



Translational research in the area of inequalities in health related to obesity in Australia

Bruce Hollingsworth

Associate Professor, Centre for Health Economics,
Monash University

Katharina Hauck

Senior Research Fellow, Centre for Health Economics,
Monash University

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Correspondence: Assoc. Professor Bruce Hollingsworth

Centre for Health Economics
Faculty of Business and Economics
Building 75
Monash University
Clayton
Melbourne, Victoria 3800
Australia

Phone: +61 (0)3 9905 0760, Fax: +61 (0)3 9905 8344
bruce.hollingsworth@buseco.monash.edu.au
katharina.hauck@buseco.monash.edu.au

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ABSTRACT

Health inequalities are a fundamental policy issue. However despite various policy initiatives in this area inequality persists, and in fact may be on the increase. Effective policy requires an understanding of the causes of inequalities. Health economics has developed tools and theories purported to be useful in measuring and identifying inequalities.

We question current economic theories in the area of obesity, an important, if not the most important, public health concern of the future. We summarise economic work in this area, suggesting a different economic perspective to that of rational choice, and go on to present some preliminary results of quantitative analysis of Australian data to support our theories, before mapping out possible areas for future research.

This paper asks more questions as it answers, aiming to set a framework for a dialogue which may ultimately help translate research findings into useable evidence for policy makers.

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1. Introduction

“One in four of our children is overweight. The explosion in obesity is so rapid that it is estimated that half of all young Australians will be overweight by 2025.”

“The stories are about the vicious circle of obesity...They're about an unequal society where often the well-off — with their nearby parklands to run in, access to healthier foods and the luxury of being able to live off a single income — stay thin, and the less well-off — with often dual working parents and easy access to cheap, high-fat, high-sugar fast foods — get fat. They're about the discrimination and stigma of obesity helping fuel a sense of defeatism: why bother losing weight?”

The Sunday Age, 21 August 2005

“Obesity is, profoundly, a socioeconomic issue”

Adam Drenowski, Director, Center for Public Health Nutrition, University of Washington (quoted in the Lancet - McCarthy, 2004)

Tackling health inequalities is a non-trivial task. Governments in most developed and developing nations have tried, yet inequalities still exist. That inequalities in health exist is no longer in dispute, this has been a persistent problem for a number of years across most countries. In fact inequalities may even be on the increase. Researchers in general, and health economists in particular, have contributed a great deal to the understanding of issues surrounding this persistence. Our aim is not to summarise this literature (for a comprehensive review a good starting point is the Report of the Issues Panel on Equity in Health <http://www.ukhen.org/Papers.pdf>), but to point out several different, but complimentary, issues, around how economics can contribute to research in one major disease area where health inequalities are evident – obesity. Our aims are to show how economics can be useful, from suggesting underlying economic models, through to how to analyse the problem quantitatively, through to discussing how to undertake research which can be translated into effective policy and practice.

Obesity is at the centre of health concerns internationally, as it is reported that for the first time in living memory life expectancy in developed countries may start to fall, due to the consequences of increased obesity in society (Olshansky et al, 2005 NEJM). It has been suggested that public health campaigns are “ill-equipped” to deal with the problem (McCarthy, 2004). Are health education and prevention campaigns being targeted at the wrong groups in society?

Is the growth in obesity related in some way to health inequalities? It has been shown that the obese (and overweight) in society are those who may be worse off in other senses as well (eg Hulshof, 1991, McCarthy, 2004, Drenowski, 2004). So, perhaps specific targeting of campaigns would be more useful. Making use of the Victorian Population Health Survey (VPHS, 2002) we can see that, overall, 48 per cent of the Victorian population are overweight or obese, including 16 per cent who are obese (see Table 1). Breaking this down 55 per cent of men are overweight or obese, including 15 per cent obese, and 43 per cent of women are overweight or obese, including 17 per cent obese. By education group there is a definite gradient, for those with only primary education, 21 per cent are obese, for those with secondary education 17 per cent are obese, and for those with tertiary education only 14 per cent are obese. This gradient is

confirmed looking at occupational groupings – for professionals 15 per cent are obese, for non professionals and others, 17 per cent are obese. When looking at household income there also appears to be an obesity gradient, for those who earn \$40,000 or less, 17.5 - 18 per cent are obese, for those who earn \$40 - \$60,000, 15.5 per cent are obese, and for those who earn over \$60,000, 14 per cent are obese. Finally when looking at type of dwelling, for those who own their property 15 per cent are obese, for those who rent 19 per cent are obese.

Table 1: Summary statistics on who is obese in Victoria (VPHS, 2002)

	1	2	3	4	Numbers
<i>Overall</i>	3%	49%	32%	16%	7,229
<i>Male</i>	2%	43%	40%	15%	2,820
<i>Female</i>	4%	53%	26%	17%	4,409
<i>Primary Education</i>	4%	46%	29%	21%	323
<i>Secondary Education</i>	4%	48.5%	30.5%	17%	3,978
<i>Tertiary Education</i>	3%	50%	33%	14%	2,928
<i>Professionals</i>	2.5%	49.5%	33%	15%	2,831
<i>Non professionals</i>	4%	48%	31%	17%	3,782
<i>Other occupations</i>	6%	52%	25%	17%	616
<i>Income less than \$20,000</i>	4%	47%	31%	18%	1,904
<i>Income \$20-\$40,000</i>	3%	50%	29.5%	17.5%	1,518
<i>Income \$40-\$60,000</i>	3%	48%	33.5%	15.5%	1,196
<i>Income over \$60,000</i>	2%	50%	34%	14%	1,862
<i>Own home</i>	3%	49%	33%	15%	5,722
<i>Rent home</i>	5%	50%	26%	19%	1,374

BMI Category Definitions: 1 = underweight, 2 = normal, 3 = overweight, 4 = obese and above (including super obese etc)

As Philipson (2001) (and others, for example McCarthy, 2004) discussed, obesity is not just a public health problem, it is an economic phenomenon. Philipson states that obesity is seen as avoidable, ie behavioural adjustments can be made by individuals if benefits exceed costs (eg to diet and physical activity, Drenowski, 2004). However, Philipson also goes on to say that there has been little previous economic analysis of obesity related issues, strange considering the enormous public health issue at stake. Philipson states this as “unfortunate”. We would go further, if this is correct, it’s a critical mistake. As health economists it is our job to link the factors impacting on behavioural change to the pressing health issues in society. To have neglected obesity in this way would be beyond unfortunate.

There is now work underway (see for example the special edition of the American Journal of Preventive Medicine, 27 (3S), 2004), and lets hope as a profession we can play catch up very quickly. We believe we can, but the state of play is such that we must conduct robust research into the economics of obesity, and translate the results of our research as effectively as possible. Evidence is emerging about the role economics can play in this area (Cutler et al, 2003, McCarthy, 2004, Sanz-de-Galdeano, 2005).

Here we summarise economic research on obesity, suggest ways economics can be of more use in this area (reporting some initial quantitative work), and start to map out an agenda for future research, including how we should work with policy makers to translate our results into a language policy makers can understand, something we are perhaps all guilty of not being very good at.

We made an interesting observation looking at the quotes at the beginning of the very timely and interesting series of articles published in *The Sunday Age* in Victoria recently. No one asked a

health economist what the underlying economic issues are. Have we nothing of any worth to say on these issues, or are we just not very good at saying it? Let's see.

2. Why is obesity a problem?

So what is obesity? The measure most commonly used to assess if an individual is obese is that of the Body Mass Index (BMI). This is a simple ratio of weight divided by height ($BMI = \text{kg/m}^2$, work your own out on the www, eg <http://www.core.monash.org/bmi.html>), below a score of 18.5 you are underweight, over 25 overweight, and over 30 is said to be obese. There is an extensive medical and epidemiological literature on obesity, suffice to say here that the anticipated public health consequences of this epidemic are potentially catastrophic in economic terms. In the USA a greater number of the population are obese than smoke, use illegal drugs, or are in ill health for reasons unrelated to obesity. In addition it is a major epidemiological risk factor for heart problems, cancer and diabetes (Monash Centre for Obesity Research, 2005, <http://www.core.monash.org>). It is reported as rivalling asthma in terms of chronic disease burden. This is aside to psychological costs related to, for example, body image and low self esteem (Averett and Korenman, 1999) and issues surrounding productivity, wages (Cawley, 2004; Baum and Ford, 2004) and job absenteeism (Bungum et al, 2003, Burton et al 1998).

Chou et al 2004 examine the factors that may be responsible for the 50 per cent increase in the number of obese adults in the US since the late 1970s, finding per capita number of fast-food and full-service restaurants, the prices of a meal in each type of restaurant, food consumed at home, cigarettes, and alcohol, and clean indoor air laws have the expected effects on obesity and explain a substantial amount of its trend. In a study of children in South Australia, related to obesity change Dollman and Pilgrim (2005) conclude "The development of targeted interventions to combat child obesity will depend on a clearer understanding of how environmental influences on weight status are distributed across the socio-demographic landscape". With regard to inequalities, in the USA it has been found that obesity rates are highest among lower income groups (Drewnowski and Darmon, 2005). Hulshof et al (2003), looking at a ten year period in the Netherlands, found dietary intake among those in higher SES groups was closer to the recommendations of the Netherlands Food and Nutrition Council, compared to those in lower SES groups. There may also be issues of food insecurity, obese people have been reported as buying cheaper food due to economic problems and fears or experiences of running out of money to buy food compared to normal weight subjects (Sarlio-Lahteenkorva and Lahelma, 2001). Sanz-de-Galdeano (2005) looks at the obesity epidemic in Europe, noting that obesity is more common among lower socioeconomic groups, especially those with lower education levels. So will increased spending on health promotion be able to counter such growth patterns, or are other factors at work here?

3. What can economists contribute to this debate?

Economists take a different perspective to, for example, epidemiologists or medics. Firstly we can look at the overall costs to society, second (and closely related to this), we can look at the cost effectiveness of policy interventions, and third, we can look at behavioural modelling.

Obesity is costly to society, in the USA costs may be around 4-8 per cent of all annual health care expenditure (Allison et al, 1999, Colditz, 1999; Kortt et al, 1998) – up to a 'conservative figure' of US\$100 billion. In Canada, costs have been estimated as up to 5 per cent of health expenditure (CN\$3.5-4 billion), with hypertension, type 2 diabetes and coronary artery disease as the main cost drivers (Birmingham et al, 1999; Katzmarzyk and Janssen, 2004). For France costs are estimated at 1.5-2.5 per cent of health expenditure (Detournay, 2000; Levy et al 1995), and for New Zealand a figure of 2.5 per cent has been estimated (Swinburn et al, 1997). In Australia "the cost of obesity to taxpayers is more than A\$1.5 billion a year and rising"(Dr Rob Moodie, Chair of

VicHealth, quoted in the Sunday Age, 28 August, 2005). Translation of costs overseas to Australia would put that figure potentially as high as A\$5 billion.

There may be large differences in health care costs by degree of obesity. Overall, a BMI of 35 to 40 has been associated with double the increase in health care expenditure above normal weight than a BMI of 30 to 35 (50 per cent compared to 25 per cent increase, respectively), with a BMI of over 40 equivalent to 100 per cent higher costs above those of normal weight. Also, gender differences in how health care is used and associated costs changed with obesity levels (Andreyeva et al, 2004). So, is the issue as simple as spending more on public health and health promotion now to save health care dollars in future?

Roux and Donaldson (2004) argue that the role of economics stretches far beyond measuring the overall cost of illness, stating that economics should be used to evaluate the use of scarce resources with regard to different strategies used in preventing and treating obesity. While we would agree, we would take this further in saying economics has a role (if not the role) in pulling together all the disparate evidence on what determines obesity, and evaluating the effect of policies on behavioural change over time. People make decisions that ultimately affect their health, but those decisions may be about transport, housing, education, or a whole list of seemingly unrelated factors. There is a lot more in a health production function than use of health care services, and a host of factors which impact upon the decision making process.

Sometimes economists assume people are 'free' to make their own 'rational' choices. This may not always be true, so telling people what is best for them may not lead to the desired behavioural change – given certain circumstances, eg having a low income, and/or being time poor ie having to work long hours in poorly paid jobs, may mean not being in any position to change your behaviour, eg you don't just need the money to buy fruit and vegetables, you need the time to prepare them. The result may be the wrong campaigns being aimed at the wrong groups. For example, evidence from the USA (Sturm, 2004) suggests the image that Americans – on average - are overworked. However, there is contrary evidence that they have more leisure time, but are still becoming larger. The limitation pointed out is that different subpopulations have very different experiences, for example data about adults tells us little about the ways adolescents are behaving. Also, what leisure time is used for is important. Sturm (2004) points out sedentary leisure industries are growing faster than GDP growth. Another example of targeting is that there may be evidence of a link between maternal employment status and overweight children. The relationship appears positive, and particularly so for mothers of a higher socioeconomic status (Anderson et al, 2003).

As economists we would ideally start off looking for a theoretical foundation for our arguments. One such theory could be, as previously mentioned, and as cited by Philipson (2001), that of rational choice. Why is obesity a problem from the viewpoint of the individual, if it is the result of choices made by that individual? Obesity is proven to be a risk factor for reducing length of life, and can be prevented by behavioural change. If this is the case, why are numbers of obese people increasing dramatically, especially among the young? Are individuals making a rational choice to be obese? It is cited in the health promotional literature that society is very efficient at producing obese individuals - "obesity is an unexpected result of a successful market economy" (Moodie, 2005). Why, from an economic point of view, is this the case?

Philipson argues that the cost of food has lowered, and the cost of expending calories has increased, the result being an overall increase in weight gained. He argues that due to technological change people do not exercise as much, in fact the cost of physical exercise has risen, in terms of time foregoing other leisure activities. A hundred years ago, people were paid to do physical work, nowadays people have to pay to exercise. So, the argument is that technological change has changed the market for calorie usage. Philipson argues that caloric consumption has not risen substantially, and is in fact inelastic with respect to income, so exercise must have fallen. He argues that leisure exercise is increasing, but work related exercise

is falling, a prime cause for obesity. Cutler et al (2003) argue that more recently rates of using calories have not changed rapidly, but rates of consumption, potentially due to technology such as food preparation times changing, have kept increasing.

Philipson goes on to offer other arguments. Historically weight was seen as an indicator of income status, ie you could afford to eat more, but falls in food prices relative to other goods mean this became a less effective economic signal. In terms of signals, the opposite may now be true. People over invest in being thin, as a potential economic signal. This is said to be a poor explanatory factor for the increase in obesity, however. If it were true that signalling were the reason for weight change in society, then rates of obesity would be falling.

A further economic theory discussed by Philipson is that market production of food has replaced household production, the most common argument is that fast food makes you obese. This is a different technological argument. Philipson argues (although he doesn't use the terminology) that this is simply the opportunity cost of the value of time. Output foregone per meal has risen in value. This is especially true given the increased value of women in the market place, rather than at home. However, Philipson argues that this cannot be explained in economic terms as the availability of health food alternatives is there in the market place, but people make a choice to have fast food. He argues that if calorific intake hasn't risen that much, fast food restaurants cannot be held accountable for peoples' lack of exercise¹.

Philipson's final explanation is that obesity may be a consequence of biological factors, either due to addiction or genetic make up. He argues that richer people in developed countries can afford to become addicted to food, something that may not happen in less developed countries (although Hakeem 2001 shows there may be a link between being overweight and income in some groups in Pakistan; also differences may be down to economic development and lifestyle transition phases. For example, in China those who are better off have a less healthy lifestyle (Kim et al 2004). We would also ask who is it that is becoming obese in developed countries, those of relatively higher or lower socio economic status? How can the dual problem of overweight adults and underweight children in developing countries be explained (Caballero, 2005)?

All of the above, from an economists' point of view, counts on a belief that markets for health and health care work, and are the best means for solving, or explaining, problems such as obesity. We can, and do, argue that this simply isn't the case.

Philipson argues that health education is swamped by advertising by food companies (don't forget alcohol, and car advertising), he cites that the USA government spends \$330 million on nutrition education, food manufactures spend \$7,000 million per annum (1997 figures). OECD data would suggest less than three per cent of health expenditure in Australia goes on health promotional activities.

In Philipson's rational choice world he argues rational people may be concerned about more in their lives than health, and may disregard the medical evidence that eating more is bad. Of course the same counts for smoking and drinking, the economic argument here is that of rational addiction. People know what they should be doing, they simply prefer not to do it. Is the same true of obesity? If so why should a health promotion campaign have any effect?

Economic arguments may be used to suggest people do not want to pay the price of losing weight, so are incentives rather than information the issue. Successful public health campaigns,

¹ Note: There may be 'crisis' effects, as people retire, or become unemployed their calorie intake, or opportunity to exercise may change, this may be shown in our data. Also in Australia there may be rural/urban effects, impacting on prices of foodstuffs, availability etc.

against smoking or drink driving have used shock tactics as an incentive. Making unhealthy activities unfashionable may be an answer. Children (and their parents) go to fast food outlets as they host parties etc. What if there were taxes on such activities, and subsidies for licensed healthy activities for children, not just the foods themselves? In addition, when do children ever make rational informed decisions? What model of rationality can they ever fit in to?

Philipson argues that some public health interventions have caused weight to increase in populations, eg campaigns to reduce smoking, taxes on cigarettes creating an economic incentive for people to smoke less and substitute smoking for eating more, although the economic evidence for this is inconclusive (Chou et al, 2004; Gruber and Frakes, in press). He argues that food stamps for the poor may increase obesity among those on a lower income.

Philipson states that the future for research in this area should be empirical in nature. We would agree with that, for example the impact of work related physical activity on obesity, or gender or race differences, and incentives to be thin. He argues that the USA is the most efficient place on earth at producing obese people, much better than Europe where food and land are more expensive, and cities aren't developed around car use. Also, Europeans aren't as good at watching television, or undertaking other less physical activities, such as surfing the web, or playing video games. 'New world' developed country such as Australia may be catching up to the USA in these respects as all of the above factors contribute well to the efficiency of production of obesity.

Finally in Philipson's research agenda the supply side is addressed, arguing how big the market for an obesity reducing drug might be. He argues that just as you wouldn't want an economist performing your medical surgery, clinicians should not design social interventions. We would sympathise with this view, but point out that not just surgeons are at risk from potential adverse events. Economists have probably killed just as many people (if not more) with bad advice as surgeons have through poor technique. Economic advice on health system implementation in developing countries stands as testament to this in terms of potentially increasing inequalities rather than reducing them.

4. A different perspective

What can we offer that is different to the above, or more enlightening in terms of a health economics contribution to the obesity epidemic? From our perspective we would argue that markets do not operate effectively in providing health for populations. Leaving markets to operate freely will simply increase inequalities. In the health economics literature this debate may be summarised by the difference between 'welfarists' and 'extra welfarists'. The former are interested in maximising social welfare from the perspective of the individual, markets and Pareto optimality, the latter are interested in maximising and measuring only changes in health related to health related resources, not measuring utility changes overall. An example may be the former's reliance on 'willingness to pay' methods, and the latter's rejection of this as being linked to ability to pay and the impact of non health related matters.

People do not choose to be less healthy deliberately - income, and other inequalities, lead to health inequalities. This is just as much the case with obesity as with other health epidemics. Lifestyle choices may be made by individuals, but they are influenced by a whole host of socioeconomic factors, meaning socioeconomically disadvantaged people have a harder time living a healthy lifestyle².

² Cutler et al (2003) argue that individuals may have a self control problem, owing to the addictive nature and instant gratification of certain foods.

Here (and as economists we feel we have to) we make an assumption, perhaps not too bold, that behavioural treatment may be more cost effective in the long run than interventionist treatment, such as surgical or pharmacological, about which there may be a certain amount of uncertainty (Clegg, 2003). We assume that proactive prevention will be more efficient than reactive treatment. As economists we would say what is needed to design appropriate policy interventions are behavioural models which explain why individuals choose certain lifestyles.

In an attempt to quantitatively demonstrate our hypotheses that rational choice may not be the underlying economic reason for obesity we have begun a programme of work to analyse the impact of socioeconomic factors on obesity in Australia. Here, we present our initial findings.

5. Data and Methods

We use data from the Victorian Population Health Survey 2002 (VPHS, 2002). It is an annual telephone survey collecting information on a randomly selected sample of the adult Victorian population. The sample includes a total of 7,500 households and is stratified by departmental region. Rural regions are oversampled. Information is collected on lifestyle, including physical activity, smoking, alcohol consumption, intake of fruit and vegetables, on the use of health services and selected health screening, on adult obesity and the prevalence of common diseases such as asthma, diabetes, heart disease and cancer, on psychological distress and on social networks. In addition, information on socio demographic characteristics such as education, employment and household income are collected. The main survey interviewing occurred during August-November 2002. Interviewers made up to nine call attempts –at different times of the day– to complete an interview where required. A group of more experienced interviewers were chosen for refusal conversions to increase participation. The participation rate was 65 per cent. Interviews were conducted in six community languages (for details see Department of Human Services 2003).

Our models are estimated on a sample of 6,418 individuals, 2,575 males and 3,843 females. The model used was arrived at after careful consideration of models in the literature reviewed, and after testing of several other models, given available data. Table 2 lists the variables used in our models.

Table 2: Variable definitions

<i>BMLN</i>	Natural logarithm of the body mass index
<i>AGE</i>	Age in years
<i>MALE</i>	1 if male, 0 if female
<i>MARRIED</i>	1 if married or living as a couple, 0 otherwise
<i>WIDOWED</i>	1 if widowed, 0 otherwise
<i>DIVORCED</i>	1 if divorced or separated, 0 otherwise
<i>NVRMAR</i>	1 if never married, 0 otherwise
<i>OVERSEAS</i>	1 if born overseas, 0 if born in Australia
<i>PRIMEDUC</i>	1 if primary or other education, 0 otherwise
<i>SEC</i>	1 if secondary education, 0 otherwise
<i>TERT</i>	1 if tertiary education, 0 otherwise
<i>EMP</i>	1 if employed or self-employed, 0 otherwise
<i>RETIRED</i>	1 if retired, 0 otherwise
<i>OTHEREMP</i>	1 if other type of employment, 0 otherwise
<i>PROF</i>	1 if professional occupation, 0 otherwise
<i>NONPROF</i>	1 if non professional occupation, 0 otherwise
<i>OTHEROCC</i>	1 if other occupation, 0 otherwise
<i>INC20</i>	1 if income below \$20,000, 0 otherwise
<i>INC2040</i>	1 if income between \$20,000 and \$40,000, 0 otherwise
<i>INC4060</i>	1 if income between \$40,000 and \$60,000, 0 otherwise
<i>INC60</i>	1 if income above \$60,000, 0 otherwise
<i>OWNED</i>	1 if living in own accommodation, 0 otherwise
<i>RENTED</i>	1 if living in rented accommodation, 0 otherwise
<i>OTHDWELL</i>	1 if living in other type of accommodation, 0 otherwise
<i>VEG</i>	Number of serves of vegetable each day
<i>BREAKFAST</i>	1 if eats breakfast every day, 0 otherwise
<i>NOWALKS</i>	1 if never walks more than 10 min, 0 if walks at least 1 time per week 10 min or more
<i>NOEXERCISE</i>	1 if never exercises vigorously, 0 if exercises at least 1 time per week

Our dependent variable is the body mass index (BMI) as a measure of obesity. We use the natural logarithm of the BMI to adjust for skewness in the distribution of BMI values and to avoid restrictions placed on the residual which would arise from the fact that the BMI cannot take negative values. We allow for a flexible relationship between age and BMI by specifying a quadratic polynomial in age (*AGE*, AGE^2). Information on marital status is provided by *MARRIED*, *WIDOWED*, *DIVORCED*, and *NVRMAR*. *OVERSEAS* indicates whether an individual has been born overseas. *SEC*, *TERT*, and *PRIMEDUC* indicate the educational status of the individual, with *PRIMEDUC* comprising primary education and other types of basic education. Employment status is captured by *EMP*, *RETIRED* AND *OTHEREMP*, which comprises individuals engaged in family care, the unemployed, students and individuals unable to work. Occupational status is captured by *PROF* (comprising managers, professionals and para-professionals), *NONPROF* (comprising trades people, sales people, plant or factory workers, and other labourers), and *OTHEROCC* (comprising people occupied with family care, and people who never work). Household income is grouped into 4 categories, *INC20*, *INC2040*, *INC4060*, and *INC60*. *OWNED*, *RENTED* and *OTHDWELL* provide information on the type of accommodation inhabited by the household, with *OTHDWELL* mainly comprising individuals in residential care homes. *VEG* indicates the number of serves of vegetables usually eaten per day, and it can take values

between 0 and 5. A 'serve' is ½ cup of cooked vegetables, or one cup of salad vegetables. BREAKFAST is included in the analysis as a measure of healthy eating habits. NOWALKS indicates individuals which never walk continuously for at least 10 minutes for recreation, exercise or to get to or from places. NOEXERCISE indicates individuals who never do any kind of vigorous physical exercise that make them breathe harder or puff and pant, such as tennis, jogging, cycling or keep fit exercises.

Descriptive statistics for the full sample and for men and women stratified by normal weight and overweight & obese are provided in Table 3. Individuals with normal weight tend to be associated with younger age (in particular women), higher incomes, higher educational status, are more likely to be divorced or have never been married, been born overseas (in particular women), are employed, live in rented accommodation, eat breakfast daily, do walk continuously for 10 min or more at least one time per week, and exercise vigorously at least one time per week compared to their overweight counterparts.

Table 3: Variable means by sub-samples of normal weight (BMI between 18.5 and 25) and overweight & obese (BMI above 25), and gender

	Full sample		Men		Women	
	<i>normal weight</i> n=3,543	<i>overweight & obese</i> n=3,441	<i>normal weight</i> n=1,214	<i>overweight & obese</i> n=1,558	<i>normal weight</i> n=2,329	<i>overweight & obese</i> n=1,883
<i>bmindex</i>	22.326	29.466	22.654	28.962	22.155	29.883
<i>age</i>	46.431	48.607	47.119	47.907	46.072	49.153
<i>married</i>	0.588	0.646	0.587	0.703	0.589	0.602
<i>widowed</i>	0.090	0.098	0.047	0.038	0.112	0.145
<i>divorced</i>	0.134	0.121	0.103	0.094	0.150	0.143
<i>nvrmar</i>	0.188	0.135	0.263	0.165	0.150	0.111
<i>overseas</i>	0.191	0.186	0.199	0.201	0.187	0.174
<i>primeduc</i>	0.042	0.050	0.045	0.039	0.040	0.058
<i>sec</i>	0.544	0.553	0.515	0.496	0.559	0.597
<i>tert</i>	0.414	0.398	0.440	0.465	0.401	0.345
<i>emp</i>	0.565	0.552	0.628	0.682	0.532	0.451
<i>retired</i>	0.210	0.228	0.239	0.200	0.195	0.250
<i>otheremp</i>	0.225	0.220	0.133	0.118	0.273	0.299
<i>prof</i>	0.395	0.392	0.442	0.460	0.371	0.339
<i>noprof</i>	0.514	0.529	0.511	0.525	0.516	0.532
<i>otherocc</i>	0.090	0.079	0.047	0.015	0.113	0.128
<i>inc20</i>	0.282	0.305	0.259	0.225	0.295	0.371
<i>inc2040</i>	0.240	0.229	0.244	0.225	0.237	0.233
<i>inc4060</i>	0.183	0.186	0.170	0.200	0.190	0.175
<i>inc60</i>	0.295	0.279	0.327	0.350	0.278	0.221
<i>owned</i>	0.788	0.794	0.787	0.822	0.789	0.773
<i>rented</i>	0.193	0.187	0.196	0.157	0.191	0.210
<i>othdwell</i>	0.019	0.019	0.016	0.021	0.020	0.017
<i>veg</i>	2.656	2.695	2.344	2.368	2.819	2.950
<i>breakfast</i>	0.427	0.377	0.450	0.362	0.415	0.388
<i>nowalks</i>	0.146	0.189	0.148	0.190	0.145	0.188
<i>noexercise</i>	0.597	0.679	0.516	0.607	0.640	0.734

6. Estimation

We estimate models for the whole sample, and for men and women separately. We use log-linear models by transforming the dependent variable BMI into natural logarithm. Our aim is to adjust for skewness in the distribution of BMI values and to avoid restrictions placed on the residual which would arise from the fact that the BMI cannot take negative values. Even after transformation, the dependent variable BMILN takes on a number of exceptionally small and large values. We have 27 observations with a BMI of either under 15 or over 50 (the lowest observed BMI is 10.96, and the highest one is 64.58). While these values may truly reflect the variation in our sample, they could be outliers due to measurement errors. Measurement error may occur because the questions on height and weight of respondents allow answers in metric and imperial measures, and in stones. This may lead to confusion on both the sides of the interviewer and the respondent. In order to take account of this possibility, we estimate robust OLS regression models. We initially fit a normal OLS regression and calculate Cook's Distance, which measures the overall influence of each observation on the regression coefficients, including the intercept (Cook and Weisberg 1982). We exclude any observation for which $D > 1$, thus excluding observations which have unusual large influence on the model and are considered gross outliers. Thereafter, we use iterative regressions based on the starting values obtained from the sample with gross outliers excluded. After each regression iteration, case weights are calculated based on the absolute value of the residuals, and regressed again using those weights until the maximum change in weights drops below 0.01. Weights derive from one of two weight functions, Huber weights (Huber 1964) and biweights (Beaton and Tukey 1974). Huber weights are used until convergence, and then, based on that result, biweights are used until convergence. Huber weighting gives observations with small residuals a weight of 1, while observations with larger residuals receive gradually smaller weights (Huber 1964). With biweighting, all observations with nonzero residuals receive some downweighting according to the smoothly decreasing biweight function (Beaton and Tukey 1974). Both weighting functions are used because Huber weights have problems dealing with severe outliers, while biweights sometimes fail to converge or have multiple solutions. The initial Huber weighting should improve the behaviour of the biweight estimator. See Berk (1990) for a general description of the issues and methods. We use STATA/SE 9.0 (STATACorp 2005) for the estimations.

7. Results

Table 4 presents the coefficient estimates and their standard errors of the robust log-linear regression for the whole sample, and for men and women separately. As we estimate log-linear models, the coefficient values need to be interpreted as constant proportional changes. By multiplying the coefficient values by 100 we obtain the percentage change in the dependent variable which results from an absolute change in the explanatory variables. All three models pass the reset test at the 5% significance level, suggesting that they do not suffer misspecification.

Table 4: Coefficient estimates ^{a,b}

	Whole sample		Men		Women	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
age	0.012	0.001	0.012	0.001	0.011	0.001
age2	-0.0001175	9.23e-06	-0.0001197	1.26e-05	-0.0001121	1.31e-05
male	0.055	0.005				
widowed	0.015	0.009	0.013	0.016	0.000	0.012
divorced	-0.022	0.007	-0.036	0.010	-0.018	0.010
nvrmar	-0.026	0.007	-0.020	0.009	-0.032	0.011
overseas	-0.018	0.006	-0.010	0.007	-0.022	0.008
tert	-0.009	0.005	-0.006	0.006	-0.010	0.007
primeduc	0.007	0.011	0.005	0.016	0.012	0.015
retired	0.024	0.009	0.020	0.012	0.034	0.013
otheremp	0.012	0.006	0.007	0.011	0.023	0.008
prof	0.001	0.005	-0.007	0.006	0.008	0.007
otherocc	0.017	0.009	-0.036	0.021	0.021	0.010
inc20	0.005	0.007	-0.006	0.010	0.007	0.009
inc4060	0.003	0.007	0.008	0.009	-0.004	0.010
inc60	0.000	0.007	0.010	0.009	-0.013	0.009
rented	0.011	0.006	-0.005	0.008	0.022	0.008
othdwell	0.036	0.018	0.064	0.024	0.014	0.025
veg	0.003	0.002	-0.002	0.002	0.007	0.002
breakfast	-0.018	0.005	-0.027	0.006	-0.012	0.006
nowalks	0.014	0.006	0.024	0.008	0.004	0.008
noexercise	0.021	0.005	0.014	0.006	0.028	0.007
cons	2.920	0.022	3.004	0.030	2.907	0.031

^a Coefficient values in **bold** indicate variables which are significant at the 5% confidence level.

^b Reset tests: whole sample: $F(2, 6393) = 1.36$, $\text{Prob} > F = 0.2567$; Men: $F(2, 2551) = 0.13$, $\text{Prob} > F = 0.8774$; Women: $F(2, 3819) = 2.60$, $\text{Prob} > F = 0.0742$

The results show that the BMI increases by 1.2 per cent with every year of age for the whole sample. However, we find a quadratic relationship between age and BMI. The relationship between age and BMI is positive up to the age 50, at which point it becomes negative: BMI decreases with increasing age beyond the age of 50. Similar findings have been found elsewhere (Chou et al, 2004). Men have, on average, a 5.5 per cent higher BMI than women. Divorced men have a 3.6 per cent lower BMI than married men, a result which cannot be observed for women. Men and women who have never been married have a 2 per cent and 3.2 per cent lower BMI than their married counterparts. Women born overseas have a 2.2 per cent lower BMI than women born in Australia. Retired women and women in other type of employment (OTHEREMP) or occupation (OTHEROCC), which are predominantly women occupied with family care, have a higher BMI than employed women (2.3 per cent for OTHEREMP, 2.1 per cent for OTHEROCC). These results are not observed for men. Household income has no significant effect on BMI. However, not owning a house – as a measure of social disadvantage - has a negative effect on weight: Men living in other types of dwellings have a 6.4 per cent higher BMI, whereas women in rented accommodation have a 2.2 per cent higher BMI. Some lifestyle factors have a significant influence on weight. With every serve of vegetables eaten, women's BMI increases by 0.7 per cent. This is a puzzling result, but may indicate that women who eat more vegetables eat more or

bigger portions in general. Ideally, we would need to measure vegetable consumption as a percentage of overall food consumption, but this information is not available to us. Eating breakfast daily lowers the BMI of men by 2.7 per cent, which may indicate that having regular breakfasts is an indication of healthy eating habits or lifestyle for men. Men and women who exercise vigorously at least once a week have a significantly lower BMI, 1.4 per cent for men and 2.8 per cent for women. Walking continuously for at least 10 minutes has a positive effect for men (2.4 per cent lower BMI), but not for women.

We are in the preliminary stages of our analysis, future work includes using more advanced techniques, such as quantile regression to account for technical problems using least squares on samples of this nature (Kan and Tsai, 2004). Also looking at dynamics over time will be important, as, for example, economic cycles may play a role in obesity levels (Ruhm, 2005). In addition we will explore the use of other explanatory variables, such as rural and urban differences.

8. Policy interventions in a failing market

Our initial results on obesity levels, who is obese, and determinants of obesity suggests leaving markets alone is not the answer, as markets in health do not clear efficiently for a multitude of reasons. Firstly, there is asymmetry of information. Individuals are not fully informed concerning the consequences of their actions, or the price of changing their behaviour. They are not fully informed about the relationships between quantities and qualities of goods. Perfect information is a bold assumption in any market. Information is asymmetric as buyers and sellers have different levels of information, for example a fast food firm may have more information on the true nutritional benefits of their products (compared to other food on offer in a marketplace) than the buyers of fast food. They can perpetuate this asymmetry by advertising, effectively crowding out information on more healthy alternatives. Poor information may contribute to obesity (Finkelstein et al, 2005), this may be a consequence of risk knowledge, with potential differences between knowledge of risk, and its use, among males and females. This may have important policy consequences (Kan et al, 2004). Asymmetry exists in part due to the financial (including time) constraints of attaining knowledge, as such providing information in a form easy to digest (forgive the pun) is crucial, for example the labelling of foods in a clear manner (Cawley, 2004).

There are issues of agency where one set of actors acts on behalf of another, for (hopefully) their benefit. We have doctors to act as our agents in medical care terms, but who can act as our agent in terms of lifestyle decisions which impact on health? We may rely on peers and other role models in this respect, sometimes not the most optimal policy in terms of maximizing health and quality of life. Doctors act as our agents because we cannot distinguish between quantities and quality of medical care interventions. However, who helps us distinguish these characteristics in health related lifestyle activities, those who spend the most on advertising, or lobby politicians the most effectively?

Doctors have the capacity to induce demand for potentially unwanted medical services, with consequent adverse effects, so we have to ask what are the parallels in health and lifestyle (HAL) activities? Is there HALID, in terms of HAL induced demand for services detrimental to our health and quality of life. If so - and the aim of the health market place (from societies point of view) is to maximize health and quality of life - then the market isn't working. Are those responsible for supplying our nutritional needs acting in a way which is detrimental to our health? How can governments intervene to adjust markets? Can there ever be an agent who would operate in this way to ensure a population receives the best food in nutritional terms. Seems unrealistic.

But what about the food supplied to children in schools, who acts as the agent there? The government has the authority to decide what is served and when. The potential for obesity as an epidemic among children in the developed world is not in dispute, and obesity in children and adolescents is a major risk factor in them becoming obese adults (Gortmaker et al, 1993). A

major example recently in terms of this relationship being used to improve the nutritional qualities of food served in schools is the role played by celebrity chef Jamie Oliver. He started a campaign in the UK which has impacted on schools, leading to the government forcing schools to change the food that they sell. In Australia, the NSW and Queensland governments legislate food that can be sold in tuckshops and canteens. In Victoria guidelines are issued, but school food outlets can sell what they like (Sunday Age, 2005). Governments can also legislate on compulsory exercise for children in schools. Exercise and diet at an early age may have important consequences as obese children have a propensity to become obese adults. Interventions targeted at younger age groups are more likely to provide significant cost savings (Bagust et al, 1999). There are examples in the USA and France of drinks and chocolate machines being removed from schools for health reasons.

Children's behaviour can be impacted upon (Wang et al, 2003), if they are educated that healthy food can taste as good as other alternatives. Parental overweight or obesity may be one means which identifies children at risk for a range of unhealthy behaviours. Promotion of a healthy lifestyle targeting overweight families, particularly in lower socio-economic groups, could be a priority (Burke et al 2001). Parents, as well as children, can be given incentives, if more healthy alternatives are subsidised, or conversely less health alternatives taxed heavily. The ability to act upon price changes depends on clear information being available on alternatives. Governments, acting as agents, may have to intervene in advertising markets so the messages they wish to promote are not crowded out by other bodies.

The message here is that the market for the production of health for children is clearly not working. Children (and their parents), especially those in lower socioeconomic classes, may not have all the information to make the best decision for their health, so governments need to intervene to correct the market. In economic terms less information on alternatives may mean individuals are less responsive to changes in price, and so taxing unhealthy food would not affect demand. In addition it would be a regressive tax if it affected those on a lower income more than those on a higher income, and this may be undesirable. Taxing and increased information combined may be one answer, as there is evidence that high sugar and fat diets, especially foods with low satiation power, are more affordable than healthy diets. Subsidising healthier diets, rather than current food subsidies in the developed world, may be a more equitable solution. There is evidence that this may be effective in schools (French, 2003) and in the wider community, where Fry and Finley (2005) estimate that subsidising healthy food across the European Union would have a cost equivalent to 30 per cent of the annual costs of obesity. Free milk used to be given out at schools, why not free (at the point of consumption) fruit? A related issue is how to potentially subsidise more physical activity. This has all sorts of implications for externalities, for example making areas safe at nights, providing parks, childcare facilities etc (Sturm, 2004; 2005).

Some individuals are well informed in the health market place. They are healthy individuals who exercise, eat healthy food, do not smoke etc. Our preliminary evidence would suggest that one problem with the market place is inequalities in health. Those who are more healthy (in BMI terms) are those with higher incomes, and have a better education and occupation. If this is the case governments need to intervene to protect those who cannot protect themselves, ie those who do not have the information, or the means to act upon it, in order that health inequalities can be reduced.

As well as an analogy to SID, in terms of HALID, there may be an analogy to small area variation in medical services, in terms of HAL alternatives. This is another area where inequalities may impact upon services. Take the example of food on offer in schools in Australia. The Victorian government may genuinely not believe they can impact upon the market for creating healthy children. This may be based on evidence, or doctrine, or the belief they are acting on behalf of Victorians. If there genuinely is ambiguity as to what the best way of offering a service is, there

will be variation across geographical areas as to what is offered. This may be an informational problem, it may be that the evidence is not being *translated* by researchers in ways in which it can effectively reach policy makers.

This is a non-trivial problem, and it currently looms very large on the agenda of all researchers. It is also an issue for policy makers how they can increase their *receptor capacity* to research findings. Both parties may be as guilty as each other. Researchers are notoriously bad at involving others in their 'ivory tower' pursuits. We need to involve policy makers, and government agencies all the way along the line in research, so that full information, and the best information, is available to those who require it in a timely manner. Just as important is policy makers making themselves available, and training if necessary in ways of understanding research findings, findings which may be critical to the health of populations within society.

A small industry has built up around research translation, but in terms of health promotion and public health the message is clear, prevention may be better (and cheaper) than cure (especially if you can prevent it, but can't cure it). Unfortunately the evidence needs to be provided better, and the policy makers need to be more willing to take information on board. Researchers can't lobby as effectively as large conglomerates at present, or use media or advertising as much. We can be effective though, just look at the campaigns against smoking and drink driving, shockingly effective. Using a celebrity champion like Jamie Oliver may be equally as effective, although he used shock tactics as well. People need to sit up and take notice.

9. The future

Even economists can't see into the future. What we can do, based on theory and the results of robust empirical research, is to predict the effect certain social policies will have. The theory we put forward is simple, and not new. Markets for producing health do not work effectively. As such governments need to intervene to make sure the result is not that those who are better off become even better off, and those worse off become even worse off. Public policies and prevention programs should decrease health inequalities, not increase them. With respect to obesity it is clear that in developed countries markets are geared at present towards efficiently producing obese people. This has to change. If it doesn't, life expectancy will fall, as will quality of life. Behavioural change can have an impact on levels of obesity, but as we have attempted to argue this is not easy to implement. The odds are stacked against health promotion being effective.

It doesn't have to be this way, shock tactics may be the order of the day. Telling people it's a nice idea to eat vegetables and go for a run in the park may not be effective. Information provision is imperfect in the market for health, people need to know exactly what the consequences of their behaviour are. The market is not working, if the aim of government is to increase life expectancy and the quality of life of the whole population. It is not the whole of the population which is efficient at being obese, those with higher incomes, better education are better at not being obese than those with lower incomes and less education. The increase in obesity over time may well be related to increases in health inequalities in developed countries. This is one area where economists need to investigate the evidence more.

It may be the case that those who require the information, incentives or subsidies are not receiving them. This is another area for investigation, both in quantitative and qualitative terms. As researchers we have a clear role to play in making the best information as available as possible in a timely manner. We face barriers to this, for example it can take several years to publish the best papers in the best academic journals. Not exactly timely provision, so we should seek other means of dissemination. Research on dissemination techniques is also required, but funding for this is very hard to come by. Policy makers need to fine tune their receptor capacity,

getting a report through to the right government agency using 'cold-calling' techniques is fraught with problems, clever use of the media may be more effective.

There are other economic issues to research in this area – externalities, or third party consequences of policies, incomplete markets – ie the provision of services the private sector would never be interested in. Government has all sorts of tools available to correct market imperfections – taxes, subsidies, direct public provision, cash transfers, regulation etc. All of these need to be carefully assessed by economists as a means of impacting upon health inequalities, and specifically the increase in obesity.

10. Conclusions

Most developed countries accept that universal provision of health care is the most efficient and equitable means of providing the population with the best possible life expectancy and quality of life. The increase in obesity makes us question how society can change the way it behaves, to avoid an overall fall in life expectancy and quality of life. As far as the provision of health care services is concerned, any increase in spending will have a marginal effect on health. The area with the most potential for affecting health in the future is clearly spending on health promotion and public health. Even modest (sustained) weight loss among the obese can yield health and economic benefits (Oster et al, 1999), although changing behaviour in terms of diet etc may not be as straightforward as some protagonists suggest (Sarlio-Lahteenkorva, 2001).

One thing we have not considered here is interventionist treatment, such as surgical means of reducing obesity, this may be effective (up to 3 per cent of the USA population may be eligible for this surgery – Livingston and Ko, 2004), and cost effective, although there appears to be a certain amount of uncertainty (Clegg, 2003). In addition pharmacotherapy is not considered here, both of these issues concern the potential 'cure' end of the scale, we are focusing on preventing the problem in the first place, through behavioural interventions.

To restate, prevention may be better than cure, especially when you can prevent something you can't cure. Obesity can be prevented. Several obstacles stand in the way of this happening. One is the amount of funding for health promotion and public health. Another is using and targeting the money spent effectively. Markets don't work in health care. Given this, in the production of health unhealthy goods are being produced. Given market failure government intervention is required to help those unable to help themselves. Shock tactics in the right area may help increase information to those who need to know. Incentives, financial and otherwise, may also help reduce levels of obesity, especially among children, targeting of whom may be a lot more effective than targeting adults (Finkelstein et al , 2004). Diet and behaviour changes are possible, regulation may be required, in for example school food provision, or limiting advertising of less healthy foods, or encouraging exercise, and for example decreasing car use, or improving housing conditions, and educational opportunities. A host of across the board societal effects may be at work.

All of this needs to be carefully researched in economic terms, by economists. A commonly held misconception is that economists add up costs. We do, but we also relate the costs of activities to their outcomes, in terms of health and quality of life, looking at the impact and effectiveness of different interventions relative to each other. We are just not very good at telling the right people this. In addition to working closely with policy makers, economists need to work with psychologists, sociologists and any other behavioural scientists who can contribute usefully to the big picture of what is happening.

It is our job to work to change this, if we do we could help to decrease health inequalities over time, and help stop the so called epidemic of obesity.

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