The Economic and Social Review, Vol. 44, No. 2, Summer, 2013, pp. 181–196

The Socio-economic Gradient of Obesity in Ireland

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Abstract: Using the nationally representative *SLÁN* datasets for 2002 and 2007 we calculate concentration indices for the incidence of obesity for men and women. We find higher concentration indices for women than for men in both years, but that the gap narrowed over time with the index rising for men but falling for women. A decomposition of the concentration index suggests that the greatest contributions to the index for both men and women come from own self-assessed health, third level education and equivalised income.

I INTRODUCTION

There is now fairly substantial evidence worldwide of a socio-economic gradient in obesity for developed countries (McLaren, 2007). The incidence of obesity (defined as a body mass index in excess of 30) tends to fall as socio-economic status increases. The phenomenon is observed for a variety of measures of socio-economic status (such as income, education, occupation) and tends to be more pronounced for females.

However, there is relatively little recent evidence concerning the socio-economic gradient of obesity in Ireland. Whelton *et al.* (2007) examine the prevalence of obesity in Ireland amongst children using data from 2001-2002

Acknowledgements: I thank the Irish Social Data Archive for making the *SLÁN* data available. I would also like to thank Owen O'Donnell, Karen Morgan and Dorothy Watson, two anonymous referees and the Economic and Social Review editor for helpful advice and comments. The usual disclaimer applies.
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and concluded that there was no consistent trend in the prevalence of obesity according to socio-economic disadvantage, which they measured by the presence of a medical card (this grants free access to primary health care and its availability is determined by a means test). Madden (2012) using the same dataset as this paper finds that obesity is more concentrated amongst lower income groups but carries out no formal analysis of the issue. Thus, there is little if no formal measurement of the socio-economic gradient in obesity for Irish adults. This paper attempts to fill this gap. We calculate concentration indices for obesity for 2002 and 2007 using nationally representative samples from the Irish population. The concentration index is a standard measure of association which indicates the degree to which a condition such as obesity varies with a continuous measure of household resources, such as income or expenditure. It has the attractive property that it provides a single index of income related inequality in obesity and it can also be used in a decomposition analysis of the factors lying behind such income related inequality. In the next section of this paper we briefly discuss the concentration index, as well as some specific methodological issues which can arise in its application to obesity. We also explain how it can be decomposed. We then describe our data and present and discuss results for concentration indices and their decomposition.

As well as being of interest in its own right, evidence concerning the socio-economic gradient of obesity in Ireland, and of how it is evolving over time, is also important from a policy perspective. Taking it as given that it is government policy to reduce the degree of obesity in society (see the National Task Force Report on Obesity, 2005), then knowledge of the relationship between obesity and the distribution of income may well influence this policy. For example, tax policies may have different impacts at different parts of the income distribution, with some evidence that lower income consumers are more price (tax) responsive (Smed *et al.*, 2007). It may also be the case that people at different parts of the income distribution may be more responsive to education and marketing campaigns. Thus knowledge of whether, and to what degree, there is a socio-economic gradient of obesity in Ireland may assist in more appropriate targeting of policies.

II THE CONCENTRATION INDEX

Suppose we have a health variable, h, where h_i is the value of that variable for individual i. Then if r_i is the fractional rank of individual i in the income distribution (or whatever measure of household resources is being used), then the concentration index is

$$C = \frac{2 * \mathrm{cov}(h_i, r_i)}{\mu_h}$$

where μ_i is the mean value of the health variable (Kakwani *et al.*, 1997). C can take on a value from –1 to +1, where a negative (positive) value indicates that the health variable is concentrated among the relatively poor (rich). Since obesity can be regarded as a reflection of ill-health, a negative value of C will indicate a situation favouring the better-off and so could be regarded as pro-rich inequality.

One attractive property of the concentration index is that it is possible to decompose C into inequalities and elasticities of health determinants. If the vector X refers to those variables influencing h, then if we assume that the health variable can be described by a linear regression of the form

$$h_i = \alpha + \beta_k X_{ki} + \varepsilon_i$$

then C can be written as

$$C = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu_h} \right) C_k + \frac{GC_\varepsilon}{\mu_h}$$

where the index k refers to the regressors in the equation, C_k is the concentration index for each of the individual regressors, β_k is the coefficient for each health determinant and $\bar{x}_k$ is the mean value of each individual regressor. GC_ε is the generalised C for the residual from the regression. The first term on the right-hand side of the above equation perhaps merits some more discussion. There are two factors which determine whether a variable makes a contribution to the concentration index. First of all, it must be the case that it influences obesity – this is captured by $\frac{\beta_k \bar{x}_k}{\mu_h}$, which is the elasticity of the health variable (obesity) with respect to the regressor. The second term, C_k, indicates the degree to which the regressor itself varies with respect to income. It is possible for a regressor to have a major influence upon obesity (a high $\frac{\beta_k \bar{x}_k}{\mu_h}$), but its impact upon the concentration index will be limited if itself it does not vary greatly with income (a low C_k).

The analysis above refers to the situation where the health variable is continuous. In the case of the incidence of obesity h_i is a binary variable which takes on values of 0 or 1. In this case a normalisation must be applied to the concentration index (since the bounds would not be –1 and +1). Wagstaff (2005) suggested a normalisation of $C_n = C/(1 - \mu_h)$. In a recent contribution

Erregeyers (2009a) suggested that the appropriate normalisation be $C_E = 4\mu_h C = 4\mu_h(1 - \mu_h)C_n$. The subsequent debate (see Wagstaff, 2009 and Erregeyers, 2009b) indicates that the issue is not quite resolved yet. In our analysis here we will apply the Erregeyers normalisation to the concentration index and its decomposition (we also carried out the analysis using the Wagstaff correction and the qualitative results were very similar, results available on request).

If we are concerned with the socio-economic gradient of the *incidence* of obesity, then clearly we must treat obesity as a binary variable. The most common definition of obesity is that suggested by the World Health Organisation (WHO) who suggest that a body mass index (BMI) in excess of 30 constitutes obesity.[1] In this instance the normalised concentration index would appear to be the appropriate measure. However, we may also be concerned with the *intensity* of obesity, conditional on someone being obese, as risk factors may increase with BMI. For example, Ha Jee *et al.* (2006) present graphs of hazard ratios for death from a number of different causes against BMI for a sample of Korean adults. The graphs of the hazard ratios show risk ratios clearly increasing with BMI, in some cases non-linearly. In that case we may wish to calculate the BMI concentration index for the obese population by simply applying the formula for C to the population with BMI in excess of 30. We could label this the *Conditional Concentration Index*.

It could be asked, why not simply calculate the concentration index for the total distribution of BMI? The reason we do not do this is because, from a public policy point of view, we are not concerned with how the distribution of BMI varies with household resources below the critical threshold of 30. While the extent to which BMI below 30 varies with household resources may be of interest in its own right, we argue that it is not of relevance in the context of the socio-economic gradient of obesity, presuming we accept the WHO obesity thresholds.

III DATA AND RESULTS

Our data comes from the *Survey of Lifestyle, Attitudes and Nutrition in Ireland*, usually known as the *SLÁN* survey. The *SLÁN* surveys were carried out in 1998, 2002 and 2007. For our purposes in this paper, the correspondence

[1] There is criticism of BMI as a measure of obesity with some authors suggesting that other measures such as total body fat, percentage body fat and waist circumference are superior measures of fatness (see Cawley and Burkhauser, 2006). Notwithstanding these arguments we still feel it is most appropriate to apply our approach to obesity as measured by BMI, as the likelihood is that it will remain the most commonly used indicator of obesity for the foreseeable future.

between the questions asked in 2002 and 2007 is closest and so it is these two years which form the basis of our study. The *SLÁN* surveys are comprehensive, nationally representative surveys with sample sizes in 2002 and 2007 of 5,992 and 10,364 respectively. It is worth pointing out that *SLÁN* 2007 was a face-to-face interview in the respondent's house, while *SLÁN* 2002 was a self-completed postal survey. Both approaches have their advantages and disadvantages: while interviewers can prompt and provide help to respondents in a face-to-face situation, the presence of the interviewer may affect the response to some questions. In the case of the self-reported survey there is always the danger that some respondents may not fully understand the question. Morgan *et al.* (2008) provide greater detail.

The issue of face-to-face versus self-completed questionnaires also arises with respect to how representative is the sample. In the case of self-completed surveys the survey will be completed by whoever chooses to fill out the form, while in the case of face-to-face surveys it is completed for the adult person in the house whose birthday is next. The former method tends to lead to a less representative sample, in that forms are more likely to be filled out by older and better educated respondents. The 2007 sample was provided by the Irish Social Science Data Archive (ISSDA) with the Geodirectory used as the sampling frame and weights supplied with the data. Weights were not supplied by the ISSDA for the 2002 data, where in this case the sampling frame was the Electoral Register, so we used weights kindly supplied by the Economic and Social Research Institute (ESRI). The *SLÁN* 2007 report discusses the issue of comparable weights for the different waves of *SLÁN* and explains the decision to choose "…a comparable weighting schema for all three years, but adding in design effects for specific years". (Morgan *et al.*, 2008). Effectively the 2002 weights were derived retrospectively, and they are believed to provide the most accurate re-weighting of the data.

In terms of the analysis carried out in this paper, it is not entirely clearcut whether weighted or unweighted data should be used. When calculating summary statistics it is generally advisable to use weighted data. Since the concentration index is essentially a descriptive statistic then weighted data is appropriate. However, when carrying out multivariate regression the use of weighted data may not be appropriate as it may affect estimated coefficients and standard errors. In this case it may be preferable to carry out the analysis with unweighted data particularly if the variables upon which the weights are based can be included as independent regressors. The decomposition of the concentration index involves the use of multivariate regression so it arguable that unweighted data should be used. However, in this instance this could be inconsistent (not in the statistical sense of the word!) as it would involve the decomposition of the unweighted concentration index, a different index from

that which was calculated in the first stage of the analysis! In this paper we will calculate the concentration index and carry out the decomposition for the weighted data but results for the unweighted data are available on request.

A further issue which has to be borne in mind is the extent to which self-reported BMI will be understated (for a general review of this issue see Connor Gorber *et al.*, 2007). The *SLÁN* data for 2007 compares self-reported with actual BMI and demonstrates that BMI is under-reported and that the degree of under-reporting increases at higher BMI levels. What is critical for this analysis is whether this under-reporting varies systematically with household resources. A recent paper by Shiely *et al.* (2010) analyses *SLÁN* data for 1998, 2002 and 2007 and concludes that BMI under-reporting may be greater among less educated groups, which would suggest that the calculated concentration indices here would be biased downwards, since "true" obesity is even more concentrated amongst the less well educated who presumably have lower incomes also. It was also higher for older respondents (who also tend to have lower educational attainment). They also conclude that the degree of mis-reporting for obesity has increased between 2002 and 2007 and that it is comparatively greater for females (though this is only the case for 2002). Thus, in terms of interpreting our results, we should beware that the concentration indices calculated here are most likely biased downwards (in absolute terms), particularly for 2007.

The particular measure of household resources which we use is equivalised net income. Respondents are asked to give their best estimate of net household income of all members of the household. This is done by presenting respondents with a set of cards where they locate their income within a set of broad intervals. They are then presented with a set of cards with narrower income intervals and we chose the midpoint of those intervals as their income. This income level was then equivalised by dividing by the square root of household size. One feature of this income data is that it is top-coded. Thus for example, the lower bound of the top bracket of (non-equivalised) income in 2002 is €1,900 but no upper bound is provided. We apply the adjustment suggested in Hout (2004) and model the top of the distribution as a Pareto distribution. It is still the case that the calculated Gini coefficients appear to be on the high side as shown in the summary income statistics in Table A1, in comparison to sources such as the *Survey of Income and Living Conditions* (*SILC*). However evidence from Van Doorslaer *et al.* (1999) suggests that there is no clear-cut relationship between calculated concentration indices and the underlying degree of income inequality. The results we present here are for income levels where this adjustment at the top of the income distribution has been applied. In practice, it makes very little

difference to the qualitative results obtained (results for non-adjusted incomes are available from the author on request).

As pointed out by Clark and Van Ourti (2009) the use of grouped income data can also lead to underestimation of the concentration index. However, the application of the equivalence scale here gives rise to within group variation in income and the number of income groupings is also sufficiently high for us to believe that the use of grouped data does not lead to any serious underestimation. One other issue arising from the use of grouped data is that it implies that some observations will be listed as having the same income. In calculation of the concentration index the program in *Stata* which we use will then randomly mix such tied observations. Since these observations will not have the same value of BMI this implies that the calculated concentration index can differ very slightly each time the analysis is carried out. This does not materially affect the results presented here.

Before examining the data for socio-economic gradient, we first present summary statistics for BMI for the two years in question. Note, we trim the data of the top and bottom 0.5 per cent by BMI for fear of very large and very small values reflecting measurement error.[2] We also drop observations where information on BMI and/or income is not provided, giving sample sizes of 4682 and 8177 for 2002 and 2007 respectively. Table 1 provides some information on BMI for 2002 and 2007. We can see that mean and median BMI have both increased slightly (by less than 1 per cent). The overweight rate (percentage of the sample with BMI over 25) has increased by nearly 2 per cent but the obesity rate (percentage of the sample with BMI over 30) has remained unchanged.

Table 1: *BMI Summary Statistics, 2002 and 2007*

Year	*Mean*	*Median*	*Per Cent Above 25*	*Per Cent Above 30*
2002 (N=4,682)	25.58	24.89	0.49	0.15
2007 (N=8,177)	25.62	25.11	0.51	0.15

Table 2 provides the same information, except this time by gender, and we note that rates of obesity (and overweight) have increased for men, quite substantially in the case of overweight. For women, on the other hand, both obesity and overweight rates have declined.

[2] Inclusion of the top and bottom 0.5 per cent leads to a very marginal fall in the indices for women, but does not have any substantive impact. Results available on request from author.

Table 2: *BMI Summary Statistics, 2002 and 2007, by Gender*

Year			*Female*	
	Mean	*Median*	*Per Cent Above 25*	*Per Cent Above 30*
2002 (N=2,733)	25.16	24.29	0.44	0.14
2007 (N=4,613)	24.90	24.11	0.43	0.13
			Male	
	Mean	*Median*	*Per Cent Above 25*	*Per Cent Above 30*
2002 (N=1,949)	26.02	25.54	0.54	0.16
2007 (N=3,564)	26.31	25.96	0.60	0.16

Table 3 presents obesity rates by gender and income quantile. A socio-economic gradient is evident, although it is not monotonic. For females, as we move from 2002 to 2007, obesity appears to fall in the middle income category but rise in the highest category (this is consistent with developments in the concentration index which is discussed below). For men, there is an increase in obesity for quintiles 1, 2 and 5, and it is also noticeable that obesity in the middle quantile falls.

Table 3: *Obesity Incidence by Income Quintile and Gender*

Quintile	*1*	*2*	*3*	*4*	*5*
2002					
Female	0.147	0.154	0.204	0.135	0.078
Male	0.153	0.173	0.171	0.146	0.136
2007					
Female	0.149	0.152	0.115	0.135	0.093
Male	0.190	0.184	0.135	0.154	0.152

In Table 4 we provide calculation of concentration indices for the incidence of obesity and also the conditional concentration indices for obesity for men and women for 2002 and 2007. Dealing first with the incidence of obesity in 2002, we note that the index for the incidence of obesity for males is not significantly different from zero. The incidence for females is substantially higher with a point estimate about four times larger than that for males, though it is only borderline significant. By 2007 the gap has narrowed, arising both from an increase in the index for men and a decrease for women and the indices are estimated more precisely. The combination of an increase in the concentration index of obesity for men while the rate remains unchanged once

Table 4: *Concentration Indices for Obesity (BMI>30, Standard Error in Brackets)*

Year	*Incidence*		*Conditional C*	
	Male	*Female*	*Male*	*Female*
2002	–0.106	–0.423	–0.003	–0.004
	(0.206)	(0.268)	(0.004)	(0.005)
2007	–0.22	–0.323	–0.002	–0.004
	(0.110)	(0.106)	(0.002)	(0.003)

again is consistent with an increase in the "share" of obesity accounted for by lower income men. For women the situation is slightly more complicated. Both the overall incidence and the index have fallen over the period (although it must be borne in mind that the index for 2002 was at borderline significance). However, the fall in the index is proportionally greater, suggesting that in relative terms there has been an increase in the "share of obesity" accounted for by better-off women.

The results for the conditional concentration indices indicate that the degree of socio-economic gradient of BMI, *conditional on being obese*, is not statistically different from zero. Given the lack of a significant (in the economic and statistical sense) socio-economic gradient for the intensity of obesity, we confine our subsequent analysis and decomposition of the concentration curve to the incidence of obesity.

Before analysing the decomposition of this index, it is useful to try to get an intuitive sense of what these figures actually mean. The sign of the concentration index indicates the direction of any relationship between the health variable and the rank in the distribution of whatever measure of household resources is being used. Thus in this case a negative value of the index indicates that obesity is more concentrated amongst the lower income groups. The magnitude of the index reflects both the strength of the relationship and the degree of variability in the health variable. In addition, Koolman and van Doorslaer (2004) have shown that multiplying the value of the index by 75 gives the percentage of the ill-health variable which, in the case of a negative index, would need to be redistributed from the poorer half to the richer half of the population to arrive at a distribution with an index of zero. Thus, for women in 2002 if 30-35 per cent of obesity could be transferred from the poorer half of the female population to the richer half, the concentration index would be zero and there would be no socio-economic gradient in obesity for females. For the sake of comparison it is also worth

noting that the concentration indices reported here are in general higher than those reported by the World Bank for under-five mortality in Vietnam (Wagstaff *et al.*, 2007).

Thus we can summarise the first set of results as follows: the socio-economic gradient in obesity is exclusively confined to the incidence of obesity rather than what we might call the intensity of obesity. It is also the case that the socio-economic gradient is more pronounced for women than for men although the gap has narrowed between 2002 and 2007. In relative terms, obesity seems to have shifted somewhat towards lower-income men and higher-income women.

We now move on to the decomposition of the concentration index. First, we need to choose a set of regressors which might plausibly influence BMI. Our choice of variables is motivated by the following factors: we need variables which might be plausibly related to obesity and also which are available on a consistent basis between *SLÁN* 2002 and *SLÁN* 2007. It is also the case that while there is some common morbidity data for the two surveys, there are also a higher degree of missing observations for these variables, and so their inclusion would entail dropping observations. On this basis we choose the following: age (and age squared to allow for a non-linear relationship), general self-assessed health status[3], smoking status, education, marital status, principal economic status and the log of equivalised income (a more detailed account of these variables is available in the appendix).

Tables 5 and 6 show (i) the elasticities of each of these covariates with respect to obesity (ii) the concentration index for each of the covariates and (iii) the contribution of each covariate to the overall concentration index (which is the product of (i) and (ii)). We present results for both men and women and for 2002 and 2007. The elasticities are computed from an OLS regression of obesity on the covariates. While in general it is preferable to estimate binary models using a probit or logit, since the decomposition only works with a *linear* relationship, we follow standard practice in the literature (e.g. Ljungvall and Gerdtham, 2010) and use a linear probability model.

Dealing with men first, Table 5 provides the decomposition for 2002 and 2007. Recall that the concentration index for 2002 was not statistically significantly different from zero, and it is also worth noting that the residual in the decomposition is greater in absolute size than the point estimate of the index. Nevertheless, the decomposition does give a pointer to the type of factors which may be important, and we see that these are age, self-assessed

[3] Self assessed health is based upon the answer to the question "In general would you say your health is poor/fair/good/very good/excellent". We use this as a simple cardinal variable in the analysis. Changing it to a binary variable (portioning it between excellent/very good and poor/fair/good) makes very little difference to the results).

Table 5: *Decomposition of Concentration Indices, Men*

	2002			*2007*		
	Elasticities	*Concentration Index*	*Contribution*	*Elasticities*	*Concentration Index*	*Contribution*
Age	6.104	–0.231	–1.413	4.634	–0.220	–1.021
Age^2	–3.335	–0.458	1.527	–2.542	–0.446	1.133
Health	–0.874	0.153	–0.134	–0.677	0.184	–0.125
Smoker	–0.058	–0.267	0.016	–0.048	–0.303	0.015
Intermediate	–0.050	–0.591	0.03	0.003	–0.566	–0.002
Leaving	–0.055	0.331	–0.018	–0.007	0.042	0
Third Level	–0.215	1.274	–0.274	–0.121	1.161	–0.141
Married	0.037	0.104	0.004	0.133	0.246	0.033
Widowed	0.020	–1.254	–0.025	0.004	–1.168	–0.004
Separated/Divorced	0.032	–0.476	–0.015	–0.007	–0.245	0.002
Home Duties	0.008	–0.173	–0.001	–0.006	–1.573	0.01
Unemployed	–0.019	–2.154	0.041	0.003	–2.286	–0.006
Retired	–0.011	–1.075	0.012	–0.008	–1.295	0.01
Student	–0.009	0.023	0	–0.008	–1.164	0.009
Sick	–0.029	–2.208	0.065	–0.014	–2.560	0.035
Other	–0.000	–1.580	0.001	–0.001	–1.235	0.001
Equiv. Y	–0.368	0.270	–0.099	–0.627	0.250	–0.157
Residual			0.177			–0.014
Total			–0.106			–0.222

health, education and income. Since age cannot be regarded as a variable open to policy, we confine the rest of our discussion to the other covariates. In terms of education, the key category is third level education, whose contribution to the index is substantially greater than the other categories (the omitted category is no formal education/left school at primary level). When we move on to 2007, we note that the estimated concentration index is statistically significant and this time the residual is down to about 20 per cent suggesting that the regressors explain a reasonable proportion of the index. In terms of contribution to the index, once again it is age, self-assessed health, education and income which are the principal factors. It is also noticeable that the absolute contribution of income has increased substantially from 2002, primarily owing to a higher elasticity of obesity with respect to income, while the elasticities for self-assessed health and education both fall. It is also interesting to note that factors such as smoking have little impact on the overall index.

Table 6 presents the same results for women. Here we note that the residuals are less than in the case of men and that for 2007 the regressors

account for over 95 per cent of the decomposition. Similar to the case with men, the principal factors are education, self-assessed health and income and similar to the case with men, in terms of elasticities alone, the importance of income increases between 2002 and 2007 while that of self-assessed health and education falls.

Table 6: *Decomposition of Concentration Indices, Women*

	Elasticities	*2002 Concentration Index*	*Contribution*	*Elasticities*	*2007 Concentration Index*	*Contribution*
Age	4.754	–0.171	–0.812	4.244	–0.168	–0.711
Age^2	–2.666	–0.372	0.993	–2.373	–0.367	0.871
Health	–1.488	0.143	–0.213	–0.941	0.176	–0.166
Smoker	–0.056	–0.489	0.027	–0.054	–0.573	0.031
Intermediate	–0.090	–0.990	0.089	–0.022	–1.019	0.023
Leaving	–0.260	0.009	–0.002	–0.122	0.018	–0.002
Third Level	–0.312	1.116	–0.348	–0.229	1.082	–0.248
Married	–0.112	0.249	–0.028	0.005	0.475	0.002
Widowed	–0.019	–1.520	0.028	–0.034	–1.445	0.049
Separated/Divorced	–0.018	–1.295	0.023	0.008	–0.964	–0.007
Home Duties	0.031	–0.930	–0.029	0.001	–0.815	–0.001
Unemployed	–0.007	–1.362	0.01	–0.001	–1.997	0.002
Retired	–0.024	–0.885	0.021	0.023	–1.146	–0.026
Student	–0.010	–0.829	0.008	0.004	–0.848	–0.003
Sick	–0.014	–1.910	0.027	0.000	–1.288	0
Other	0.008	0.158	0.001	0.003	–1.032	–0.003
Equiv. Y	–0.434	0.261	–0.114	–0.549	0.249	–0.137
Residual			–0.104			0.003
Total			–0.423			–0.323

It is important to appreciate that the decompositions above represent a convenient and useful way of accounting for the concentration index, but that caution must be exercised in inferring causality, not just owing to unobserved confounders but also in terms of direction. Thus, while ill-health may lead to obesity, it is also perfectly possible that obesity may lead to ill-health. Bearing this in mind, however, are there policy insights to be drawn from these results? The link between education and obesity, which has been observed elsewhere is evident again here, in particular the extra protective effect which third level education appears to provide (see Ljungvall and Gerdtham, 2010) although it is noticeable that this protective effect appears to be diminishing. What is also noticeable is the increased sensitivity of obesity to income over

the 2002-2007 period, which is observed for both men and women. These two developments are consistent with a situation whereby knowledge (as represented by education) becomes less important in terms of diet/exercise as compared to budgetary factors. Drenowski and Specter (2004) and Drenowski and Darmon (2005) have argued that budgetary pressures can have an important effect upon obesity as households switch to low-cost energy-dense foods. However, given overall developments in incomes and living standards in Ireland over the 2002-2007 period, it is hard to argue that household budgets were getting tighter.

IV CONCLUSION

This paper has provided a formal analysis of the socio-economic gradient in obesity in Ireland. The results suggest that this gradient is steeper for women than for men, but that the gap between the gradients has narrowed between 2002 and 2007. There appears to be a switch towards relatively greater obesity amongst lower income men and higher income women. This is in the context of overall obesity for women declining.

We also provide a regression-based decomposition of income related inequality in obesity. The main contributors are self-assessed general health, third-level education and income. The former two factors are negatively related to obesity, yet positively related to income and this combination leads to them contributing to income related inequality in obesity. The contribution of third level education declined between 2002 and 2007 for both men and women as the elasticity of obesity with respect to third level education declined and also as its concentration amongst the better-off decreased. The sensitivity of obesity to income increased over the 2002-2007 period, with no obvious explanation as to why this occurred.

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APPENDIX

Table A1: *Summary Equivalised Income Statistics (including top-code Pareto adjustment)*

Year	*Mean*	*St Dev*	*Median*	*Max*	*Min*	*Gini*
2002 (N=4,682)	348.2	296.1	249.5	3285.2	13.3	0.402
2007 (N=8,177)	506.3	344.0	419.75	2351	17.55	0.35

List of Variables Used for Decomposition

Age	Response to question: what age are you (in years)? Actual answer used.
Education	Question is "What is the highest level of education completed to date?". Omitted category is no formal education/primary education. Remaining categories are Inter Cert/Junior Cert (i.e. leaving school at 15-16), Leaving Certificate (leaving school at 17-18), 3rd Level (including diploma/certificate).
Principal Economic Status	Response to question: how would you best describe your situation with respect to work? Categories are: employed, self-employed, farmer, on training scheme (all these combined into one category "employed"), student, home duties, long-term sick, retired, other. Omitted category is employed.
Smoker	Response to question: do you now smoke every day, some days or not at all? Coded 1-0 with "1" applying to every day smoker.
Health	Based on response to question: in general, how would you say your health is? Responses are coded 1-5 based on: excellent, very good, good, fair, poor. Actual value is used.
Income	Response to question concerning approximate level of net household income, including all types of income, after tax and PRSI deductions. Respondents are presented with a set of cards where they locate their income within a set of broad intervals. They are then presented with a set of cards with narrower income intervals and midpoints of these intervals are chosen except for top bracket which is modelled as Pareto distribution.
Marital Status	Response to question: what is your current marital status? Responses are: single, cohabiting, married, separated, divorced, widowed. Categories married/cohabiting are merged, also categories separated/divorced. Omitted category is single.