alcohol	76
4.19	Median intake (g/d) of fruit, vegetables and fruit and vegetables for all women	78
4.20	Median intake (g/d) of fruit, vegetables and fruit and vegetables for the low education group	78
4.21	Median intake (g/d) of fruit, vegetables and fruit and vegetables for the middle education group	78

Table Number	Title	Page Number
4.22	Median intake (g/d) of fruit, vegetables and fruit and vegetables for the high education group	79
4.23	Median intake (g/d) of fruit, vegetables and fruit and vegetables in the 18-34 y by education with and without juice and potatoes included	79
4.24	Median intake (g/d) of fruit, vegetables and fruit and vegetables in the 35-54 y by education with and without juice and potatoes included	80
4.25	Median intake (g/d) of fruit, vegetables and fruit and vegetables in the 55-74 y by education with and without juice and potatoes included	80
4.26	Stratified analysis of % energy from fat by 3 <sup>rd</sup> factor in 18-34 y group, low versus high education	95
4.27	Effect modification of education-diet relationships in 3 age groups	97
4.28	Mean values of selected nutrients ( $\pm$ SEM) by obesity for the 18-34 year group	104
4.29	Mean values of selected nutrients ( $\pm$ SEM) by obesity for the 35-54 year group	104
4.30	Mean values of selected nutrients ( $\pm$ SEM) by obesity for the 55-74 year group	105
4.31	ANOVA of dietary variables in obese and non-obese women, stratified by under-reporting in the 18-34 year group	106
4.32	ANOVA of dietary variables in obese and non-obese women, stratified by under-reporting in the 35-54 year group	107
4.33	ANOVA of dietary variables in obese and non-obese women, stratified by under-reporting in the 55-74 year group	108
4.34	Final model of the multivariate logistic regression of education and obesity in the 18-34 year group	110
4.35	Final model of the multivariate logistic regression of education and obesity in the 35-54 year group	112
4.36	Final model of the multivariate logistic regression of education and obesity in the 55-74 year group	113
5.1	Comparison of energy and nutrient intake in the present study with the Nova Scotia Nutrition Survey	117
H1	Stratified analysis of fat by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	198
H2	Stratified analysis of fat by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	199
H3	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	200
H4	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	201
H5	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	202
H6	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	203

Table Number	Title	Page Number
H7	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	204
H8	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	205
H9	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	206
H10	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	207
H11	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 18-34 year group low versus middle education	208
H12	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 18-34 year group low versus high education	209
H13	Stratified analysis of fat by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	210
H14	Stratified analysis of fat by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	211
H15	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	212
H16	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	213
H17	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	214
H18	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	215
H19	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	216
H20	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	217
H21	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	218
H22	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	219
H23	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 35-54 year group low versus middle education	220
H24	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	221
H25	Stratified analysis of fat by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	222

<b>Table Number</b>	<b>Title</b>	<b>Page Number</b>
H26	Stratified analysis of fat by 3 <sup>rd</sup> variable in 55-74 year group low versus high education	223
H27	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	224
H28	Stratified analysis of CHO by 3 <sup>rd</sup> variable in 55-74 year group low versus high education	225
H29	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	226
H30	Stratified analysis of NSP by 3 <sup>rd</sup> variable in 55-74 year group low versus high education	227
H31	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	228
H32	Stratified analysis of Insoluble NSP by 3 <sup>rd</sup> variable in 35-54 year group low versus high education	229
H33	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	230
H34	Stratified analysis of Soluble NSP by 3 <sup>rd</sup> variable in 55-74 year group low versus high education	231
H35	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 55-74 year group low versus middle education	232
H36	Stratified analysis of total energy by 3 <sup>rd</sup> variable in 55-74 year group low versus high education	233
H37	Stratified analysis of total energy by activity level in 18-34 year group	234
H38	Stratified analysis of total energy by activity level in 35-54 year group	235
H39	Stratified analysis of total energy by activity level in 55-74 year group	236

## LIST OF FIGURES

Figure Number	Title	Page Number
4.1	Distribution of % energy from fat by education in 18-34 year group	82
4.2	Distribution of % energy from fat by education in 35-54 year group	82
4.3	Distribution of % energy from fat by education in 55-74 year group	83
4.4	Distribution of % energy from CHO by education in 18-34 year group	85
4.5	Distribution of % energy from CHO by education in 35-54 year group	85
4.6	Distribution of % energy from CHO by education in 55-74 year group	86
4.7	Distribution of total NSP (g/d) by education in 18-34 year group	86
4.8	Distribution of total NSP (g/d) by education in 35-54 year group	87
4.9	Distribution of total NSP (g/d) by education in 55-74 year group	87
4.10	Distribution of insoluble NSP (g/d) by education in 18-34 year group	89
4.11	Distribution of insoluble NSP (g/d) by education in 35-54 year group	89
4.12	Distribution of insoluble NSP (g/d) by education in 55-74 year group	90
4.13	Distribution of soluble NSP (g/d) by education in 18-34 year group	91
4.14	Distribution of soluble NSP (g/d) by education in 35-54 year group	91
4.15	Distribution of soluble NSP (g/d) by education in 55-74 year group	92
4.16	Distribution of energy intake by education in 18-34 year group	92
4.17	Distribution of energy intake by education in 35-54 year group	94
4.18	Distribution of energy intake by education in 55-74 year group	94

## 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, Kuzmarski 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<sup>2</sup> indicates obesity (Health and Welfare Canada, 1988), while in Europe, a value 30 kg/m<sup>2</sup> is used (Seidell, 1995). In the USA, values of 25, 27.3, 27.8 and 30 kg/m<sup>2</sup> have all been used to indicate obesity (James, 1996; Flegal, Carroll, Kuczarski 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, osteoarthritis, 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<sup>2</sup>, overweight is considered 25-27 kg/m<sup>2</sup> (St. Jeor, 1997), and obesity is considered greater than or equal to 27 kg/m<sup>2</sup> (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<sup>2</sup> 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<sup>2</sup> for men and  $\geq 27.3$  kg/m<sup>2</sup> for women, while in 1995, a World Health Organization (WHO) expert committee decided on BMI cut-points of 25, 30 and 40 kg/m<sup>2</sup> 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<sup>2</sup>, Grade II being a BMI between 30-39 kg/m<sup>2</sup> and extreme obesity or Grade III being  $\geq 40$  kg/m<sup>2</sup>. 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<sup>2</sup>, 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<sup>1</sup> 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