Education is a key determinant of health in Europe: a comparative analysis of 11 countries

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SUMMARY

This paper has contributed to confirming the link between education and health in developed countries. The analysis is based on 11 European Union countries. We estimate country-specific health functions, where the dependent variable is self-reported health status and the education attainment is one of the main inputs. All eight waves (1994–2001) of the European Community Household Panel are deployed. A random effects ordered probit is estimated in order to control, to a given extent, for unobserved heterogeneity. Explanatory variables are both time invariant (education attainment and gender) and time varying (gross wages, hours of work, age and living alone). Results confirm the positive impact of secondary education on health in most cases and tertiary education in all cases, even after controlling for other inputs in the health function and taking unobserved heterogeneity into account. Secondary education has an impact on health in all countries in the sample except for The Netherlands and UK. The effect does not differ between secondary and tertiary education in France, Ireland and Greece. The correlation between education and health is interpreted in different but complementary ways by diverse approaches and we may not disentangle the precise mechanism that connects health with education from our results. Anyway, it seems clear that better coordination is needed between education and health policies to effectively improve health literacy. Other relevant results from our study are that women register poorer health than men, age contributes to worsening health status and wages contribute positively to health.

Key words: health status; education attainment; Europe

INTRODUCTION

The link between health and education: an interdisciplinary issue

The positive correlation between education and health is a well-known empirical regularity in several disciplines: public health (see a survey in Glouberman and Millar, 2003; Higgins et al., 2008), health education and health literacy studies [see, e.g. (Kickbusch, 2001; Peerson and Saunders, 2009)], sociology (Ross and Wu, 1995) and health economics (Becker, 2007; Grossman, 2008), among others. Each discipline interprets the role of education and the mechanism that explains the above-mentioned correlation in a different way: in the human capital approach in health economics, the mechanism may be twofold (Grossman, 2008): education may increase efficiency in the individual production of health or it may contribute to a more health-oriented allocation of resources. Critics of this view (Fuchs, 1982) would rather expect no causal relationship but a positive correlation due to unobservable third variables, namely, future-oriented persons happen to be more educated and invest more in health. Other approaches pay attention to employment as a transmission channel: educated individuals are
more likely to be employed, which is better for health than being unemployed (Higgins et al., 2008). Higher education attainment is also associated with the potential to earn a higher income, which buys health care and funds healthy habits. In sociology (Ross and Wu, 1995), education is seen as a source of sociopsychological resources and as well associated with healthy lifestyles. In public health, more educated people tend to prefer healthy habits or avoid unhealthy ones (Rahkonen and Puska, 1995) and education is a key component of health literacy (Zarcadoolas et al., 2005). In industrial health approaches, the type of job is also relevant (in Higgins et al., 2008): the likelihood of encountering hazards and the physical work environment influence health. Those with higher educational attainment are more likely to work in a safer environment. It is difficult to disentangle which of the above-mentioned is/are the causal mechanism in empirical research. The truth is probably a combination of them all.

Health is also a relevant issue in multidisciplinary approaches such as the capabilities approach. The core of Sen’s theory is the idea that what people can do (capabilities) should be the focus of welfare evaluations and government policy instead of what they actually do (functionings). Sen (Sen, 2002) refrained from providing a list of capabilities, but Nussbaum (Nussbaum, 1999) provided such a list. In Nussbaum’s list of ten capabilities, the second one is bodily health. Finally, in any discussion of social equity and justice, illness and health must figure as a major concern.

Aims of the study
This study aims at measuring the effects of individual education attainment on self-reported health. To that aim, we estimate country-specific health functions where education attainment is one of the main inputs. The present analysis is exclusively based on high-income countries (11 EU countries). Although European societies are amongst the most educated and healthiest in the world, there is still room for action, as a high proportion of the population fails to meet the ‘minimum level of literacy needed to cope with the demands of life and work’ (OECD, 1997). In this piece of work, we measure the effects of secondary and higher education on health, which suggests further effort in post-compulsory education in order to contribute to the population’s health in the mid and long run.

Comparative analyses are particularly important in the study of the education-health nexus, since they allow testing whether this nexus holds in different institutional frameworks and contexts. Examples are Van Doorslaer and Koolman (Van Doorslaer and Koolman, 2004), von dem Knesebeck et al. (von dem Knesebeck et al., 2006) and Eikemo et al. (Eikemo et al., 2008), all of which deploy European-wide general comparable data sets such as the European Community Household Panel (ECHP) and the European Social Survey. We try to contribute to this strand of the literature, namely, comparative analyses of the link between education and health. To that aim, we use all eight waves of the ECHP to estimate country-specific health production functions. The use of panel data techniques (random-effects ordered probit models) enables control to a given extent for unobserved heterogeneity, allowing for the possibility than some omitted variables in our specification may be constant over time (e.g. genetic conditions and cultural traits) and others may be fixed between cases but vary over time (such as (un)healthy habits).

DATA AND METHODOLOGY

The European community household panel
The ECHP is based on a standardized annual questionnaire conducted in most EU-15 countries since 1994 to 2001 (Eurostat, 2004). The target population of the ECHP consists of all private households; people living in collective residences, such as hospitals, are not included (this means that this type of survey may underestimate health problems, since severely hampered persons will most likely be either living in institutions or not be able to answer the questionnaire even if living at home). Our analysis covers 11 countries where individuals reported their health status: Denmark, Germany, The Netherlands, Belgium, France, the UK, Ireland, Italy, Greece, Spain and Portugal.

In order to apply panel data techniques, we maximize the number of waves to be used (it began in 1994, with a sample of some 60 500 nationally representative households, i.e.
approximately 130 000 adults aged 16 years and over, and it concluded in 2001). This has come at the cost of doing without some control variables that were not available either across all countries or in all waves. A detailed description of the quality of the survey, including representativeness and non-response problems, may be found in Peracchi (Peracchi, 2002). The resulting sample is restricted to 25–64 wage earners who work more than 15 h (workers with shorter weekly hours do not report wages) per week and provided valid values in all the relevant variables in the analysis.

Self-reported health status will be the dependent variable in the health production functions. It is captured through the following question: how is your health in general? Available answers are: ‘very good’, ‘good’, ‘fair’, ‘bad’ and ‘very bad’. The answer in France was made using a 1–6 Laeken scale and was later harmonised to the five categories available in the rest of the countries. Self-reporting health status may be thought to be affected by personality traits and cultural differences between countries. It is also correlated with age: elderly people tend to systematically report lower health status. Still, self-assessment of health status has proved to be correlated with the risk of disability and morbidity, and once the baseline functional ability and sociodemographic status are controlled for, subjective health indicators predict future levels of functional disability and have shown to be potent predictors of mortality (Idler and Kasl, 1995; Ettner, 1996; Frankenberg and Jones, 2004).

**Methodology: the health function**

The health function can be expressed through the following equation [see, e.g. Frechette, 2001 for a more complete explanation]:

\[
h_{it} = \beta x_{it} + \nu_{it} + u_{i} \quad i = 1, \ldots, N, \quad t = 1, \ldots, 8
\]

where \(x_{it}\) is a vector of observable time invariant factors [education attainment (coded according to the International Standard Classification of Education (ISCED-97) and aggregated in three values: 1 for tertiary education level (ISCED 5–7), 2 for secondary education level (ISCED 3) and 3 (ISCED 0–2, less than secondary education level). and time-varying factors [gross wages (expressed in purchase parity standard €), hours of work, age and living alone]. Due to inconsistencies over time in The Netherlands and France, in these two countries the level of education reported in the first interview has been allocated in the rest of the interviews. As a result, the distribution of the population across different education levels remains quite similar to the one published by the OECD and gender. \(h_{it}\) is a self-assessed health status indicator of individual \(i\) at time \(t\), and it is unobserved. Instead, the researcher observes

\[
h_{it} = \begin{cases} 
0 & \text{if } h_{it}^1 \leq \mu_0 \\
1 & \text{if } \mu_0 < h_{it}^1 \leq \mu_1 \\
2 & \text{if } \mu_1 < h_{it}^1 \leq \mu_2 \\
3 & \text{if } \mu_2 < h_{it}^1 \leq \mu_3 \\
4 & \text{if } \mu_3 < h_{it}^1 
\end{cases} \]

The \(\mu_j\) \((j = 0, \ldots, 3)\) are called cutpoints or threshold parameters. They are estimated by the data and contribute to match the probabilities associated with each of the discrete outcomes.

The most relevant input in the health function, education attainment, was discussed in the introduction of the paper. Women tend to report more health problems than men, which may result from less paid work and lower wages combined with more hours spent in household labour and child care, and fewer hours of leisure and sleep (Bird and Freemont, 1991). There is a well-established relationship between living alone and health (Russell and Taylor, 2009). It is well known that people who differ in age will also differ, everything else the same, in health status (von dem Knesebeck et al., 2006), and even education differentials in health may vary across age groups.

There is plenty of literature in several disciplines (particularly in industrial health) about the effects of working hours on health [for a survey, see, e.g. (Sparks et al., 1997)]. Research on working hours is very often based on particular samples of professionals or as a control variable in studies of differences across men and women (Verbrugge, 1985). Results point to a negative effect of working hours on health, usually via stress and fatigue. Since we have not been able to control for several job characteristics here (The inclusion of other job characteristics would have meant renouncing to either waves or countries. Occupation has not been included either since it is missing for more than 10% of the sample in Denmark, The Netherlands and Belgium.). We use wage both
as a proxy for working conditions and as an input for demand for health care. Income is a basic input in health production functions (Evans and Viscusi, 1993; Ettner, 1996; Hartog and Oosterbeek, 1998; Ecob and Smith, 1999; Hurd and Kapteyn, 2003).

We finally included year dummies to identify time-varying features affecting all interviewees in the same way; $u_i$ is an individual-specific error term; it is assumed to be a random component constant over time; $v_{it}$ is a time- and individual-specific error term and it is assumed to be exogenous (i.e. uncorrelated with explanatory variables), normally distributed and uncorrelated across individuals and over time and with $u_i$. As a result, we end up with regressions where we control both for differences over time within individuals and differences across individuals at a given moment of time. Finally, $\beta$ is a vector of estimated parameters. The ordered nature of the dependent variable calls for a random effects ordered probit to be estimated (Greene, 2003) in STATA 10. In random effects models, each individual has a different intercept resulting from a random deviation from some mean intercept. The intercept is a draw from some distribution for each unit, and it is independent of the error for a particular observation. Instead of trying to estimate one parameter for every individual (as in fixed effects), only parameters describing the distribution from which each unit’s intercept is drawn are needed. This will be possible in large data sets, and random effects will be more efficient than fixed effects. Table A1 (in the Annex) shows some basic descriptive statistics and results of the statistical models are displayed in Table 1 and discussed in the next section.

DISCUSSION OF RESULTS AND CONCLUSIONS

Main results from the multivariate analysis

The relevant coefficients in Table 1 confirm the positive impact of secondary education on health in most cases and tertiary education in all cases, even after controlling for other inputs in the health function and taking unobserved heterogeneity into account via random effects estimations. To test whether tertiary education increases health compared to secondary education attainment, a second specification has been estimated, taking tertiary education level as reference category (see the first two rows of Table 1) Secondary education has an impact on health in all countries in the sample except for The Netherlands and the UK (this result is also found in the UK in von dem Knesebeck et al., 2006). The effect does not differ between secondary and tertiary education in France, Ireland and Greece. In order to prove the preference for this specification, in Table 1, rho and the likelihood test for random effect versus pooled regression are displayed. Rho (a proxy for the variance in the distribution of $s_{it}$) turns out to be always significantly different from zero and the high values in the log-likelihood test contribute to rejecting the hypothesis of random effects not being better than pool.

Differences in the effect of education on health across countries are, at this point, difficult to disentangle. Portugal and Greece tend to register the highest effect of education and their populations report the lowest levels of education. However, there is not a clear relationship that goes from least educated countries to higher relative effect of education in terms of improving in health. Denmark is a clear exception in this sense. From the results, we may infer that investing in health care is not the only way to improve health in the mid and long run: since more qualified individuals are proved to perform persistently better in the self-provision of health, more responsibilities will correspond to education in the pursuit of welfare in the future.

As far as other inputs are concerned, results reported in Table 1 show that wages are always positively correlated with health, in line with previous evidence (Evans and Viscusi, 1993; Ross and Wu, 1995; Ettner, 1996; Ecob and Smith, 1999, among others). Interestingly enough, women register lower health status in all countries except in Denmark, which is consistent with previous evidence as well (Verbrugge, 1985; Bird and Fremont, 1991; Hartog and Oosterbeek, 1998; Messing and Ostlin, 2006). Age always contributes to the depreciation of the stock of health (and is, therefore, negatively correlated with health), which is, again, a well-documented fact. The impact of weekly hours is either negative or not significant in most countries. Living alone does not turn out to be significant in the determination of health. We think this is due to the
Table 1: Country-specific health equations: random-effects ordered probits

<table>
<thead>
<tr>
<th>D</th>
<th>DK</th>
<th>NL</th>
<th>B</th>
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<th>EL</th>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (ref: tertiary education, ISCED 5–7)</td>
<td>0.218**</td>
<td>-0.349**</td>
<td>-0.267**</td>
<td>-0.354**</td>
<td>-0.169**</td>
<td>-0.128**</td>
<td>-0.175**</td>
<td>-0.300**</td>
<td>-0.289**</td>
<td>-0.216**</td>
</tr>
<tr>
<td>Secondary education (ISCED 3)</td>
<td>-0.113**</td>
<td>0.106**</td>
<td>-0.251**</td>
<td>-0.246**</td>
<td>-0.049</td>
<td>-0.083*</td>
<td>-0.021</td>
<td>-0.171**</td>
<td>-0.064</td>
<td>-0.077*</td>
</tr>
<tr>
<td>(ISCED 1 and 2)</td>
<td>-3.975</td>
<td>-3.177</td>
<td>-6.555</td>
<td>-5.367</td>
<td>-1.415</td>
<td>-2.842</td>
<td>-0.450</td>
<td>-4.407</td>
<td>-1.608</td>
<td>-2.809</td>
</tr>
<tr>
<td>Wages and hours of work</td>
<td>0.105**</td>
<td>0.243**</td>
<td>0.016 (0.463)</td>
<td>0.108*</td>
<td>0.120**</td>
<td>0.044 (1.418)</td>
<td>0.154**</td>
<td>0.129**</td>
<td>0.225**</td>
<td>0.138**</td>
</tr>
<tr>
<td>Gross hourly wage (in logs)</td>
<td>0.218**</td>
<td>0.349**</td>
<td>0.267**</td>
<td>0.354**</td>
<td>0.169**</td>
<td>0.128**</td>
<td>0.175**</td>
<td>0.300**</td>
<td>0.289**</td>
<td>0.216**</td>
</tr>
<tr>
<td>Sex (ref: male)</td>
<td>0.124**</td>
<td>-0.018</td>
<td>-0.181**</td>
<td>-0.231**</td>
<td>-0.128**</td>
<td>-0.110*</td>
<td>0.170**</td>
<td>-0.204**</td>
<td>-0.170**</td>
<td>-0.063**</td>
</tr>
<tr>
<td>Age (ref: 25–29 years old)</td>
<td>-0.294**</td>
<td>-0.142*</td>
<td>-0.140**</td>
<td>-0.175**</td>
<td>-0.206**</td>
<td>0.005 (0.158)</td>
<td>-0.217**</td>
<td>-0.282**</td>
<td>-0.236**</td>
<td>-0.208**</td>
</tr>
<tr>
<td>Living arrangements (ref: non-living alone)</td>
<td>0.034 (1.077)</td>
<td>0.025 (0.540)</td>
<td>0.029 (0.817)</td>
<td>-0.077</td>
<td>0.019 (0.536)</td>
<td>0.003 (0.071)</td>
<td>-0.101</td>
<td>-0.057</td>
<td>-0.020</td>
<td>-0.036</td>
</tr>
<tr>
<td>Living alone</td>
<td>0.559**</td>
<td>0.559**</td>
<td>0.534**</td>
<td>0.605**</td>
<td>0.501**</td>
<td>0.520**</td>
<td>0.518**</td>
<td>0.477**</td>
<td>0.405**</td>
<td>0.343**</td>
</tr>
<tr>
<td>Rho</td>
<td>0.121**</td>
<td>0.730**</td>
<td>0.738**</td>
<td>0.823**</td>
<td>0.852**</td>
<td>0.228**</td>
<td>0.751**</td>
<td>1.167**</td>
<td>1.290**</td>
<td>0.931**</td>
</tr>
<tr>
<td>LL test pooled versus r.e.</td>
<td>1791.72</td>
<td>710.64</td>
<td>731.87</td>
<td>376.41</td>
<td>1327.59</td>
<td>1660.62</td>
<td>469.89</td>
<td>1422.25</td>
<td>1280.78</td>
<td>1498.33</td>
</tr>
<tr>
<td>Number of observations</td>
<td>43 355</td>
<td>18 932</td>
<td>35 530</td>
<td>17 464</td>
<td>34 10</td>
<td>30 410</td>
<td>16 599</td>
<td>36 867</td>
<td>18 251</td>
<td>31 757</td>
</tr>
</tbody>
</table>

*Wave dummies were also included. Absolute value of t-statistics in parentheses; cutpoints omitted.
*Significant at 5%; **significant at 1%.
fact that our sample consists of people of working age, and living alone is a risk factor particularly amongst the elderly (Russell and Taylor, 2009).

**CONCLUSIONS**

This paper has contributed to confirming the link between education and health in developed countries, where ulterior improvements in education among the population should still have positive effects in terms of health. This result backs the education policies in the EU addressed in the Lisbon Agenda, and it encourages efforts in post-compulsory education.

From our results, we may not disentangle the mechanism that connects health with education. One possibility goes through health literacy; education may improve the degree to which individuals understand health information (Nutbeam, 2000). This calls for better coordination between education and health policies to effectively improve health literacy. For example, specific training and informative campaigns on health issues may differ for people of different ages and education attainment. Some authors (Nutbeam, 2000) show that health literacy is a key outcome from health education. Since the ECHP has no information about health literacy, there is no way to separate the effect of general education from literacy or their interactions.

The positive link between education and health must be necessarily addressed from an interdisciplinary approach in order to better understand the mechanisms behind the correlation between education and health (Zarcadoolas et al., 2005). Interdisciplinary research teams made up by professionals of public health, sociology, economics and education sciences, among others, could contribute with helpful results to the design of policies for health promotion.

**Limitations and future lines of research**

We still need to address some of the limitations of our paper and to point to future lines of research. First, the design of the study does not enable us to conclude whether the link between education and health is truly causal. This has policy implications, for we should only conclude that investments in education will have positive effects on health if we may prove causality. We should therefore be careful when concluding that education does have a positive effect on health and that this calls for further investments in post-compulsory education. Secondly, we explain levels of health by using levels of education. It is often argued that inequality in health may be an even more relevant issue (Mellor and Milyo, 2002; Van Doorslaer and Koolman, 2004). Health inequalities are driven by inequalities in other inputs of the health function, such as income and regional socioeconomic inequalities (Van Doorslaer and Koolman, 2004). This would be a very interesting and fruitful line of research in the future. Another limitation [shared with von dem Knesebeck et al., 2006] is the problem of common method variance, since both the dependent and the independent variables are self-reported. Nevertheless, we have shown evidence about reliability of self-reported health measures. There is nothing we can do about response rates in the survey, which may possibly be biased due to health problems. Finally, several control variables have not been treated in this paper for the sake of homogeneity across samples, and others are just not available in the data set. Examples of the former are occupation, industry and type of contract, and for the latter, it would be most interesting to find data sets with information about health literacy, cultural and ethnical traits [there is some acknowledgment in the biomedical community that racial and ethnic categories are social and not genetic (Braun, 2002). For instance, in the US, there are very relevant differences in the academic performance and, previously, in infant health, between different ethnic groups, and they are basically explained by the fact that ethnic minorities are more prone to live in poverty and deprivation (Fiscella and Kitzman, 2009)]. The fact that we are estimating country specific wage equations with control for unobserved individual heterogeneity may, to a given extent, account for such types of variables, but it will never allow for treating them explicitly, which may be most interesting.

**ACKNOWLEDGEMENTS**

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Statistical Office of the European Communities (Eurostat).

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**REFERENCES**


APPENDIX A

Table A1: Descriptive statistics (country specific)

| Health status     | D    | DK   | NL   | B    | F    | UK   | IRL  | I    | EL   | E    | P    |
|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Very bad          | 1.34 | 0.25 | 0.18 | 0.18 | 1.32 | 0.79 | 0.12 | 0.35 | 0.19 | 0.26 | 0.69 |
| Bad               | 9.68 | 1.32 | 1.48 | 1.47 | 1.82 | 4.82 | 0.54 | 2.91 | 0.94 | 2.55 | 6.27 |
| Good              | 48.01| 33.92| 62.65| 57.69| 54.76| 49.48| 35.70| 54.13| 23.78| 61.16| 58.20|
| Very good         | 9.00 | 53.36| 21.08| 26.44| 14.26| 25.58| 55.55| 17.63| 69.05| 21.10| 3.85 |

<table>
<thead>
<tr>
<th>Education attainment</th>
<th>D</th>
<th>DK</th>
<th>NL</th>
<th>B</th>
<th>F</th>
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<th>I</th>
<th>EL</th>
<th>E</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISCED 5–7</td>
<td>24.94</td>
<td>37.79</td>
<td>23.47</td>
<td>45.30</td>
<td>29.98</td>
<td>49.19</td>
<td>25.20</td>
<td>12.85</td>
<td>32.30</td>
<td>32.40</td>
<td>11.32</td>
</tr>
<tr>
<td>ISCED 3</td>
<td>58.65</td>
<td>46.31</td>
<td>53.04</td>
<td>33.17</td>
<td>42.42</td>
<td>13.36</td>
<td>40.71</td>
<td>45.69</td>
<td>34.22</td>
<td>19.69</td>
<td>13.39</td>
</tr>
<tr>
<td>ISCED 0–2</td>
<td>16.41</td>
<td>15.90</td>
<td>23.49</td>
<td>21.52</td>
<td>27.60</td>
<td>37.45</td>
<td>34.09</td>
<td>41.46</td>
<td>33.48</td>
<td>47.90</td>
<td>75.29</td>
</tr>
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<table>
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<tr>
<th>Other characteristics</th>
<th>D</th>
<th>DK</th>
<th>NL</th>
<th>B</th>
<th>F</th>
<th>UK</th>
<th>IRL</th>
<th>I</th>
<th>EL</th>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>44.19</td>
<td>48.53</td>
<td>45.43</td>
<td>46.28</td>
<td>45.90</td>
<td>51.67</td>
<td>44.43</td>
<td>39.63</td>
<td>37.58</td>
<td>37.10</td>
<td>43.88</td>
</tr>
<tr>
<td>Living alone</td>
<td>8.68</td>
<td>13.08</td>
<td>10.55</td>
<td>8.23</td>
<td>9.95</td>
<td>8.64</td>
<td>4.14</td>
<td>4.61</td>
<td>4.30</td>
<td>4.33</td>
<td>2.61</td>
</tr>
<tr>
<td>Gross wage (ln)</td>
<td>6.96</td>
<td>7.60</td>
<td>7.42</td>
<td>7.20</td>
<td>7.26</td>
<td>7.25</td>
<td>6.15</td>
<td>7.73</td>
<td>7.56</td>
<td>7.45</td>
<td>6.56</td>
</tr>
<tr>
<td>Weekly working hours (ln)</td>
<td>3.58</td>
<td>3.60</td>
<td>3.40</td>
<td>3.60</td>
<td>3.62</td>
<td>3.58</td>
<td>3.53</td>
<td>3.60</td>
<td>3.65</td>
<td>3.64</td>
<td>3.67</td>
</tr>
</tbody>
</table>

| N (unweighted)        | 43355| 18932| 35530| 17464| 34154| 30410| 16599| 36867| 18251| 31757| 28407|