CAN WEIGHTLOSS DIET AND BODYWEIGHT SATISFACTION EXPLAIN SOCIAL SPREAD OF WEIGHT GAINS IN AUSTRALIA?

ABSTRACT

In light of increasing levels of obesity in Australia, this paper undertakes two-stage analysis of dieting status of Australians using the ninth wave of the Household Income and Labour Dynamics Australia (HILDA) survey. In the first stage, the heath lifestyles are used to cluster population into different distinct groups using a latent class model. In the second stage, a logistic model is used to identify factors that influence the dieting status of individuals. This two-stage framework is based on the bounded rationality of cost-benefit analysis but controls for systematic deviations in from the rationality assumption by accounting for the latent health lifestyles. This paper makes several important contributions in the literature of obesity economics. First, self-assessed bodyweight satisfaction is found to be the most influencing factor. Second, the relative ranks of Body Mass Index appear to be more important than BMI norms or absolute BMI in explaining variations in self-assessed bodyweight satisfaction. Third, based on these two findings we posit a new mechanism on how the social spread of weight gains had happened in Australia using the theories of social comparison and cognitive learning. Some policy interventions are also discussed.

KEY WORDS: Health lifestyles, weight loss diet; HILDA; bodyweight satisfaction

1. Introduction

This paper aims to provide three contributions in the literature of obesity economics. First, it aims to identify factors that motivate Australian to undertake dieting to lose weight, taking into account systematic deviations from the rational choice framework due to inherent lifestyle differences across individuals. Second, it provides empirical evidences on a recent hypothesis that individual's weight is influenced by the weight of people through social interactions. Third, the compilation of these two empirical results posits a new mechanism on how the social spread of weight gains had happened in Australia.

Australia has the third largest rate of obesity in the world (Oecd, 2014). In Australia, the number of adults that are overweight or obese rose from 56.3% in 1995 to 62.8% in 2012 (Australian Bureau of Statistics, 2012). It is forecasted that less than one third of the Australian population will be at a healthy bodyweight by 2025 (Walls et al., 2012). Obesity imposes a large financial burden on the Australian economy. In 2005 it was estimated that overweight and obese adults cost the Australian economy $56.6 billion, with $21 billion in direct health care and non-health care costs, and an additional $35.6 billion through government subsidies (Colagiuri et al., 2010)

There is a general agreement that the balance between energy consumption and expenditure determines an individual's weight gain or weight loss; therefore, in order to lose weight an individual must expend more calories than they consume by undertaking behavioural change to either reduce calorie consumption and/or undertake further physical activity (Who, 2015). Lowering caloric intake and/or undertaking further physical activity can reduce overweight and obesity; however this requires behavioural change. Therefore economic analysis proves to be useful as it helps us understand what motivates such behavioural change. While there are many theoretical models explaining the social spread of obesity (Burke and Heiland, 2007; Dragone and Savorelli, 2012; Hammond and Ornstein, 2014; Mann, 2008; Strulik, 2014; Wirl and Feichtinger, 2010; Wisman and Capehart, 2010), yet few studies model weight loss dieting behaviours to explain the phenomenon of the cycle of weight gains and loss in one's lifetime through the force of cyclical consumption of food.

Dockner and Feichtinger (1993) argues that food consumption can be additive and this additive force causes current consumption increase while the satiating force of gaining weight causes consumption decrease as weight accumulates. Moving away from from the assumption of food addiction , Levy (2002) argues that the satisfaction from eating is counterbalanced by increasing probability of dying as weight deviates from the physiologically optimal level, therefore there exists cyclical weight phenomena. This study also shows that in the presence of socio-cultural norms of appearance, the rationally stationary weight of fat people is lower than otherwise and the rationally stationary weight of lean people is greater than otherwise. However, these studies do not modally specifically weight loss decisions.

Rosin (2012) provides a theoretical economic analysis of an individual's decision process for weight-loss dieting. This framework incorporated the benefits and costs of weight loss with other behavioural traits, such as the effort required to diet, the influence of social norms, present-biased time preferences and a distinction between naiveté and sophistication. The framework proposes that dieting is an increasing function of the individual's initial bodyweight and a decreasing function of effort and social norms. However, the model did not consider time and resources restraints. Goldfarb et al. (2006) on the other hand argued that motives for dieting can be provoked by age, disease, physical life events, seasonal or episodic style, smoking cessation,

or innovations in new diet drugs, methods or knowledge. However, this analysis focuses solely on dieting decisions that are driven by the benefits of weight loss and does not seek to explain other factors that may disincentivise dieting behaviour.

Many survey-based empirical analyses aiming to identify factors related to weight loss attempts have been undertaken recently (Bayyari et al., 2013; Fitzpatrick et al., 2015; Getaneh et al., 2013). These studies have identified several factors that have a significant effect on weight loss behaviour including dissatisfaction with bodyweight, receiving weight loss advice from professionals, age, gender, income the number of previous dieting attempts, BMI, perceived impact of weight on social interaction and a higher level of education. However, these studies have utilised small sample sizes that are not nationally representative and in many cases failed to include relevant economic variables such as income, levels of spare time and residential location. Blanchflower et al. (2009) is one exception, however this study tested the peer effects of body weight satisfaction and weight loss dieting status in two separate studies without any implications of the relationship between these two phenomena.

Behavioural studies also suggests there are several behavioural traits that might produce systematic deviations from the rational choice framework and lead to a condition of overweightness. These include such traits as time preferences (Borghans and Golsteyn, 2006; Komlos et al., 2004; Zhang and Rashad, 2008), health consciousness (Wardle & Steptoe, 2003), locus of control (Strickland, 1978; Wallston and Wallston, 1978) and a reluctance to change dietary habits due to either an addiction to certain ingredients or the individual having food neophobia (Dovey et al., 2008; Dragone, 2009). As these characteristics are not directly observable, variations in weight loss decisions are subject to underlying latent factors. The literature, however, lacks empirical investigations that take into account these latent factors in explaining the preference endogeneity.

In this paper, we undertake an empirical analysis of weight dieting behaviour in the context of Australia using HILDA, which is representative of the Australian population. Our aim is to identify important factors that influence such behaviour and the degree of such influence. Our empirical investigation is built upon the rational decision making framework in which individuals are assume to be bounded rational. More specifically, our empirical models explicitly imply that individuals have done some forms of cost and benefit analysis before taking efforts to diet to lose weight. However, as argued in the literature, there exists systematic deviation from the rationality of making economic choice due to inherent lifestyle factors. To address this issue, we adopt a two-stage analytical framework. In the first stage, latent modelling is used to correct this endogeneity by classifying people into different groups based on observed manifestation of the latent lifestyle factor. In the second stage, we estimate logit models to analyse determinants of dieting behaviour. To our knowledge, no previous studies have taken this approach.

The second gap in the literature is related to a recent hypothesis of overweight and obesity being a "social" contagious disease (Burke and Heiland, 2007; Cohen-Cole and Fletcher, 2008; Strulik, 2014). Burke and Heiland (2007) has argued that due to social interaction, the body weight standard becomes more relaxed as average weight increases in response to food price declines; the relaxed standard then leads to further weight increases. Strulik (2014) hypothesizes that the social disapproval for displaying an overweight body is continuously but slowly updated by the actual observation of the prevalence of overweight members of society. This phenomenon

provides a social multiplier that amplifies the "impact effect" of exogenous shocks such as food price decrease. An important common assumption in these two studies is that one's appearance is evaluated by others; or in other words, there is underlying phenomena that an individual comparing his or her bodyweight or bodyweight satisfaction with that of other individuals. In fact, this relative comparison of bodyweight is just another phenomenon predicted by the long-established theories of social comparison started by (Festinger, 1954).

Interestingly, there are abundant empirical studies consistently documenting a strong association between body weight satisfaction and engagement or intention to engage in weight-loss activities; therefore we also examine the influence of bodyweight satisfaction on dieting behaviour in our empirical study. Note that investigation on the environmental factors that influence bodyweight satisfaction is of empirical nature and currently lacks research evidence. (Blanchflower, et al., 2009) examined the relationship between the bodyweight satisfaction and the absolute and relative-norm BMI indicators in Eurobarometer Surveys and in the German Socioeconomic Panel (GSEP) data.[1] One significant result from this study is that relative-norm BMI has strong statistical relationship but not absolute BMI. However, it is desirable from the view point of social comparison theories that relative ranking in terms of bodyweight is also important. Therefore, we improve the work of Blanchflower, et al. (2009) model by examining the influence of the relative ranking of individual's bodyweight in the reference group on bodyweight satisfaction.

The findings of two empirical works in the present paper presenting two interesting important empirical evidences to help explain a new mechanism of how social contagion of overweight can be sustaining regardless much efforts from policies and individuals to reduce weight. First, body weight satisfaction determines efforts of dieting to lose weight. Second, body weight satisfaction is influenced by social norms in terms of the relative ranking of weights. Therefore, if there is a shock to the distribution of weights and this shock increases people weight but as long as weight-based relative rankings do not change significantly, there could be no major change in the efforts to lose weight. This implies that there is a worrying tendency of increased weight in the long run, explaining the sustained existence of overweight in our modern society.

The paper is structured as follows: Section 2 provides the conceptual decision framework and the empirical strategy. Section 3 describe dataset and presents the empirical results from the model that examine the determinants of dieting behaviour decision. Chapter 4 investigates the driving factors of bodyweight satisfaction. Section 6 concludes the paper.

2. Methodological background

2.1 Economic models of dieting behaviours

A common base for most of economic approach to modelling dieting behaviour is that weight-changing behaviour occurs when the benefits of that change exceed the cost of undertaking that change. As dieting behaviour imposes costs and benefits on the individual, rational individuals compare these costs and benefits and makes their decision accordingly. In this approach, weight loss behaviour is expected to provide potential (delayed) benefits by improving the individual's health and body appearance (i.e body image). Benefits can also be perceived through reduction

[1] In the German Socioeconomic Panel dataset, relative BMI is defined as the person's BMI divided by a comparison peers' BMI level (defined as a cell mean given by year, gender, federal state (or country in Eurobarometer data), and education).

in the disutility of being overweight. This type of behavioural change also involves additional costs including financial, access and time costs. For example, accessing exercise facilities may require a paid gym membership, and conducting exercise can cost time. Individuals with limited resources would therefore be under a constraint to undertake such behavioural change.

There are several analytical models on weight loss dieting in economics literature and most of them are grounded in the rational choice framework to explain the stylized fact of repeated efforts of dieting to lose weight (i.e. cyclical dieting). Dockner and Feichtinger (1993) appears to be the first attempt to apply the theory of rational addition of Becker and Murphy (1988) model to eating decisions. This study shows that the food consumption choices of a rational individual, and consequently his or her weight path, can exhibit cycles with gradual increases followed by gradual decreases. In particular, these cycles require two counter-balancing effects: the addictive force causes current consumption increase due to the commutation of past consumption and the satiating force causes consumption decrease as weight accumulates. This model, however, requires additive nature of food consumption.

Levy (2002) moves away from assumption of food addiction and focuses on the health effects (increase in probability of dying sooner) of being overweight to explain the possibility of rational cyclical food consumption and consequently over- and underweightness. Strict diets and binges are considered as two instances of food consumption cycles. In this model, utility is derived by consuming food and a rational individual plans his or her food-consumption trajectory so as to maximise expected utility over lifetime. However, the satisfaction from eating is counterbalanced by increasing probability of dying as weight deviates from the physiologically optimal level. The paper found out that when physiological, psychological, environmental and socio-cultural reasons for divergence from a physiologically optimal weight do not exist, the steady state is a state of overweightness. This study also argued that if there exists socio-cultural norms of appearance, the rationally stationary weight of fat people is lower than otherwise and the rationally stationary weight of lean people is greater than otherwise.

Both Dockner and Feichtinger (1993) and Levy (2002) do not directly attempt to model weight loss dieting behaviours as done in Goldfarb, et al. (2006), Suranovic and Goldfarb (2007), and Rosin (2012). Goldfarb, et al. (2006) provides a simple graphic choice model that includes both the utility of food consumption and disutility from weight being above or below one's ideal weight. This paper identifies three disutility effects of being away from ideal weight: negative health effect, negative appearance effects, and increased difficulties and costs of searching for cloth, squeezing in small airplane seats, or performing physical activities. As mentioned earlier, this study also identified many differing motives to diet and in dependence on these motives, various outcomes of dieting arrive. For example, in the case of disease-provoked dieting, the individual discovers that his health is threatened by his current weight situation and this shift the individual's desired health-and-appearance weight level to arrive at a new lower equilibrium weight. The authors argue that lower equilibrium weight level implies that the individual finds it desirable to reduce weight and food intake or in other words the individual *will consider dieting.* The individual will consider dieting because he needs to take into account adjustment costs of a diet in his cost and benefit calculation.

Suranovic and Goldfab (2007) presents an economic model to describe food consumption choices that lead to dieting. In this study, food consumption has three possible effects on individual utility: a positive benefit from food consumption, a disutility effect resulting from weight gain, and a negative effect caused by dieting. With bounded rationality, an individual is

assumed to maximize utility in each period rather than projecting the long-term impact of food on weight and future utility. One important finding of this model is that diet will reduce weight but lasts only one period. In the next period, the disutility of weight falls due to lower weight, together with the marginal benefit in food consumption and the desire to avoid further dieting costs causes a return to a higher consumption level. However, the dieting causes habitual consumption to fall, which implies weight will continue to fall modestly for several periods following the diet.

Using the same framework of bounded rationality, Rosin (2012) develops a repeated eating model to understand what influence the extent of dieting given the individual perceives himself as overweight and would like to lose weight. One good feature of this work is that the model also predicts the impact of social norms in terms of the cultural values of thinness as presented by extremely underweight fashion models. One important implication of this theoretical model is that higher exogenous initial body weight and stronger social norms favouring low body weight increase the duration of dieting, whereas more dieting experience decreases the duration of dieting. In addition, income and diet strictness have a more complex effect. As similar to other models, this study also predicts that body weight at the end of the period is higher despite the longer dieting and the greater efforts because greater dieting efforts do not fully offset the effects of a metabolic slowdown or a higher initial body weight.

There are three important drawback of these economic models. First, these models do not consider peer effects which are considered to be an important factor that impact obesity, diet and physical activity in the literature (Cawley, 2015; Trogdon and Allaire, 2014). Second, ideal weight variables are taken exogenously while the literature has shown that body weight satisfaction and subjective norms in terms of the role of others influence strongly the behavioural intentional and behaviours to change the body through dietary restriction or increased physical exercise (Lee et al., 2009; Shakya et al., 2015). Lastly, individuals' deviation from bounded rationality is absence in these studies.

In terms of empirical analysis, there is an increasing number of survey-based studies which aim to identify factors related to weight loss attempts (Bayyari, et al., 2013; Fitzpatrick, et al., 2015; Getaneh, et al., 2013). Factors such as bodyweight dissatisfaction, age, gender, income, education, previous dieting attempts, BMI, and perceived impact of weight on social interaction are identified to be strongly related with dieting behaviours. Many of these studies have utilised small sample sizes and in many cases failed to include relevant economic variables such as levels of spare time and residential location. Blanchflower, et al. (2009) is one exception; however this study tests the peer effects of body weight satisfaction and weight loss dieting status in two separate empirical works without any implications of the relationship between these two variables.

2.2 Social influences

Several aspects of social interactions have been found to have substantial influence on the emergence and persistence of overweight and obesity (see detailed discussions in Cawley (2015) and in Davies and Wardle (1994). Many empirical studies have established statistical relationship between weight of a person and the weight of peers being his or her friends or family relatives (Christakis and Fowler, 2007; Yakusheva et al., 2014). These empirical results are consistent with the theories of social cognition and comparison which proposes that

individuals' behaviours may arise and be reinforced through the forces of observing, comparing and imitating others (Bandura, 1986; Buunk and Gibbons, 2007; Festinger, 1954).

Another aspect of social influence on overweight is through the force of social norms. This pathway implies that being overweight generates less disutility if many others are also overweight or people being heavier if the prevalence of being overweight in society is high. Supporting empirical evidences have been reported in studies using large-scale survey data in many developed economies. Blanchflower, et al. (2009) report that females across European countries are less dissatisfied with their actual weight when it is relatively low compared to average weight. Using French data, Etile (2007) presents similar findings and argues that social norms and habitual BMI affect ideal BMI, which in turn affect actual BMI. Trogdon et al. (2008) also find statistical correlation between individual BMI was correlated with mean peer BMI and that the probability of being overweight was correlated with the proportion of overweight peers for U.S. adolescents.

The presence of peer and social norms effects could lead to the social multiplier effect that explains the "social" contagion of overweight in the last few decades after the world food price decrease (Burke and Heiland, 2007; Cohen-Cole and Fletcher, 2008; Strulik, 2014). Burke and Heiland (2007) has argued that due to social interaction, the body weight standard becomes more relaxed as average weight increases in response to food price declines; the relaxed standard then leads to further weight increases. Dragone and Savorelli (2012) propose dynamic theories of body size evolution but a socially desirable weight is exogenous and parametrically given. In contrast, Strulik (2014) takes a simpler static relation between food consumption and body weight and allows the endogeneity of socially desirable weight on the distribution of body weight in a society.

The extended models in Strulik (2014) provide several interesting results in relation to the gradient effect of income in obesity, the evaluation of one's appearance by others, and dietary selection and exercise for weight loss. These extensions are built around finding solutions to an optimal problem being marginal utility gained from food consumption equal to the marginal disutility due to overweight given the individual are constrained by budget and choices of healthy or unhealthy dietary food. The disutility coming from body weight dissatisfaction is treated as a variable to address social dynamics while disutility from health effects of overweight is treated parametrically. Strulik (2014) has solved solutions to the optimal problem and this solution suggests that overweight individuals who prefers the unhealthy food will gain more weight for any given level of social norms if the unhealthy food is sufficiently cheaper than healthy food.

However, the concept of relative ranking, given its importance in economics as shown in the literature of life satisfaction, happiness, and competition (Boyce et al., 2010; Brown et al., 2008; Clark et al., 2008), is not discussed implicitly in those models. The concept of relative ranks, however, are found to have strong influence on health-related decisions or behaviours (Daly et al., 2015; Wood et al., 2012).

2.3 Health lifestyle

The significance of ways of living for health is clear but this concept of lifestyle in health is relatively new. Recent literature has defined health lifestyle as collective patterns of health-related behaviour based on choices from options available to people according to their life

chances (Cockerham, 2005; Korp, 2008). Based on the seminal works of Weber (1922/1978) and Bourdieu (1990), Cockerham (2005) presents a theoretical model of health lifestyles with structural variables providing the social context for socialization and experience that influence life choices (agency). Variables such as social classes, gender, age, ethnicity, religion, and living conditions form are identified as important structural variables which also collectively constitute life chances. Choices and chances interact and commission the formation of dispositions to act, then leading to those actions such as alcohol use, smoking, diet, and other health-related actions. These actions repeat, which constitutes patterns of health lifestyles.

Decisions about whether or not to live healthfully is a key aspect of health lifestyles and are often involved with eating habits, exercise, stress coping, smoking, alcohol consumption, drug use, accident risks and physical appearance (Stefansdottir and Vilhjalmsson, 2007). Empirical studies have shown strong statistical correlations of certain health-related behaviours such as smoking and alcohol consumption (Burke et al., 1988; Milligan et al.), coffee, alcohol and cigarettes (Istvan and Matarazzo, 1984), physical inactivity and smoking (Emmons et al., 1994); hence it is expected that health lifestyles is a multidimensional phenomenon which displays many possible manifestations in daily life activities. The nature of multidimensionality of lifestyle is simply due to the complex nature of lifestyles in a broader context where individuals' patterns of behaviours which conforms to the individual's orientation toward the three major roles of: household member, a worker, and a consumer under resources constraint (Salomon and Ben-Akiva, 1983). Literature in public health has utilised this latent and multidimensional lifestyle to investigate variations in the health-related behaviours as well as the clustering of populations into distinct groups for more effective public health policy interventions (Collins and Lanza, 2010; Emmons, et al., 1994; Huh et al., 2011; Leech et al., 2014; Moschonis et al., 2014; Patnode et al., 2011)

2.4 Empirical strategy

As argued in the literature, lifestyles are latent and manifest in reasonably consistent patterns of health-related behaviours; therefore consequently one can expect that the behaviours of individuals belonging to distinct groups may present systematic deviations from bounded rationality. Diet is often also considered as one related aspects of the patterns of health lifestyle, therefore we argue that the latent lifestyle can be used to cluster population into distinct groups based on other manifested health behaviours such as smoking, drinking, etc. Once individuals are classified into distinct groups, one can adopt bounded rationality framework to investigate dieting behaviours; this guides us to adopt a two-stage modelling approach[2]. In the first stage, latent class modelling is used to classify individuals into distinct groups based on observed manifestation of latent lifestyle factors. In the second stage, logistic regression is used to establish statistical relationships between dieting behaviour and various explanatory variables including bodyweight satisfaction and dummy variables for distinct latent groups that individuals belong to as the results from the first stage.

[2] We do not aim to investigate causality between dieting behaviours and explanatory variables in the present study due to two reasons. First, as we use only a single year dataset, this limits our capacity to apply more sophisticated econometric techniques to study causality. Second, as the results of our empirical work arrived us to an alternative hypothesis that helps explain the persistence of the current social contagions of overweight, we decided to focus this paper on this hypothesis.

Stage 1: Latent class modelling

As discussed previously, various factors of lifestyle has been found to differentiate between individuals' diet and other health-related behaviours and they are latent phenomena; therefore latent class models appear to be a logical choice in this analysis. Also note that this technique has been widely used in behavioural and health economics studies; see for example Laska et al. (2009), Deb and Trivedi (2002), Øvrum (2011), Mathur et al. (2014) and Fitzpatrick, et al. (2015). The main objective of this technique is to classify a heterogeneous population into homogenous groups of individuals (i.e. clusters)[3]. Following this estimation, statistical tests, such as the likelihood ratio, chi square or parsimony indices, such as the Bayesian information criterion (BIC), can be used to empirically identify the optimal number of clusters underlying the population.

In this paper, latent class discrete factor model is used as this model allows the analysis of more than one latent factor, which traditional latent class cluster models do not allow. Furthermore, unlike traditional cluster approaches, latent variables can be dichotomous or ordered rather than solely nominal (Vermunt and Magidson, 2013). The Latent Class Discrete Factor model has the following form:

$$f(\boldsymbol{m_i}|L) = \sum_{l_1=1}^{K_1}\sum_{l_2=1}^{K_2}\dots\sum_{l_M=1}^{K_M} P(l_1, l_2, \dots, l_M) f(\boldsymbol{m_i}|\boldsymbol{l}) \\ = \sum_{l_1=1}^{K_1}\sum_{l_2=1}^{K_2}\dots\sum_{l_L=1}^{K_M} P(l_1, l_2, \dots, l_L) \cdot \prod_{h=1}^{H} f(m_{ih}|\, l_1, l_2, \dots, l_M) \tag{1}$$

with the discrete latent factors $\boldsymbol{l}$ intervening with mutually independent manifest indicator variables $\boldsymbol{m_i}$. The probability density of $\boldsymbol{m_i}$ given $\boldsymbol{l}$ is provided by $\boldsymbol{f(m_i|l)}$.

Stage 2: Logistic model

In the second stage, we utilise a logistic regression model to examine the relationship between weight loss dieting behaviour by individuals with many explanatory variables. In a binary logistic regression, the response variable Y_i is dichotomous, either 0 or 1. This dichotomy is suitable for this analysis as an individual either undertakes ($Y_i = 1$) or does not undertake ($Y_i = 0$) weight loss dieting behaviour. The probability of each event occurring can then be denoted by:

$$\Pr(Y_i = 1) = \pi(\boldsymbol{x}_i) \text{ and } \Pr(Y_i = 0) = 1 - \pi(\boldsymbol{x}_i) \tag{2}$$

[3] One can also use factor analysis for clustering purposes. However, factor analysis is concerned with the structure of variables (i.e., the correlations of those manifest variables), whereas latent class modelling is more concerned with the structures of cases (i.e., the latent taxonomic structure or relations among individuals in the used sample). In this paper we prefer to use latent class modelling as we are not interested in manifest variables but on the latent structure.

A binary logistic model insinuates that the choice outcome Y_i is determined by a vector of independent explanatory variables, *x*. Parameters can then be derived from a Bernoulli distribution, where:

$$\log\left(\frac{\pi(\boldsymbol{x})}{1-\pi(\boldsymbol{x})}\right) = \beta x \qquad (3)$$

Therefore, given a model with n explanatory variables, we would have the model:

$$\log\left(\frac{\pi}{1-\pi}\right) = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n \qquad (4)$$

The regression coefficients (β_n) express the magnitude of each contributing factor in terms of log odds. A positive coefficient suggests that the explanatory variable (x_n) increases the probability of the chosen outcome ($Y_i = 1$) with a negative coefficient portraying the opposite. The explanatory variables also include dummy proxies for various distinct clusters that were estimated in (1). One can also estimate these logistic models separately for each distinct group.

3. Data source & the description of variables

3.1 Data source

The Australian representative dataset utilised for this empirical analysis was drawn from the ninth wave of the HILDA survey. This longitudinal dataset was collected for the year 2009 from sampled household members over the age of 15 years through both face-to-face interviews and self-completion questionnaires. This survey was chosen as it contains a major health module that provided key variables that were not available in other waves of the survey. Initially this provided 13,301 observations, however after removing incomplete responses and responses with a zero income, 9,797 observations remained.[4] Descriptive statistics of variables used are in Table 1.

Table 1: Descriptive Statistics (INCLUDE MANIFEST VARIABLES & BMI, BMI SQUARED AND RANKS)

Variable	Mean	Std. Dev.	Min	Max
Age	45.0591	17.7603	15	97
Total Financial Year Disposable Income	41,199.48	41,555.22	3	651,287
Female	0.5258	0.4994	0	1
Currently Pregnant	0.0308	0.1729	0	1
Given birth in last 6 months	0.0191	0.1368	0	1
Member of A=association/club	0.3945	0.4888	0	1
Resides in major city	0.6190	0.4857	0	1
Diagnosed with a serious illness	0.4313	0.4953	0	1
Individual's satisfaction with bodyweight				
Very satisfied	0.1001	0.3002	0	1
Satisfied	0.2819	0.4500	0	1

[4] PanelWhiz (http://www.PanelWhiz.eu) written by John P. Haisken-DeNew (john@PanelWhiz.eu) was used to extract data.

Neither satisfied nor dissatisfied	0.2341	0.4234	0	1
Dissatisfied	0.3086	0.4619	0	1
Very dissatisfied	0.0753	0.2639	0	1
Individual's self-assessment of health				
Excellent	0.1294	0.3357	0	1
Very good	0.3808	0.4856	0	1
Good	0.3413	0.4742	0	1
Fair	0.1194	0.3243	0	1
Poor	0.0290	0.1678	0	1
Self-perceived levels of free time				
Almost always	0.0099	0.0990	0	1
Often	0.5359	0.2252	0	1
Sometimes	0.2263	0.4185	0	1
Rarely	0.4883	0.4999	0	1
Never	0.2219	0.4155	0	1
Highest education achieved				
Year 11 and below	0.3061	0.4609	0	1
Year 12	0.1581	0.3649	0	1
Certificate III or IV	0.2042	0.4032	0	1
Advanced diploma or diploma	0.0922	0.2893	0	1
Bachelor or honours	0.1396	0.3466	0	1
Graduate diploma or graduate certificate	0.0582	0.2343	0	1
Postgraduate – masters or doctorate	0.0414	0.1993	0	1

3.2 Manifest indicators of the latent health lifestyle phenomenon

The literature has argued that locus of control, time preferences and health consciousness are likely to be associated with differing lifestyles (Wardle & Steptoe, 2003). Reedy et al. (2005) also provided evidence that differing health behaviour clusters can respond differently to interventions aiming at increasing fruit and vegetable consumption. Informed by these backgrounds, we decide to use smoking, binge drinking, fruit consumption, vegetable consumption and physical activity as manifest indicators of the lifestyle. Note that these variables have been used for latent class analysis by de Vries et al. (2008).

The variable smoking was constructed from responses to the survey question "Do you smoke cigarettes or any other tobacco products?" The variable alcohol consumption was based on whether the individual engaged in binge drinking which was classified as seven or more standard drinks for a male or five or more standard drinks for a female in one sitting. For vegetable consumption, the responses to the survey question were dichotomised into 0 = does not consume vegetables every day and 1 = consumes vegetables every day. Similarly, for fruit intake, the responses were dichotomised into 0 and 1. Adult guidelines suggest that at a minimum of three, 30 minute sessions of vigorous exercise or five, 30 minute sessions of moderate exercise should be undertaken per week(Schoenborn and Stommel, 2011). The survey asked "In general, how often do you participate in moderate of intensive physical activity for at least 30 minutes?" The categorical response set for this survey question prevented the differentiation of vigorous and moderate exercise sessions. Therefore, six categorical response were dichotomised to be either 0 = doesn't exercise 3 times per week or 1 = exercises at least 3 times per week. Table 1 provides descriptive statistics for these variables.

3.3 Dieting status variable and explanatory variables

Within the sample, more than 57% individuals are classified as having an unhealthy bodyweight (what crieteria used here?) and less than 23% of these overweight individuals reported that they were undertaking a weight loss diet. In fact, the survey provides a question that asks the respondent "Are you currently on a diet to lose weight?" with the responses of yes (16.6%) or no (83.4%). Clearly the answer yes (being currently on a diet to lose weight) reflects both a newly made decision and an extended status of being on diet after a certain period of time. Conceptually, whether to start attempt to lose weight from today and whether to continue being on diet to keep the current weight are two different decisions. However, as data collected this question is only available in one year and data does not allow us to trace past status of being on diet, we are unable to distinguish these conceptual notions; therefore our empirical results need cautious interpretations in terms of causal relationships between status of being on diet and explanatory variables.

Table 1 also provides descriptive statistics for explanatory variables selected to best reflect the respondent's bodyweight satisfaction, health condition differences, and resource constraints in terms of finance, time, and access. Additional control variables for life event, age, gender and education are also incorporated to account for individual heterogeneity.

HILDA's questionnaire asks "How satisfied are you with your current weight?", using a 5-point Likert response scale ranging from 1 = very satisfied to 5 = very dissatisfied. Approximately a third of the population were at least dissatisfied with their weight. We included this variable into our analysis as there is rich empirical literature reporting a strong association of bodyweight dissatisfaction with both intention and actual engagement in weight loss behaviours such as dietary restriction and exercise (Lee, et al., 2009). We also hypothesise that the more dissatisfied the individual is with their appearance, the more likely they are to diet.

The presence of serious illness[5] is used to capture variations in the respondents' health; therefore it captures differing incentives and needs to lose weight. Self-perceived health measures, on the other hand, is included to capture variations in intentions to lose weight and self-assessed status of health as a consequence of efforts done in the past. Note that for those who have less needs to lose weight, dieting could present some disutility in terms of more expensive direct expenses of dietary restrictions, more time taken away from leisure in order to prepare meals, eating food that give less utility. Therefore, we expect that people with positive self-assessment of their heath will be less likely to undertake diet to lose weight.

Time and financial constraints are also included. The time constraint was measured using the respondent's self-perceived levels of free time. As the availability of free time decreases, the higher the opportunity costs of time spent on exercising and preparing meals. It is therefore predicted that when free time increases, the likelihood of undertaking weight loss behaviour increases. A measure of self-declared total financial year disposable income (in natural log values to mitigate the effects of the sharply skewed distribution of income) is used. It is predicted that an individual with a higher income has a greater probability of undertaking weight

[5] Serious illnesses include arthritis or osteoporosis, asthma, any type of cancer, chronic bronchitis or emphysema, depression or anxiety, type 1 or 2 diabetes, high blood pressure and heart disease.

loss dieting. This hypothesis is based on the notion that a wealthier individual would have a greater ability to afford more costs involved in restricted dietary activities.

To analyse whether having access to such facilities increases the likelihood of the individual undertaking weight loss behaviour, a variable representing whether the respondent was an active member of a sporting, hobby or community-based club or association is included. Note that access to such clubs is likely to offer the availability of more services that can facilitate weight loss behaviour, such as community support, exercise equipment or the organisation of physical activity; therefore individuals who are an active member of a club or association will be more likely to undertake weight loss dieting.

As identified by Goldfarb et al. (2006), certain life events may increase the incentive to undertake or avoid weight loss behaviour. Notably, a female who is pregnant is less likely to diet (Davies and Wardle, 1994). Similarly, as put forward by Goldfarb et al. (2006), after a woman has given birth she is likely to undertake dieting to lose the excess weight she may have gained during the pregnancy. To control for these life events, a variable was constructed to denote if the female respondent was pregnant at the time of the study or had given birth a child within the previous six months.

Location is included to capture variations in the surrounding living environment and differing levels of healthy food costs and access to health services across locations in Australia. A positive relationship between socioeconomic status and weight-controlling behaviour has been found in previous studies (Siu et al., 2011; Wardle & Griffith, 2001; Jeffery & French, 1996). Therefore, a control for the participants' education level was used that measured the highest level of education achieved by the individual. Furthermore, the allocative efficiency hypothesis suggests that educated individuals are more likely to make better informed and rational decisions in regards to their health (Grossman, 1972). Fuchs (1982) also suggests that educated individuals are less likely to have present-biased time preferences and therefore are more likely to have increased investments in their health. Therefore it is hypothesised that the higher the education level, the more likely the individual is to undertake weight loss dieting.

3.4 Determining variables of body weight satisfaction

Following (Blanchflower, et al., 2009), we aim to examine a statistical relationship between bodyweight satisfaction with various measures that are predicted to influence bodyweight satisfaction by social comparison theories. The absolute body mass index (BMI) is calculated from self-stated height and weight measurements and the relative-norm BMI was calculated as the mean value of the given reference groups classified by age and gender. Twenty reference groups are constructed using gender (male and female) and age (10 groups from 15 to 75 years old) as shown in Appendix 1.

To test rank hypothesis, we also include the BMI-based relative rank for each individual. Relative rank is calculated in relation to his or her reference group. To do this, the number of people within the reference group's population who had a BMI larger[6] than that of the individual $(i-1)$ was compared to the total size of the reference group's population $(n-1)$. This

[6] For this study it was assumed that an individual always considered a larger BMI to be worse than a smaller BMI.

individual rank (Ri) was then normalised to fall between 0 and 1. Therefore, the individual's relative rank was constructed by a ratio of (i -1) to (n-1).

As discussed previously, empirical studies have identified that older individuals are more likely to be satisfied with their body weight. Also, it was found that females were more likely to be dissatisfied with their body weight, regardless of their BMI. More highly educated individuals, ceteris paribus, were also identified to be more likely dissatisfied with their body weight. In order to examine whether the Australian data provided congruent results with these studies, variables for age, gender and education were included.

4. Empirical results and discussion

4.1 Classification of latent lifestyle phenomena

Using the BIC criterion in selecting among various specification of model (1)[7], the two discrete factor model with two levels was chosen. The profile output based on this model specification is outlined in Table 2. From this output, for each discrete factor, a healthy and an unhealthy group are identified. For the following logit model analysis, a dummy variable was used to denote whether an individual was more likely to be within the unhealthy group of that particular latent trait. It was expected that if the individual was more likely to be in the unhealthy group of that particular latent factor, they were less likely to undertake weight loss behaviour/dieting.

Table 2: Classification of lifestyle

	Discrete factor 1		**Discrete factor 2**	
	Level 1	**Level 2**	**Level 1**	**Level 2**
	Healthy	*Unhealthy*	*Unhealthy*	*Healthy*
Discrete factor level size	0.7880	0.2120	0.5644	0.4356
Indicators				
Non-smoker	0.8780	0.5082	0.7453	0.8700
Avoids binge drinking	0.9818	0.4803	0.9099	0.8309
Eats vegetables 7 days a week	0.5573	0.2723	0.2935	0.7604
Eats fruit 7 days a week	0.5322	0.1549	0.1931	0.7879
Exercises 3+ times a week	0.5137	0.5065	0.4335	0.6142

The classification of the healthy and unhealthy level for each discrete factor was based on a comparative analysis of the probability of meeting the set lifestyle standards. The cluster with a higher probability of being a non-smoker, avoiding binge drinking, eating vegetables seven days a week, eating fruit seven days a week and exercising three or more times a week were considered to manifest healthier lifestyle behaviours. All indicators were given equal weighting and the level that had the healthiest characteristics for the most indicators was deemed the healthy cluster of the discrete latent factor lifestyle. For discrete latent factor 1, level 1 was deemed the healthy cluster as they had a higher probability of meeting the healthier outcome in every indicator. In discrete latent factor 2, level 2 was healthier on all indicators compared to level 1 except avoiding binge drinking and was therefore labelled the healthy cluster.

[7] The smaller the BIC, the more superior the model fit.

4.2 Determinants of weight loss dieting behaviour

The results of the logistic regression model (4) are provided in Table 3 with odds ratios. Overall the model fits well with the data used. The signs of all coefficients are in line with the previous hypothesised relationships but the magnitudes of each effect differed greatly.

Table 3: Results of logistic regression

Currently on a weight loss diet	Odds ratio	Std. err.
Individuals satisfaction with bodyweight		
Very dissatisfied	43.4794***	11.6031
Dissatisfied	23.5026***	6.0435
Neither satisfied nor dissatisfied	6.4139***	1.6860
Satisfied	2.8083***	0.7557
Very satisfied (base)	-	-
Individual's self-assessed health		
Poor	1.3611	0.2677
Fair	1.2101	0.1676
Good	1.1575	0.1337
Very good	1.2185*	0.1359
Excellent (base)	-	-
Individual's self-perceived levels of free time		
Almost always	1.3624	0.3945
Often	1.2895*	0.1831
Sometimes	1.1948*	0.1113
Rarely	1.1571*	0.0894
Never (base)	-	-
Diagnosed with serious illness	1.1986***	0.0817
Age	0.9856***	0.0022
Log of total financial year disposable income	1.0875***	0.0353
Female	1.7940***	0.1207
Currently pregnant	0.3898***	0.0885
Given birth in last 6 months	1.1672	0.0885
Member of association/club	1.2784***	0.0798
Resides in major city	1.1172*	0.0707
Discrete factor 1 level 2	0.7751***	0.0648
Discrete factor 2 level 1	0.7583***	0.0476
Education		
Postgraduate – maters or doctorate	1.0153	0.1672
Graduate diploma or graduate certificate	0.9733	0.1654
Bachelor or honours	1.0291	0.1705
Advanced diploma or diploma	1.2460	0.2174
Certificate III or IV	0.9479	0.1592
Year 12	1.0248	0.1937
Year 11 and below (base)	-	-
Constant	0.0118***	0.0056
Pearson's chi-squared (x^2) (14)	1612.45***	
Pseudo R^2	0.1830	
Correctly classified	83.93%	
Observations	9,797	

*** p<0.01, ** p<0.05, * p<0.1

Bodyweight satisfaction was found to be the statistically strongest influencing factor in the model. In comparison to an individual who is very satisfied with their bodyweight, a very dissatisfied individual is, *ceteris paribus*, 43.48 times more likely to be undertaking a weight loss diet, a dissatisfied individual is 23.5 times more likely, a neither satisfied nor dissatisfied individual is 6.4 times more likely, and a satisfied individual was 2.8 times as likely. This results is in line with many previous studies (see Lee, et al. (2009) for review of empirical evidence in various contexts). Note that body satisfaction is an affective and attitudinal component of body image which involves cognitive, emotive and behavioural aspects of an individual in relation to body size, shape, and aesthetics (Cash and Pruzinsky, 1990; Lee, et al., 2009). Hence, understanding how bodyweight satisfaction influences individual's decision to undertake weight loss diet is very important for the purpose of interventions to reduce obesity. In this study, due to data constraint we are not able to address this question empirically. However, we highlight one possible mechanism through which an individual derives his or her utility through body appearance; therefore those who have low levels of bodyweight satisfaction could have more incentives to lose weight and engage in activities to lose weight. In fact, Grogan (2006) argued that bodyweight satisfaction represents the individual's concern with appearance and therefore losing weight can also present potential benefits through an improve body appearance.

Most of dummy variables for self-assesment of health conditions are not statistically correllated with dieting status. One exception is that those self-assessing their health very good is 21.85% more likely to diet compared to those self-assessing their health excellent. This could be due to correlations between self-assessment of health conditions with self-assessment of bodyweight satisfaction (need one reference here). However, results show that those being diagnosed with a serious illness was 19.86% more likely to be on a weight loss diet than an individual who had not been diagnosed with a serious illness and this relationship is significant at the 1% level. This finding supported two phenomena. First, Goldfarb et al. (2006) has argued that "disease-provoked" dieting occurs when the individual is diagnosed with a condition that requires weight loss to reduce threats to their personal health. Second, weight loss is often prescribed to those having such illnesses as arthritis, asthma, diabetes, high blood pressure, and heart disease. Nevertheless, this positive relationship is congruent with previous studies (Getaneh et al., 2013; Zapka et al. 2009).

Results also presents significant positive relationship between income and dieting behaviour at the 1% level. Regardless minor magnitude of this relationship with a 1% increase in income is associated with a 4.4% increase in the probability of being on a weight loss diet, this result favours the effects to the income constraint put forward by Rosin (2012). However, there are many possible explanations for this relationship. First and directly, one can explain that higher income allows individuals to pay for more expensive dietary restrictions. Note that a 'healthy eating' diet has been recognised to consist of foods with low-energy density, such as vegetables and fruit and these foods are more expensive in terms of energy per unit cost and per serving (Whybrow et al., 2011). Therefore, lower income means that it is more financially difficult to diet to lose weight. While dieting to lose weight does not necessarily require more expensive food, individuals simply might not know this. It is also possible that under financial constraints, people opt to prepare food themselves rather than consuming ready-to-eat high energy food. As preparing food takes time away from working or leisure, it imposes opportunity costs. Therefore, it is important to provide people with information on how to diet without expensive baskets of food and drink or how to prepare healthier food with less time; so that direct and indirect financial constraints can be reduced.

The variables being a member of an association and living in a major city are both estimated to have a positive association with weight loss dieting. An individual who is a member of an association, *ceteris paribus*, is 27.8% more likely to be undertaking weight loss dieting. This is an interesting finding in the context of Australia where recommendations had been made to subsidise individuals' membership to fitness clubs in order to improve the incentive to undertake better weight control behaviours(2009). However, one needs to take this interpretation with caution as there could exist a self-selection issue in the data which we are not able to control due to lack of data. Self-selection could happen when individuals who care more about body images are often more likely to undertake diet to control weight. Otherwise, this finding provides another avenue for one who wish to evaluate the values of one specific types of social capital in Australia through the social interactions within the environment of sport, gym clubs and associations.

Residing in a major city is estimated to increase the probability of being on a weight loss diet by 11.72%. As noted in the literature, those living outside major cities may need to spend an additional financial cost for healthier food due to differences in the food prices between rural and urban regions in Australia (one citation here). In addition, rural or remote areas of Australia have poorer access to health services (Morell et al., 2014); therefore there is people in rural and remote areas have less access to advices regarding the need to get diet to lose weight. Note that previous studies have documented higher obesity in rural areas in Australia. Nevertheless this finding reinforce the notion of regional inequality in terms of undertaking diet. It is also worth investigating whether such regional inequality exists for other types of efforts to lose weight as more empirical evidence would provide more useful information for policy purposes.

The signs of the coefficients for age, gender and the control variables for life events (pregnancy and post-pregnancy) are consistent with the hypotheses discussed in the literature. A one-unit increase in age was estimated to reduce the odds of being on a diet by 1.44%. It was also found that females were 1.794 times more likely to be on a diet than males. Being pregnant is asslocated with lower probability of undertaking diet. However, education is not found to be significant, a finding which contradicts previously discussed studies (Zapka et al., 2009; Siu et al., 2011). The result for education could be due to the fact that its direct impact is either minimal or its indirect impacts have been picked up by other relevant variables as education is expected to affect diet through a variety of mechanisms such as income, location, occupation, or even lifestyles (Cawley, 2015).

In terms of policy intervention, these results favour further emphasising to individuals the benefits of a healthy bodyweight status based on an absolute value who are older, male or less educated. In addition, further support that policy incentives will need to be larger for these individuals to begin participation in weight loss behaviour compared to individuals who are younger, female or more highly educated.

4.3 Relative ranking hypothesis in bodyweight satisfaction

Appendix 2 reports the empirical results of five logistic regression models. This is an exploratory approach to assess empirically the relative explanatory power of differing bodyweight-based variables in explaining observed variations in the level of bodyweight satisfaction across individuals. Results show that the rank hypothesis (relative rank of BMI in reference groups) explained the most overall variation of bodyweight satisfaction in terms of a

Pseudo R^2 values and be the paramount indicator based on the model's BIC while the absolute level of BMI and BMI square fails to enhance further explanatory power. In general, the model which has mean BMI of reference-group (i.e. relative to the social norm) and relative BMI rank in reference group appears to suit data better; therefore we report in Table 4 the full results of this model.

Table 4: Results of Ordered Logistic Regression

Body Weight Dissatisfaction	Confident	Std. Err.
Relative BMI rank in reference group	4.1482***	0.0763
Mean BMI of reference-group	0.0883***	0.0184
Age	-0.0236***	0.0013
Postgraduate – Masters or Doctorate	0.3750***	0.0950
Graduate Diploma/Graduate Certificate	0.2994***	0.0825
Bachelor or Honours	0.2671***	0.0602
Advanced Diploma or Diploma	0.4150***	0.0687
Certificate III or IV	0.1147**	0.0528
Year 12	0.1298**	0.5667
Male	-1.0647***	0.0381
cut1	0.3020	0.4364
cut2	2.3662	0.4371
cut3	3.6501	0.4379
cut4	6.1636	0.4400
Observations	10881	
Pseudo R2	12.65%	

*** p<0.01, ** p<0.05, * p<0.1

4.4 Contagion of overweight: a new mechanism of social influence

The results of two empirical studies in the present paper deliver some useful empirical reflections on the mechanism of the "social" contagious disease of overweight. First, suppose that there is a shock which is driven by weight gains in a reasonably significant segment of the society. One situation, this shock could shift the entire distribution upwards to a higher level of weights in a way that leaves relative BMI ranks unchanged. As the relative ranks do not change, this shock does not effects bodyweight satisfaction. Another situation involves the shift of some parts of the distribution, for example the lower end of the weight distribution, which change the relative BMI ranks in a way that improves bodyweight satisfaction of the people in the remaining scale of the distribution. In these two situation, the outcome of the shock have negative impacts on the effort levels to diet to lose weight holding others (particularly the level of physical activity) constant.

Second, as shown in Section 4.2, higher bodyweight satisfaction reduces incentives to undertake weight loss activities; therefore it leads to a more uniform increase in the bodyweight of larger population. This is a real worrying cause of the social spread of overweight and obesity over time due to the amplifying effects of increased bodyweight satisfaction, increased bodyweight relative ranks, and reduced incentives to lose weight. Note that this mechanism differs from

previous models (Burke and Heiland, 2007; Hammond and Ornstein, 2014; Strulik, 2014). Previous models mainly consider the social multiplier effects through relative BMIs, which explicitly requires some forms of information processing by individual using information on BMI or similar indexes of body mass. Our hypothesis in this paper, however, focuses on the relative ranks of BMI which assumes less information processing by individuals. Second, our model focuses on the status of dieting to lose weight, meaning that individuals if they do undertake diet to lose weight they have some forms of disagreement with their weight level (given their health lifestyle in general and other resource constraints), rather than the weight level; therefore there may exist both mechanisms that social influence increase weight and reduce efforts to lose weight and both mechanisms help prolong or increase the magnitude of the overweight phenomena.

This new mechanism through which social comparison influence overweight is important for policy considerations for some reasons. First, as if the policy ignored this new mechanism, the role of social influence would be underestimated; therefore the potential of social influence solutions to reduce the spread of overweight would be undermined. Second, one can also suggest to use information about the relative rank to affect the individual's diet decisions. Recent studies found that when students are informed of their rankings based on practice tests they perform significantly better on the actual test than the individuals who are not informed (Azmat and Iriberri, 2010; Tran and Zeckhauser, 2012). These results suggest that knowledge of relative ranks in terms of body weight may affects weight loss behaviours in a positive manner.

5. Conclusion

In this paper, we proposed to use a two-stage analytical framework to examine the factors that influence the weight loss dieting behaviours of individuals. In the first stage, the heath lifestyles are used to classify the entire data population into different distinct groups. In the second stage, a logistic model is used to estimate the statistical impacts of those important driving factors on variations of the dieting behaviours across individuals. This two-stage framework is based on the bounded rationality framework of cost-benefit analysis in terms of diet to lose weight. However, this two stage approach allows us to control for systematic deviations in the behaviours from the rationality framework which are caused by the health lifestyles. We proposed to use latent class modelling approach as health lifestyles are latent and multidimensional in nature.

We also applied this framework using a national representative dataset for Australia (i.e. the ninth wave of HILDA) and the empirical analysis provides strong evidence that latent lifestyles are important underlying factors. Statistically significant drivers of the weight loss dieting status include bodyweight satisfaction, self-assessed health, being diagnosed with a serious illness, the amount of spare time available, age, income, gender, being pregnant, being a member of an association/club, and residing in a major city. These findings provide several useful implications for policy designs as well as future research.

As self-assessed bodyweight satisfaction was found to have the strongest influence on weight loss dieting status, we also investigated what determinants of bodyweight satisfaction. Interestingly, the BMI-based relative ranks appeared to be the most important factors in comparison with the norm BMI and absolute BMI, which is consistent with the relative rank hypothesis. Combining these two results together we have put forward another mechanism to explain the persistence of overweight problem in Australia. Due to data constraints and limited space of this paper, we were not able to present either conceptual model to explain this

mechanism or empirical studies that use panel data to detect the casuality of rank hypothesis on body weight satistfaction that affects the decisions or effort levels to diet to lose weight.

Acknowledgement:

HILDA

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Appendix 1 Specified Reference Groups Based on Age and Gender

15-17 years old & Male	15-17 years old & Female
18-19 years old & Male	18-19 years old & Female
20-21 years old & Male	20-21 years old & Female
22-24 years old & Male	22-24 years old & Female
25-34 years old & Male	25-34 years old & Female
35-44 years old & Male	35-44 years old & Female
45-54 years old & Male	45-54 years old & Female
55-64 years old & Male	55-64 years old & Female
65-74 years old & Male	65-74 years old & Female
75 years or over & Male	75 years or over & Female

Appendix 2: Pooled Ordered Logistic Regression Analyses Comparing Predictors

Regression and Variables[#]	Coefficient	Std. Err.	Pseudo R^2	BIC
Regression 1			0.1257	28387.13
Relative BMI rank in reference group	4.2162***	0.0751		
Regression 2			0.1204	28567.79
BMI	0.5332***	0.0176		
BMI squared	-0.0054***	0.0003		
Regression 3			0.0217	31751.50
Mean BMI of reference-group	0.2945***	0.0175		
Regression 4			0.1265	28373.44
Relative BMI rank in reference group	4.1482***	0.0763		
Mean BMI of reference-group	0.0883***	0.0184		
Regression 5			0.1266	28388.96
Relative BMI Rank in reference group	4.4999***	0.3572		
Mean BMI of reference-group	0.0901***	0.0185		
BMI	-0.0718	0.0528		
BMI squared	0.0009	0.0006		

#: All five models are controlled for the effects of age, gender, and education. The results are consistent findings of previous studies; therefore we decided not to report. However, full results are available upon email request.

*** p<0.01, ** p<0.05, * p<0.1