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Abstract: Smoking, low physical activity and frequent alcohol consumption may have substantial health risks in terms of disease, quality of life and mortality. Understanding inequality in relation to these behaviours among older people is important in the context of a rapidly ageing population. In this study, we examine income-related inequality in relation to these three key health behaviours using data on older adults from both the Republic of Ireland and Northern Ireland. We employ concentration indices and decompose them to determine the factors which contribute most to inequality. We then examine whether differences exist between the two regions. We find that smoking and low physical activity are more concentrated among those with lower incomes in both regions. In relation to physical activity, the magnitude of the inequality is higher for Northern Ireland. Frequent alcohol consumption is more concentrated among those with higher incomes in both regions. Self-assessed health and age tend to feature prominently for all behaviours in terms of contribution to inequality. Marital status and labour market status tend to play a less pronounced role. In terms of Northern Ireland/Republic of Ireland comparisons with respect to the decompositions, probably the biggest difference is to be observed in the greater role accorded to labour market status in the Republic. For the other factors, the orders of magnitude are reasonably similar. This suggests that in many cases it may be the same underlying factors which lie behind income related inequalities.

JEL: I14; J14

Keywords: inequality; health behaviours; older adults; Republic of Ireland; Northern Ireland

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I. INTRODUCTION

The strong, detrimental effects of smoking, heavy alcohol consumption and physical inactivity on longevity and healthy ageing are well documented. Current and former smoking are strongly related to mortality and ill-health and have been identified as risk factors for functional status decline (Østbye et al., 2002; LaCroix et al., 1993; Gellert et al., 2012). Low physical activity is also associated with a plethora of adverse outcomes such as decreased quality of life (Dolan et al., 2008; Rejeski and Mihalko, 2001), increased risk of disease (Haskell et al., 2007; Telford, 2007) and increased risk of premature mortality (Warburton et al., 2006). Similar to what has been found in studies on the effect of alcohol on mortality, a U-shaped relationship between alcohol consumption and the development of disability has also been reported among middle-aged and older adults (Østbye et al., 2002).

While socioeconomic gradients in health behaviours in the general population have been well studied (Cutler and Lleras-Muney, 2010; Pampel et al., 2010), the extent to which hazardous lifestyles are also more prevalent among socioeconomically disadvantaged groups of older adults is not as well known. An exception is a recent study by Shaw and colleagues (2013). Using data on older American adults, the authors found that while smoking and inactivity are higher at lower levels of wealth, heavy drinking decreases at lower levels of wealth.

In this paper, we add to this limited literature by examining health inequalities among individuals aged 50 and above in Northern Ireland and the Republic of Ireland in relation to three key health behaviours: smoking, alcohol consumption, and physical activity. We do so using descriptive statistics as well as through the construction of a concentration index for each of the three health behaviours of interest. The concentration index is a single measure which summarises the degree to which the distribution of the health behaviour differs according to income. This measure has also the attractive property that it can be decomposed to analyse the factors lying behind such inequality as well as the contribution of such factors to inequality. To our knowledge, this is the first study that uses these techniques to measure and compare inequalities in health behaviours among older adults in Northern Ireland and the Republic of Ireland.

Comparisons between the Republic of Ireland and Northern Ireland have a unique value because of the many similarities and differences between the two parts of the island. Although the two regions share the same land mass, their health care system differs substantially. Briefly, in the Republic of Ireland there is a complex system of entitlement to free or subsidized health care, with entitlements depending on income, age and in some cases the presence of illnesses. Entitlement to a medical card is decided on the basis of a means test and possession of such a card entitles the holder to a number of services free of charge. Among these probably the most important are GP visits and prescription medicines (apart from a small prescription charge). Those aged 70 and over applying for a medical card are subject to a higher income threshold than their younger counterparts. Around half of the population have privately funded health insurance (McNamara et al., 2013). Northern Ireland is part of the overall UK health system, but with responsibility locally devolved. The UK operates a universal public healthcare coverage system with only around 11% of the population having private health insurance (Ward et al., 2009).

Although examining socioeconomic gradients in these two policy contexts cannot directly allow us to make inferences on the effectiveness of the respective health care systems in reducing inequalities, it may allow us to ascertain whether the factors contributing to inequality differ or are similar in these two juisdictions. If similar results are found despite the different health care systems, then this might suggest that the forces underlying, or contributing, to these results may be deep-rooted and independent of health care systems.

The remainder of the paper is structured as follows. Section II provides an overview of the concentration index. Section III presents the data and describes the variables used in the empirical analysis. Results are reported in Section IV. Section V concludes and discusses the findings.

II.   THE CONCENTRATION INDEX

A concentration index is a single measure of inequality which can be decomposed to analyse the factors lying behind such inequality as well as the contribution of such

factors to inequality (Kakwani et al., 1997; Wagstaff et al., 1989; O'Donnell and Wagstaff, 2008). The index summarises the degree to which the distribution of a health outcome or behaviour differs according to income (or some other measure of household resources). It is closely related to the well-known Gini-coefficient in income inequality analysis. Indeed the concentration index for income is, in fact, the Gini coefficient.

Suppose we have a variable of ill-health, 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

1)
$$C = \frac{2 * cov(h_i, r_i)}{\mu_h}$$

where μ_h 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 variable of ill-health is concentrated among the relatively poor (rich). 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

(2)
$$h_i = \alpha + \beta_k X_{ki} + \varepsilon$$

then C can be written as

(3)
$$C = \sum_k \left(\frac{\beta_k \overline{x}_k}{\mu_h} \right) C_k + \frac{GC_\varepsilon}{\mu_h}$$

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. 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 the health variable - this is captured by $\frac{\beta_k \bar{x}_k}{\mu_h}$ which is the elasticity of the health variable 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 health (a high $\frac{\beta_k \bar{x}_k}{\mu_h}$), but its impact upon the concentration index will be limited if it does not vary greatly with income (a low C_k).

The situation above assumes the health variable is continuous. In the case of a binary health variable h_i, where h takes on values of 0 or 1, 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- μ_h). In a recent contribution, Erreygers (2009) suggested that the appropriate normalisation be C_E = $4\mu_h C$ = $4\mu_h(1-\mu_h)C_n$. This is the approach we adopt.

III. DATA AND VARIABLE DESCRIPTION

Data

This study uses the first waves of the Northern Ireland Health Survey (HSNI) for Northern Ireland and The Irish Longitudinal Study of Ageing (TILDA) for the Republic of Ireland.

The Northern Ireland Health Survey is a study of adults aged 16 and above residing in private households in Northern Ireland. It is commissioned by the Department of Health, Social Services and Public Safety in Northern Ireland and carried out by the Central Survey Unit of the Northern Ireland Statistics and Research Agency. A total of 4,971 individuals aged 16 and above were interviewed between April 2010 and March 2011. The sample was randomly selected from the Land and Property Services list of private addresses and a response rate of 62% was achieved. As our analysis focuses on older adults, we only use data for respondents aged 50 and above, who

represent 41% of the sample.

The HSNI is based on two data collection techniques: the computer-assisted personal interview (CAPI) and the computer-assisted self interviewing (CASI). The latter is used for potentially sensitive questions, which are answered directly by respondents using the interviewers' computer. Respondents are also given the option to use a self-completion booklet instead.

The Irish Longitudinal Study on Ageing is a nationally representative study of community dwelling individuals aged 50 and above (and their spouses or partners of any age) residing in Ireland. It is funded by the Department of Health and Children, Atlantic Philanthropies and Irish Life. A total of 8,504 respondents were recruited between 18 October 2009 and 22 February 2011. The sample was generated using the Irish Geodirectory, a comprehensive and up-to-date listing and mapping of all residential addresses in the Republic of Ireland. The response rate was 62 percent.

Data collected in TILDA is made of three components: the CAPI questionnaire; a self-completion questionnaire (SCQ), designed to explore certain areas that are considered particularly sensitive for respondents to answer directly to an interviewer; and the health assessment component of the study, conducted both in dedicated TILDA health assessment centres and, alternatively, in respondents' homes. As questions on alcohol consumption are asked in the SCQ, our analysis is based on respondents who completed both the CAPI and the SCQ.

The HSNI and TILDA datasets are comparable in that they both collect information on different aspects of the respondents' lives, ranging from physical and behavioural health to standards of living. Also crucial for our analyses is the timing of data collection, as the surveys were conducted at approximately the same time period. The two studies, however, differ in one important respect: while TILDA is a study on ageing, the HSNI is targeted to the general adult population. As a result of this, the Northern Irish sample reduces considerably if only older individuals are selected. To illustrate, there are 2,020 respondents aged 50 and over in the HSNI. This compares to a total of 6,912 respondents in TILDA completing both the CAPI and SCQ.

As our analysis is based only on cases where full information on the variables of interest is available, the final sample sizes are 6,215 for the Republic and 1,577 for

Northern Ireland, resulting in a combined sample of 7,792. For both regions, the variable with the greatest number of missing observations is income. While missing observations in (self-reported) income is virtually always an issue in empirical work and difficult to fully resolve, the proportion who do not report income is relatively small in both samples. Also, in analysis not reported here, we find that, in both samples, missing observationsare highest among women and individuals who are not in employment or retirement.

Health Behaviours

Smoking, low physical activity levels and heavy alcohol consumption are important barriers to healthy ageing as they are associated with a variety of adverse outcomes including functional status decline, increased risk of disease and increased risk of premature mortality (Østbye et al., 2002; Gellert et al., 2012; Dolan et al., 2008; Warburton et al., 2006). In order to understand whether inequalities exist for these key health behaviours, we calculate concentration indices and use decomposition analysis to

determine which factors contribute most to inequality. Before turning to this formal analysis, we present descriptive statistics for all the variables employed in our analysis.

Smoking

The first health behaviour examined in this study is smoking. We construct a binary variable denoting whether or not the respondent is a smoker or not. Table 1 shows that smoking rates appear to be similar in the two regions with 19 percent of older people in TILDA reporting that they currently smoke and 17 percent of people in the HSNI study.

- Table 1 around here -

Low physical activity

The second health behaviour examined in this study is low physical activity. Physical

activity is measured using the International Physical Activity Questionnaire (IPAQ). Both datasets contain questions from the short form of this questionnaire which is comprised of questions related to the time respondents spent being physically active during the last 7 days. Respondents are asked how many days they spent walking, or doing moderate-intensity or vigorous-intensity activities in the past 7 days and how much time they spent on these activity on those days.

Using information on days and time spent on different activities we can calculate the number of MET-minutes (metabolic equivalent task) per activity per week. MET-minutes are a way of measuring activity intensity (Kronenberg et al., 2000). We calculate the respondents' MET-minutes by multiplying each activity's MET value by the time spent on that activity. The MET for walking is 3.3, 4 for moderate activities and 8 for vigorous activities (Ainsworth et al., 2011). Respondents' level of activity can be categorised into three categories depending on both the type and amount of activity undertaken. Following Ainsworth et al. (2011), the criteria for these categories are as follows:

- *High:* vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week OR 7 or more days of any combination of walking, moderate-intensity OR vigorous-intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

- *Moderate:* 3 or more days of vigorous-intensity activity of at least 20 minutes per day OR 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day OR 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET-minutes/week.

- *Low:* This is the lowest level of physical activity. Those individuals who do not meet criteria for the high and moderate categories are considered to have a low physical activity level.

Our key indicator of physical activity is based on the criteria above, as it takes into account the time spent on activities and the type of activity undertaken. That is we focus on those who fall into the low category.

Table 2 shows that around half of respondents fall into the low physical activity category in Northern Ireland, compared to around one in five in the Republic. Conversely, the proportion of those who fall into the moderate and high physical activity categories is higher in the Republic than in Northern Ireland. Large differences in physical activity among older adults across the two regions have also been found in other studies. For example, using data on community dwelling individuals aged 65 and above in the Republic of Ireland and Northern Ireland, McGee et al. (2005) found that 77% of respondents believed that they were exercising enough in the Republic, compared to 56% in Northern Ireland. In Table 3 we examine low activity levels by age group among the over 50s for Northern Ireland and the Republic of Ireland respectively. Unsurprisingly, in both regions the levels of low physical activity increase with age. At all age groups, levels of low activity are higher in Northern Ireland.

- Tables 2 and 3 around here –

Alcohol consumption
The final health behavior examined is alcohol consumption. While moderate alcohol consumption is associated with a number of positive outcomes, including lower levels of cardiovascular risk as highlighted by Di Castelnuovo et al. (2010), it is important to remember that problematic and excessive alcohol consumption has clear adverse health consequences (Ostermann et al., 2001; Perreira and Sloan, 2002).

In both TILDA and the HSNI, respondents are asked how often have they have had an alcoholic drink. The response categories are: almost every day, 5 or 6 days a week, 3 or 4 days a week, once or twice a week, once or twice a month, less than once a month and the last response option is "Not at all in the last 6 months" for TILDA and "Not at all in the last 12 months" for HSNI. We categorise respondents into two groups: those who drink very frequently and those who do not. We consider those who drink almost everyday and those who drink 5 to 6 days per week to be frequent

drinkers[2].

Comparable data on the quantity of alcohol consumed is not available in both data sets and so we do not know the amount of alcohol consumed by these frequent drinkers. Therefore the amount consumed may or may not be moderate. Although we are unable to determine whether consumption levels are moderate or not, we are able to ascertain whether frequent alcohol consumption is equally distributed in terms of income.

From Figure 1 we can see that rates of high frequency alcohol consumption are higher in the Republic of Ireland than in Northern Ireland with approximately 10 percent of people drinking on at least 5 to 7 days per week compared to only 6 percent in Northern Ireland.

- Figure 1 around here -

Living Standards Variable

The measure of living standards used to construct the concentration indices in this study is equivalised household income.

Respondents in the HSNI sample are asked to select their total gross household income from 38 income bands. Respondents in the TILDA sample are asked to state their approximate total net household income. If they refuse or cannot provide a point estimate, they are given the option to select their approximate total household income from 5 income bands. We use the midpoint of each of these income bands for those who only select an income band.

Household income is then equivalised by dividing it by the square root of household size. This method of equivalisation is supported by the literature (Avendano and Glymour, 2008; Avendano et al., 2009; Buhmann et al., 1988; Huisman et al., 2003). The distribution of equivalised income in the Republic and Northern Ireland is shown in Figures 2 and 3, respectively.

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[2] We also investigated different cut-off points, for example distinguishing those who drink every day from all other respondents, and the main results held.

- Figures 2 and 3 around here -

In order to construct concentration indexes, we create a variable denoting income rank for each region. Using gross household income for HSNI respondents and net household income for TILDA respondents should not substantially affect the construction of the concentration indices. This would only be a problem if re-ranking occurred when moving from gross to net income or vice versa.[3]

Aside from the issue of comparability of income across these two regions, we do not include income in the decomposition as recent research by Eerreygers and Kessels (2013) has cautioned against its inclusion in decomposition analyses.

Decomposition Variables

Following its construction, the concentration index can be decomposed into inequalities and elasticities of health determinants. It is important to note that in the decomposition which follows we are constrained to employ those variables which are available on a directly comparable basis between HSNI and TILDA.

The variables used in the decompositions are: gender; age; marital status; religion; self-rated health; and labour market status. Unfortunately, we cannot include educational attainment as respondents in the HSNI study aged 70 and above are not asked about their level of education. However, we do run a separate analysis on those aged 50-70, for whom we do have education for both samples, and presents the results in Section IV.

Table 4 lists the variables used in the decomposition analysis. In both regions, around 47 percent of respondents are males. Age is coded in five-year age-bands as more detailed information on age is not available for public-use in the HSNI dataset.

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[3] In analyses not reported here, we investigated this further using data for Ireland from the 2010 wave of the EU Survey of Income and Living Conditions (EU-SILC). An advantage of this dataset is that two measures of income are included for the same respondents: total gross household income and total net disposable household income. We calculated the Spearman rank correlation for two definitions of income and found that for individuals aged 50 and above (N = 3,669), the rank correlation is 0.9899. For the complete sample of all ages (N = 11,005), the rank correlation is 0.9862. Given the high degree of correlation between the two definitions of income, we conclude that using net rather than gross income for the Republic of Ireland should not undermine our results.

The proportion of individuals in each age category is similar for both samples, although there is a slightly higher proportion of younger individuals in the Republic.

In the Republic, 70 percent of respondents are married (or living with a partner) compared to 62 percent of respondents in the North. Separation and divorce are higher in the North (11 percent versus 6 percent). Approximately 17 percent of respondents in the North are widowed compared to 14 percent in the Republic.

Labour market status is also collected in both studies. A higher proportion of respondents in the TILDA sample (37 percent) are employed or self-employed than in the HSNI sample (30 percent), whereas a higher proportion of the HSNI sample are retired (50 percent compared to 38 percent). The category labelled "Other economic status" groups a number of other categories whose sample sizes are too small to model separately. These other categories include those who are unemployed, in education or training, looking after their home or family, permanently sick as well as other situations. Approximately 25 percent of respondents in TILDA and 20 percent in HSNI are grouped into this "other" category.

- Table 4 around here -

IV.   **RESULTS**

Concentration Indices

The concentration index (CI) indicates the extent to which any particular health activity or status is concentrated more amongst the poor or the rich. It can take on a value from -1 to +1. Since the health variables we analyse can be regarded as higher-risk behaviours, a negative CI indicates a situation where the health behaviours are concentrated amongst the less well-off, and thus could be regarded as pro-rich (or anti-poor) inequality. A positive value of CI indicates a situation where the health behaviours are concentrated amongst the better-off and so could be regarded as pro-poor inequality.

Table 5 provides concentration indices for smoking, low physical activity and frequent drinking. For both the Republic of Ireland and Northern Ireland a

statistically significant negative CI is found for smoking and low physical activity, indicating that these behaviours are concentrated amongst the poor. While the CI for smoking is slightly higher in absolute value for Northern Ireland, the overall order of magnitude is very similar to that of the Republic (-0.13 and -0.10, respectively). The CI for low physical activity is considerably greater for Northern Ireland however (-0.20 as compared to -0.09 in the Republic). This suggests that this particular dimension of ill-health is more concentrated amongst the poor and indicates a higher degree of pro-rich inequality in this behaviour in the North.

Conversely, a positive CI is estimated for frequent alcohol consumption for both Northern Ireland and the Republic and the order of magnitude is very similar (around 0.05). This indicates that frequent alcohol consumption is concentrated among those with higher incomes and thus contributes to pro-poor inequality.

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 rank in the distribution of whatever measure of household resources is being used. The magnitude 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.

- Table 5 around here -

Decomposition for respondents aged 50 and above

One attractive property of the CI is that it is possible to decompose the index according to the contributions of individual factors. If we regard, say smoking, as depending upon a number of factors, then the CI for smoking will be the sum of the contribution of each of these factors. In turn the contribution of each factor is the product of the sensitivity of health with respect to that factor (i.e. elasticity of health

with respect to that factor) and the degree of income-related inequality in that factor itself (i.e. CI for that factor). The interpretation of the CI for each factor is similar to that of the overall CI. There is typically a residual factor also, reflecting the role of factors which we do not or cannot observe.

It should also be stressed at this stage that the decomposition reflects an association between, say, smoking and the contributory factors. It should not be interpreted as reflecting causation. In many cases it is possible that causation operates in both directions. It may also be possible that the association reflects the effect of a third, unobserved, factor.

The results of the decomposition for smoking, low physical activity and frequent drinking are provided in Tables 6 to 8 respectively.

Smoking
Focusing first on smoking, the entries in each column of Table 6 give the elasticity of smoking with respect to each factor, the CI for each factor, the total contribution of each factor to the smoking CI and the percentage contribution of each factor to the smoking CI for the Republic of Ireland and Northern Ireland, respectively. A positive value of the percentage contribution for each factor indicates that this factor operates to bring about the concentration of smoking amongst the less well-off. A negative value indicates that the factor operates in the opposite direction, i.e. on its own this factor would lead to smoking being more concentrated amongst the better-off. It is worth noting that the residual in the decomposition is about 57 percent in the Republic and 75 percent in Northern Ireland, indicating a greater role for unobserved factors in explaining smoking in the North.

- Table 6 around here -

The entries of Table 6 show that in both regions poor health (defined as answering less than "good" health to a question on self-assessed health) makes a substantial contribution to the negative CI. This arises because poor health is positively associated with smoking and is also heavily concentrated among the less well-off. To

illustrate, poor health contributes 17 percent and 25 percent of the income-related smoking inequality in the Republic of Ireland and Northern Ireland, respectively.

In both regions, being older reduces the probability of smoking and since older people generally have lower incomes, the contribution of this factor is to reduce the degree to which smoking is concentrated amongst the poor. The lower probability of smoking amongst the older may also reflect a survival effect, in the sense that non-smokers typically live longer.

Being widowed, separated/divorced or never married however all work to increase the degree to which smoking is concentrated amongst lower income groups. All three factors are associated with higher probabilities of smoking and since they are concentrated amongst lower incomes, their contribution to the smoking CI is of the order of around 18 percent in both regions.

Finally, the contributions of the factors capturing labour market status are also worth commenting on. `Other economic status', which includes mainly individuals who are in unemployment or sick and disabled, is positively associated with smoking in both regions, and the elasticity is much higher in the Republic (0.13 in the Republic of Ireland versus 0.035 in Northern Ireland). Also, the contribution of 'other economic status' to the smoking CI is almost four times the size in the Republic (23 percent in the Republic of Ireland versus 6 percent in Northern Ireland).

Overall, the relative contributions of various factors to the negative CI in smoking for Northern Ireland and the Republic show considerable similarity, with the exception of labour market status. This may reflect issues concerning differences in the definition of "other economic status" in the North and the Republic and is a potentially useful area for further research.

Low physical activity

Turning now to low physical activity (see Table 7), we note first of all that the residuals for both the North and the Republic are much lower at about 12 percent and 5 percent respectively. Poor health makes the greatest contribution to the negative CI for low physical activity in both the North and the Republic and the order of magnitude is similar in both cases. The pathway appears reasonably

straightforward. Poor health is associated with low physical activity and is heavily concentrated among the less well-off. It should be noted that the relationship between low physical activity and poor health is likely to be simultaneous, in the sense that low physical activity is likely to be both a cause and effect of poor health. As might also be expected, age also makes a substantial contribution to the negative CI. The elderly are more likely to report low physical activity and also have lower incomes.

- Table 7 around here -

The role of marital status is less pronounced for physical activity than for smoking. The relative contribution is considerably higher for the North than for the Republic, reflecting in particular a stronger association between widowhood and lower physical exercise and also a higher CI for widowhood itself. It is not clear what is driving this stronger association. Labour market status also plays a role, and as in the case of smoking, the role is greater in the Republic than in the North (where it is negligible).

Thus overall, once again we see similarity in the contributions of age and self-assessed health for both the North and the Republic. However, the relative contributions of marital and labour market status differ, with a greater role for the former in the North and the latter in the Republic.

Alcohol consumption
It is worth bearing in mind that unlike the other two activities, the total CI for frequent drinking is positive, i.e. frequent drinking is more concentrated amongst the better-off. In this case, a positive (negative) value of the percentage contribution for each factor indicates that this factor operates to bring about the concentration of drinking amongst the more (less) well-off.

The results for the decomposition for alcohol consumption are presented in Table 8. They show a relatively high residual of around 75 percent for both the North and the Republic, indicating that much of the income related inequality in drinking is

unexplained. Consistent with the relatively low fraction of the CI which is "explained", most individual factors make relatively modest contributions. There are differences between the Republic of Ireland and Northern Ireland which are worthy of note. The first of these is with respect to age. The overall relationship between age and drinking is more pronounced in the North than in the Republic, though in both cases, being older is associated with lower drinking. Allied to the fact that older people have lower incomes, this contributes to a lower concentration of frequent drinking amongst the poor and hence a higher concentration amongst the rich. Thus overall, age contributes about 12 percent of the positive CI of the North but around 3 percent for the Republic.

- Table 8 around here -

The role of retirement also differs between the North and the Republic. In both cases being retired is associated with a higher incidence of frequent drinking and thus in both cases it makes a negative contribution to the CI (given that retirement is associated with lower incomes). This association is much stronger in the North, and so the negative contribution of retirement is about -16 percent in the North but only about -5 percent in the Republic. In contrast, "other economic status" contributes positively to the CI, since it has a negative association both with frequent drinking and with income.

Self-assessed health contributes positively to the CI and the order of magnitude is similar for both the North and the Republic. The key issue here is the relationship between more frequent drinking and health. For both North and the Republic, more frequent drinking is associated with a lower probability of poor health. While this may appear counter-intuitive, as indicated previously there is evidence to suggest that moderate drinking may have a protective effect on health. Ideally we would like to have a measure of drinking intensity as well as frequency of drinking and it is possible that such a measure would have a negative association with health.

Decomposition for respondents aged 50 to 70

As explained above, education level is not included in our main analysis as in the HSNI study respondents aged 70 and above are not asked about their level of education. However, because education level for individuals aged 50 to 70 is provided in both datasets, we run a separate analysis on this restricted age group and include education level among the variables employed for the decomposition analysis. We code education levels according to the International Standard Classification of Education (ISCED) to facilitate comparisons across regions (OECD, 1999). We identify three groups: up to lower secondary; higher secondary; and tertiary education. Around 47% of respondents in the Republic have lower secondary education, 19% have upper secondary education and the remaining 34% have tertiary education. These compare to 47%, 20% and 33% in Northern Ireland.

For brevity, we do not present CI and decomposition tables for this subgroup, but summarise the results. We find that the concentration indices are qualitatively similar to those for the whole group (age 50 and above) for physical activity and for alcohol consumption. However, the concentration indices for smoking are larger for both the Republic of Ireland (-0.14) and Northern Ireland (-0.20). This suggests that for this age group smoking is even more concentrated among the less well-off.

It is possible that this reflects a cohort effect as well as an age effect. It seems reasonable to suggest that public knowledge of the negative effects of smoking became widespread in the 1960s, the period when many of this group might have started smoking. If knowledge of these negative effects is first absorbed by the more educated (before eventually spreading to other less-educated groups), then it is likely that the concentration indices would be higher for this cohort.

Decomposing these indices with the inclusion of education reveals that for the three health behaviours under consideration education is an important contributor to inequality for both regions. The contribution of upper secondary and tertiary education to smoking inequality is similar for both regions (approximately 20-22 percent). The contribution of education to inequality in physical activity is greater in the Republic (17 percent versus 10 percent). The contribution of education to inequality in alcohol consumption is greater in the Republic (41 percent versus 30

percent).

V. CONCLUSIONS AND DISCUSSION

In this section we summarise the results, provide a general discussion of our findings and examine some possible policy implications which may arise. Before doing so, some preliminary, cautionary, comments are warranted.

First, as we adopted an explicitly comparative perspective with the analysis, we were limited to employing in that analysis only those variables which were available on a comparable basis in both Northern Ireland and the Republic of Ireland. Thus while it would have been desirable to incorporate variables such as body mass index, single year of age and education into our main analysis this was not possible, owing to data limitations. There are also some differences in the questions and/or response scales to questions between the two studies (e.g. alcohol consumption and income) which we described above.

Secondly, in calculating concentration indices we are measuring the degree of income related inequality in a number of health behaviours. The subsequent decomposition of the concentration indices can be viewed as a sophisticated method of identifying some of the factors lying behind inequality, but we cannot assign causal interpretations. To do so, we would need either a randomised controlled trial, or some other means to identify some sources of genuinely exogenous variation. The relationship between the health behaviours and the variables in the decomposition are likely to be simultaneous and potentially affected by other, unobserved, factors. To give a more concrete example, while physical activity is likely to be limited by poor health, it is also likely that low physical activity will in turn lead to poorer health. It is also possible that both low physical activity and poor health are affected by a third factor such as poor environment.

However, concentration indices provide a very useful summary of income-related inequality and their decomposition can point to areas where further research is required in order to tease out the complex issues of causality referred to above. By employing concentration indexes, we found that smoking and low levels of exercise

are both concentrated amongst lower income groups, while frequent drinking is concentrated (though to a lesser extent) amongst higher income groups. The degree of such concentration is quite similar in both Northern Ireland and the Republic, with the exception of low levels of physical exercise, which appears to be more highly concentrated amongst lower income groups in the North.

Based on these findings, our study confirms that in the three areas of health behaviours which were investigated, a socio-economic gradient is present for older people. In itself, this is important, since it confirms that such gradients do not disappear with age, and that income-related health inequality is an important issue amongst the elderly, a proportion of the population which is projected to grow in the future.

It is also notable that two of the three socio-economic gradients are "pro-rich" or "anti-poor". This suggests that some form of policy intervention may be required. If we regard individual well-being as depending upon both income and health (and other factors), then differences in "bad" health behaviours which are concentrated amongst the less well-off will lead to inequalities in well-being which will be greater than those observed in income alone.

There do not seem to be any new or innovative policy implications which arise from this research concerning smoking. It is notable that the overall concentration index is of similar magnitude and the contributions from most of the variables in the decomposition are also very similar. The only exception is the contribution from "other economic status" in the Republic of Ireland which is not evident in Northern Ireland. As explained in the data section, "other economic status" is something of a catch-all term to pick up a number of categories and the definition may not be exactly comparable between Northern Ireland and the Republic.

Perhaps the single most striking finding from our analysis is the strongly negative concentration index for low physical activity in Northern Ireland. Analysis of the summary statistics indicate that levels of physical activity are considerably lower amongst the elderly in Northern Ireland compared to the Republic. The gap in the concentration indices indicate that this difference is most pronounced amongst lower income groups. The decomposition suggests a strong role for marital status in

terms of driving this result. There is also a somewhat lesser role for retirement in that being retired is associated with greater physical exercise and this effect seems stronger in the Republic.

While, as ever, caution must be exercised in interpreting the decompositions in terms of causal relationships, these results suggest that the link between widowhood and exercise merits further exploration. Given the additional role of retirement it is possible that support structures for widowhood and retirement in general are in some way different between the two areas and in such a way that is more supportive of exercise in the Republic.

The third health behaviour investigated was frequent drinking, and here, unusually, the adverse health behaviour was more concentrated amongst higher income groups, although the degree of concentration was not as great as with smoking and low physical exercise. The positive association between frequent drinking and income clearly reflects an income effect i.e. alcohol consumption, unlike smoking, is positively related to income. What is also somewhat puzzling is the positive relationship between frequent drinking and self-assessed health. It is possible that the measure of frequent drinking is not capturing what might be regarded as "problem drinking" and ideally we would have a measure which reflects drinking intensity, as well as drinking frequency, to address this. Unfortunately, once again, data limitations rule this out.

However, in terms of the measures we do have, the decomposition shows the role between retirement status and frequent drinking, and the much stronger effect of retirement upon drinking in Northern Ireland. It is tempting to link this back to the association between retirement and physical exercise referred to above, though that is perhaps overly speculative. Nevertheless, the results for exercise and frequent drinking are suggestive of a difference between Northern Ireland and the Republic in terms of how the social domain operates amongst the elderly.

In terms of the explicitly comparative aspect of the results, it is notable that for the contributions of many of the factors in the decompositions, the sign and order of magnitude in Northern Ireland and the Republic are quite similar. This suggests that in many cases it may be the same underlying factors which lie behind income related

inequalities. Bearing in mind the caveats about causality which we have repeated many times, it also suggests that there may be scope for joint policies.

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Table 1: Smoking by Region

	Republic of Ireland Proportion	Northern Ireland Proportion
Never smoked	0.45	0.40
Used to smoke	0.38	0.41
Smokes	0.17	0.19

Table 2: Physical Activity by Region

	Republic of Ireland Proportion	Northern Ireland Proportion
Low	0.19	0.48
Moderate	0.46	0.34
High	0.35	0.18

Table 3: Low Physical Activity Level by Age-group by Region

	Republic of Ireland Proportion	Northern Ireland Proportion
50-54	0.14	0.39
55-59	0.16	0.37
60-64	0.16	0.42
65-69	0.16	0.49
70-74	0.23	0.49
75-79	0.32	0.66
80+	0.39	0.72
Total	0.19	0.48

Table 4: Sample Characteristics of Respondents Aged 50 and Over by Region

	Republic of Ireland Proportion	Northern Ireland Proportion
Male	0.47	0.47
Age: 50-54	0.20	0.18
Age: 55-59	0.20	0.16
Age: 60-64	0.17	0.18
Age 65-69	0.15	0.18
Age 70-74	0.12	0.12
Age 75-79	0.08	0.10
Age 80 and over	0.07	0.09
Married/Partner	0.70	0.62
Never married	0.10	0.09
Separated/Divorced	0.06	0.11
Widowed	0.14	0.17
Catholic	0.89	0.36
Other Christian	0.05	0.52
Other religion	0.01	0.09
No religion	0.05	0.04
Self rated health: very good	0.45	0.21
Self rated health: good	0.33	0.36
Self rated health: fair	0.18	0.28
Self rated health: less than fair	0.04	0.15
Employed or self-employed	0.37	0.30
Retired	0.38	0.50
Other economic status	0.25	0.20

Table 5: Concentration Index by Region

	Republic of Ireland			Northern Ireland		
Variable	CI	se	t	CI	se	t
Smokes	-0.0997	0.0108	-9.19	-0.1307	0.0220	-5.93
Low physical activity	-0.0868	0.0114	-7.64	-0.1996	0.0282	-7.08
Drinks 5-7 days per week	0.0541	0.0093	5.83	0.0551	0.0159	3.46

Table 6: Decomposition Analysis for Smoking by Region

	Smokes							
	Republic of Ireland				Northern Ireland			
Variable	Elas.	CI	Cont.	% Cont.	Elas.	CI	Cont.	% Cont.
Male	0.0687	0.0241	0.0017	-1.6592	0.0709	0.0314	0.0022	-1.7005
Age: 55-59	-0.0504	0.0686	-0.0035	3.4657	-0.0186	0.0862	-0.0016	1.2240
Age: 60-64	-0.0779	0.0282	-0.0022	2.2059	-0.0400	0.0573	-0.0023	1.7566
Age: 65-69	-0.0785	-0.0359	0.0028	-2.8284	-0.0977	-0.0037	0.0004	-0.2730
Age: 70-74	-0.0791	-0.0720	0.0057	-5.7116	-0.0720	-0.0996	0.0072	-5.4897
Age: 75-79	-0.0582	-0.1109	0.0065	-6.4710	-0.0696	-0.1248	0.0087	-6.6405
Age: 80+	-0.0569	-0.1484	0.0084	-8.4747	-0.0915	-0.1722	0.0158	-12.0568
Never married	0.0284	-0.0889	-0.0025	2.5303	0.0202	-0.1037	-0.0021	1.6055
Separated/Divorced	0.0553	-0.0977	-0.0054	5.4219	0.0516	-0.1281	-0.0066	5.0536
Widowed	0.0645	-0.1498	-0.0097	9.6902	0.0968	-0.1578	-0.0153	11.6885
Catholic	0.0966	-0.0042	-0.0004	-0.0004	0.0216	-0.0323	-0.0007	0.5353
Self rated health: good	0.0696	-0.0254	-0.0018	1.7776	0.1263	0.0622	0.0079	-6.0125
Self rated health: fair	0.0888	-0.1286	-0.0114	11.4591	0.0972	-0.0725	-0.0070	5.3911
Self rated health: less than fair	0.0300	-0.1735	-0.0052	5.2182	0.1592	-0.1570	-0.0250	19.1176
Retired	0.1041	-0.0289	-0.0030	3.0211	0.1026	-0.0591	-0.0061	4.6413
Other economic status	0.1300	-0.1798	-0.0234	23.4458	0.0350	-0.2137	-0.0075	5.7226
Residual			-0.0564	56.9095			-0.0986	75.4369
Total			-0.0997	100			-0.1307	100

Reference categories: Female, Age 50-54, Married, Non-Catholic, Self-rated health very good, Employed or self-employed.

Abbreviations: Elas: elasticity; CI: contribution index; Cont: contribution; % Cont: % contribution

Table 7: Decomposition Analysis for Low Physical Activity by Region

	Low physical activity							
	Republic of Ireland				Northern Ireland			
Variable	Elas.	CI	Cont.	% Cont.	Elas.	CI	Cont.	% Cont.
Male	-0.1377	0.0268	-0.0037	4.2573	-0.0545	0.0800	-0.0044	2.1824
Age: 55-59	0.0201	0.0764	0.0015	-1.7693	-0.0097	0.2198	-0.0021	1.0629
Age: 60-64	0.0164	0.0315	0.0005	-0.5936	0.0079	0.1462	0.0012	-0.5786
Age: 65-69	0.0100	-0.0401	-0.0004	0.4612	0.0531	0.0093	-0.0005	0.2478
Age: 70-74	0.0593	-0.0803	-0.0048	5.4846	0.0299	-0.2541	-0.0076	3.8096
Age: 75-79	0.0766	-0.1237	-0.0095	10.9122	0.0481	-0.3183	-0.0153	7.6751
Age: 80+	0.0924	-0.1655	-0.0153	17.6140	0.0555	-0.4392	-0.0244	12.2038
Never married	-0.0031	-0.0992	0.0003	-0.3489	0.0017	-0.2645	-0.0004	0.2235
Separated/Divorced	0.0000	-0.1089	0.0000	0.0039	0.0223	-0.3267	-0.0073	3.6460
Widowed	0.0033	-0.1671	-0.0006	0.6433	0.0509	-0.4026	-0.0205	10.2586
Catholic	0.0886	-0.0047	-0.0004	0.4808	0.0351	-0.0825	-0.0029	1.4523
Self rated health: good	0.0906	-0.0284	-0.0026	2.9637	0.1350	0.1587	0.0214	-10.7318
Self rated health: fair	0.1602	-0.1434	-0.0230	26.4737	0.2122	-0.1849	-0.0392	19.6623
Self rated health: less than fair	0.0886	-0.1934	-0.0171	19.7455	0.1755	-0.4004	-0.0703	35.2094
Retired	-0.0309	-0.0323	0.0010	-1.1494	-0.0169	-0.1509	0.0026	-1.2797
Other economic status	0.0404	-0.2005	-0.0081	9.3283	0.0114	-0.5450	-0.0062	3.1205
Residual			-0.0047	5.4928			-0.0236	11.8359
Total			-0.0868	100			-0.1996	100

Reference categories: Female, Age 50-54, Married, Non-Catholic, Self-rated health very good, Employed or self-employed.
Abbreviations: Elas: elasticity; CI: contribution index; Cont: contribution; % Cont: % contribution

Table 8: Decomposition Analysis for Frequent Alcohol Consumption by Region

| | Low physical activity | | | | | | | |
| | Republic of Ireland | | | | Northern Ireland | | | |
Variable	Elas.	CI	Cont.	% Cont.	Elas.	CI	Cont.	% Cont.
Male	0.2747	0.0141	0.0039	7.1488	0.2453	0.0105	0.0026	4.6697
Age: 55-59	-0.0083	0.0401	-0.0003	-0.6167	0.0205	0.0288	0.0006	1.0734
Age: 60-64	0.0406	0.0165	0.0007	1.2408	-0.0253	0.0192	-0.0005	-0.8799
Age: 65-69	-0.0209	-0.0210	0.0004	0.8128	-0.0703	-0.0012	0.0001	0.1557
Age: 70-74	0.0008	-0.0421	0.0000	-0.0619	-0.0587	-0.0333	0.0020	3.5489
Age: 75-79	-0.0130	-0.0649	0.0008	1.5573	-0.0464	-0.0417	0.0019	3.5152
Age: 80+	-0.0015	-0.0868	0.0001	0.2345	-0.0415	-0.0576	0.0024	4.3362
Never married	-0.0132	-0.0520	0.0007	1.2691	0.0167	-0.0347	-0.0006	-1.0489
Separated/Divorced	0.0151	-0.0572	-0.0009	-1.5967	-0.0048	-0.0428	0.0002	0.3767
Widowed	0.0063	-0.0877	-0.0006	-1.0291	-0.0294	-0.0528	0.0016	2.8209
Catholic	-0.9210	-0.0025	0.0023	4.2072	-0.0353	-0.0108	0.0004	0.6921
Self rated health: good	-0.0229	-0.0149	0.0003	0.6301	0.0230	0.0208	0.0005	0.8675
Self rated health: fair	-0.0456	-0.0753	0.0034	6.3378	-0.0512	-0.0242	0.0012	2.2517
Self rated health: less than fair	-0.0053	-0.1015	0.0005	0.9916	-0.0380	-0.0525	0.0020	3.6195
Retired	0.1456	-0.0169	-0.0025	-4.5569	0.4344	-0.0198	-0.0086	-15.5945
Other economic status	-0.0433	-0.1052	0.0046	8.4301	-0.0942	-0.0715	0.0067	12.2130
Residual			0.0406	75.0011			0.0427	77.3828
Total			0.0541	100			0.0551	100

Reference categories: Female, Age 50-54, Married, Non-Catholic, Self-rated health very good, Employed or self-employed.
Abbreviations: Elas: elasticity; CI: contribution index; Cont: contribution; % Cont: % contribution

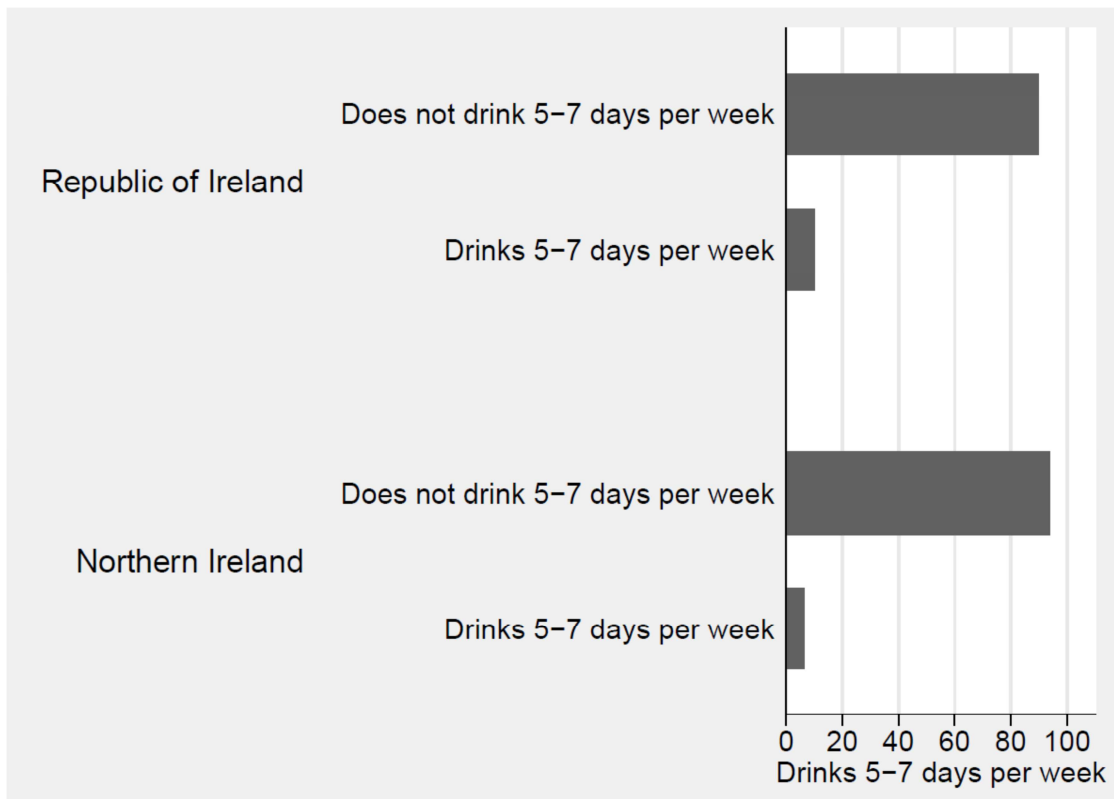Figure 1: Proportion Drinking 5-7 Days per week by Region

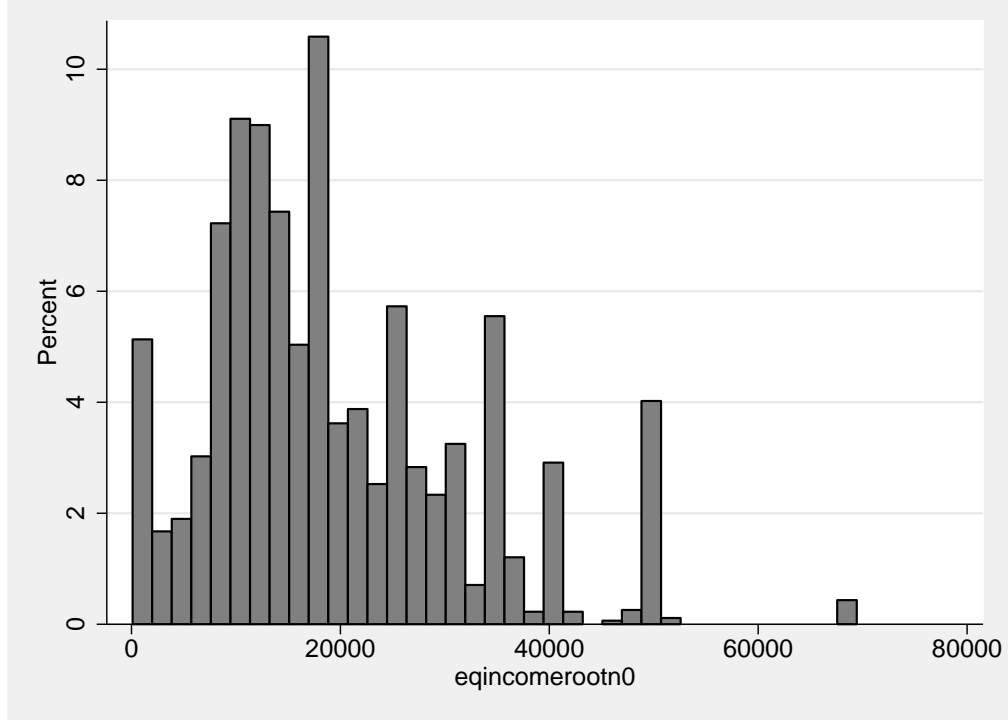Figure 2: Equivalised Net Income in the Republic of Ireland (in British Pounds)

Figure 3: Equivalised Gross Income in Northern Ireland (in British Pounds)