Author's response to reviews

Title: Socioeconomic inequalities in risk factors for noncommunicable diseases in low-income and middle-income countries

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Version: 3 Date: 22 August 2012

Author's response to reviews: see over
Responses to Editorial and Reviewer Suggestions

1. Editor’s Comments

- Authors should give more details in the Statistical analysis section, namely:
  They should provide more information (currently restricted to few rows in page 10) on methods adopted to account for sample designs in the calculation of risk factor prevalence and in the Poisson regression models.

The explanation about incorporating sampling design is expanded in the text:

“WHS had a stratified, multi-stage cluster design where each household had a known non-zero probability of selection. All analyses were weighted accounting for the individual survey sample designs. Specifically, each respondent in the country datasets was given a post-stratification sampling weight. This weight reflected each country’s population, in such a way that if the sample size for two given countries are the same (but the population sizes of the countries are different), more weight is given to the country with higher population when calculating the pooled estimates. The non-independence of observations within the surveys clusters were also incorporated in the analysis using the Taylor linearized variance estimation. Stata 11® was used for all analyses. [37]”

- Authors should also give details about Poisson models used to estimate SII and RII.

Interpretation of RII depends on which model specification the variable “individual’s rank by wealth” is used. If it is used in a logit model, then RII is interpreted as odds ratio of our variable of interest across the entire distribution of economic status (Tanja AJ Houweling, Anton E Kunst, Johan P Mackenbach. Measuring health inequality among children in developing countries: does the choice of the indicator of economic status matter? International Journal for Equity in Health 2003, 2:8 (9 October 2003)). If it is used in a Poisson model, RII will be interpreted as rate ratio (or risk ratio) of our variable of interest across the entire distribution of economic status (Makenbackh et al Socioeconomic Inequalities in Health in 22 European Countries. N Engl J Med 2008; 358:2468-2481).

It is true that we could have used a logit model to assess the association of the binary outcome of NCD risk factors with wealth/education (alone or controlling for confounders). The reason to use Poisson regression with robust variance was that, in the large sample of cross-sectional data, it produces more accurate results than a logit model when the outcome of interest has a high prevalence as compared to the Mantel-Hanzel gold standard. In addition, the interpretation of its measure of association is easier than the logit model (odds ratio) for general readers. The robust variance option is used to get an unbiased standard error. In the cited methodological article, Barros et al compared different models with the gold standard (Mantel Hanzel stratification) and concluded that Poisson regression with robust variance or Binary regression with robust variance provided more accurate estimates compared with a logit model when the binary outcome has a high prevalence. The disadvantage of Binary regression is that it does not provide convergent
iterations most of the time, and setting up the starting value may be time consuming and inefficient.

Furthermore, we have added another reference: a methodological paper which uses a similar approach and explains the benefits of this type of model (Guangyong Zou. A Modified Poisson Regression Approach to Prospective Studies with Binary Data. Am. J. Epidemiol. (2004) 159 (7): 702-706. ).

In line with the editor’s comments we have decided to state more explicitly our reasoning behind choosing this model. Please see the modified text and additional reference in the first paragraph of the Statistical Analysis section: “A Poisson regression model with a robust variance was used to generate prevalence rate ratio values with 95% confidence intervals. This type of model provides more accurate estimates compared with logit models when the binary outcome has a high prevalence.[33,34]”

- I'm not familiar with the SII and RII, but authors should justify the adoption of a continuous exposure variable ranging from 0 to 1 when exposure is actually categorical (quintile of wealth status and education attained). For example, was the variable 0 for the highest wealth quintile, 0.25 for the second, 0.50 for the third, 0.75 for the fourth, and 1 for the lowest quintile?

To calculate SII and RII, the whole population (weighted sample) are ranked from the most disadvantaged group to the least disadvantaged according to social groups - wealth/education categories. The population of each wealth/education category covers a range in the cumulative distribution of the population and is given a score based on the midpoint of its range in the cumulative distribution in the population. The social groups first are ordered from lowest to highest. The population of each social-group category covers a range in the cumulative distribution of the population and is given a score based on the midpoint of its range in the cumulative distribution in the population. For instance, table below shows the midpoints of educational groups among men living in middle-income group in the smoking dataset based on distribution of educational levels.

<table>
<thead>
<tr>
<th>Educational level</th>
<th>Proportional Distribution</th>
<th>Cumulative range</th>
<th>Midpoint of cumulative range</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal schooling</td>
<td>0.0610</td>
<td>0 - 0.0610</td>
<td>0.0305</td>
</tr>
<tr>
<td>Less than primary school</td>
<td>0.0856</td>
<td>0.0610 – 0.1466</td>
<td>0.1038</td>
</tr>
<tr>
<td>Primary school completed</td>
<td>0.1980</td>
<td>0.1466 – 0.3446</td>
<td>0.2456</td>
</tr>
<tr>
<td>Secondary/high school completed</td>
<td>0.5287</td>
<td>0.3446 – 0.8734</td>
<td>0.6090</td>
</tr>
<tr>
<td>College completed or above</td>
<td>0.1266</td>
<td>0.8734 – 1.0000</td>
<td>0.9367</td>
</tr>
</tbody>
</table>

To interpret the results of the regression model, "one unit change" of “individual’s rank by education/wealth” refers to the entire distribution of the population by education/wealth (rank 1
minus rank zero regarded as one unit change), so the exponentiated coefficient (ratio) for variable “individual’s rank by education/wealth” will be interpreted as the effect of change in the whole distribution of population by education/wealth, i.e. the rate ratio between the lowest to the highest (while considering all other individuals in the regression).

To clarify this, we have modified the text in the second paragraph of the Statistical Analysis section: “The SII and RII can be interpreted as the prevalence rate difference and the prevalence rate ratio between those at top rank (representing the lowest level of education/wealth) and those at rank zero (representing the highest level of education/wealth), while taking into the effect across the entire distribution of education/wealth.”

- In the Discussion section, authors could consider differences between a relative SES index (quintiles of wealth status built within each country) and an absolute SES index (education attained irrespective of its distribution within each country).

While education grouping was on an absolute basis - highest level of education attainment irrespective of country of residence – wealth quintiles were derived from the asset index which scored the relative position of each household comparing to others within each country. We show fairly similar patterning of risk factors across education and wealth levels while each of stratifiers were defined based on a different term (absolute or relative) . This suggests that irrespective of whether inequalities are relative, such as wealth distributions within countries, or absolute, such as with years of education completed irrespective of place of residence, inequalities in risk factors across these stratifiers are similar. In other words, wealth and education related inequalities in health exist in countries at all levels of development. We haven’t examined the interactions between these within and other countries. Thus, should education inequalities be reduced in countries, what impact this would have on wealth related inequalities in health remains an open question.

- In the Discussion, authors state that the association between inequality and smoking was observed in both sexes and group of countries; however this does not seem to hold for women in MIC.

Both education-related and wealth related inequalities in daily smoking were statistically significant in women in MIC while not taking into account all confounders (model 1).

- In Tables 1 and 2, it would be better for the reader to specify that quintile are ordered for increasing wealth/education.

Additional explanatory text was added to the table legend of Table 2, which displays wealth-related absolute inequality: “Wealth quintiles are ordered by increasing wealth.”

2. Reviewer 1 Comments

Reviewer: Anand Krishnan
Reviewer's report:
Compulsory Revisions

Abstract:

- Methods: Confounding factors that were included in adjustment may be listed.

A list of confounding factors has been added to the Methods section of the abstract.

- The slope and relative index of inequality may be described of reader to understand what it means. The result in abstract incidentally does not use these indices, apparently. It might be better to align the two.

The sentence was amended as follows, to explain the slope and relative indices of inequality: Socioeconomic inequalities were measured using the slope index of inequality, reflecting differences in prevalence rates, and the relative index of inequality, reflecting the prevalence ratio between the two extremes of wealth or education accounting for the entire distribution.

- Conclusion: to add “non-communicable disease” to risk factor prevalence.

This has been added to the manuscript.

Main Article:

- From Ethics point of view, it may be clarified whether at the time of taking consent, it was informed to the respondent that the data will be pooled across globally and such an analysis would be done.

It is not explicitly mentioned in the consent, but respondents were informed that this is part of the larger international WHO Study.

- It is not clear what * in table 2 means – one would assume statistical significance based on convention. If yes, how was it estimated.

This was a mistake, which has been corrected.

- Discussion is currently the weakest part of the paper. Discussion need to substantially revised to focus on

  i) analysis of pathways through which SES would act on the risk factors based on review.
  ii) And how this explains the presence of SES gradient in some and not all risk factors. And difference in results for education and wealth index.
Possible determinants of wealth- and education-based inequality for each risk factor are considered throughout the discussion section. For example, we discuss the marketing of tobacco to vulnerable populations, the unequal ability to participate in or benefit from tobacco control initiatives, differences in leisure vs. work-time/commuting physical activity, and the contradictory determinants of alcohol abuse.


Additional text and referencing was added to the first paragraph of the Discussion section: “Historically, the adoption of risky health behaviours tends to transition from higher to lower socioeconomic groups as countries grow richer: new behaviours are adopted earlier by higher socioeconomic groups, who largely abandon these behaviours over time upon learning of the associated detrimental health effects due to health promotion efforts. Lower socioeconomic groups tend to engage in risky health behaviours later in the course of economic development of a country.[38] Acknowledging that the timing and patterning of this transition are risk-factor dependent, these characteristic transition patterns may help to explain variance in our findings.”

iii) Why addition of additional confounders change the results in a big way. Why present model 1 when model two takes care of more confounders unless it helps in understanding the issues.

We would like to disentangle the pure association of each risk factor with wealth/education controlling for potential confounders.

iv) What are the implications of these results to public health functionaries/ policy makers.

Additional text and referencing has been added to the Conclusion section regarding Rose’s high-risk and population approaches. The final two paragraphs of the conclusion now read “Rose (1985) suggested complementary approaches to preventive health actions, centered around the high-risk strategy and the population strategy.[66] A high-risk strategy impedes risk distribution by targeting resources to high-risk individuals who are most likely to partake in a risky health behaviour, thus enhancing the cost effectiveness of preventive health programs, improving the benefit to risk ratio, and increasing the likelihood for appropriate interventions. For example, current daily smoking and low fruit and vegetable consumption consistently demonstrated regular inequality, emphasizing the importance of equity-focused policy and program approaches. Integrating equity components into monitoring and surveillance is a step towards ensuring that interventions reach and benefit high-risk populations.[67] Rose’s population strategy prescribes radical changes at a population level, attempting sweeping environmental changes and shifting behavioural norms.[66] Effective poverty-reduction and education-based campaigns will help to improve conditions that enable better health outcomes at a population level.[68]”
Minor Revisions

- Appropriate key words to include social determinants, inequity or inequality may be added.

The MESH keywords listed include “socioeconomic factors,” which directly encompasses inequality, and the concept of social determinants.

- To provide appropriate reference for Stata 11®.

This reference has been added.

3. Reviewer 2 Comments

(Extracted from notes embedded in PDF file)

- (Page 7, following sentence: “This procedure was approved by the institutional review boards”): Review boards from where? each country's collaborating lead institution?

The sentence now reads: “This procedure was approved by the institutional review boards in each study country.”

- (Page 10, following sentence: “Data were adjusted for country of residence and age (Model 1), as well as other confounding factors: marital status, urban/rural area, and education or wealth (Model 2).”): Was income within individuals used as a stratifying variable or as a control variable? From the introduction I assumed this was a stratifying variable to assess within country socio economic inequalities

The wealth variable served both purposes: it was, along with education, one of the two main stratifying variables. When we were considering education as a stratifying variable, wealth served as a control variable. The same was true for education.

- (Page 14, following sentence: “Interventions at national and international levels stand to benefit by adopting equity focused approaches to reduce smoking prevalence, bearing in mind that population groups may differ in their ability to participate in such initiatives and/or experience intended health benefits.[43-45]”): Given that this was the strongest inequality, the role of the tobacco industry should be briefly mentioned, as they are shifting marketing efforts that target the most disadvantaged populations within low and middle income countries. This is likely to contribute to the high inequalities found in your study.

Additional text and references were added to this paragraph: “While tobacco reduction efforts have achieved considerable success in high-income countries,[44,45] tobacco companies have
intensified marketing strategies to target vulnerable populations of LMICs, such as women and adolescents.[46-48]”

- (Page 15, sentence: “...increased advocacy and partnerships across health and non-health sectors, however, can help to create and maintain environments that encourage active lifestyles...”): physical, social and cultural environments

This has been added to the manuscript.

- (Page 16, preceding “Strengths and Limitations” heading): An additional paragraph seems missing here that touches on what was mentioned earlier on in the manuscript, regarding

It is not apparent what the reviewer was referring to, as the comment on the missing part is missing!

- (Page 18, bottom of page): Please elaborate more on the concept of Interventions aimed at reaching and achieving sustained benefits for high-risk populations, which you briefly mention here and in the abstract of your paper. This seems an important point and a take home message for policy makers and practitioners. Given the findings of your paper what would be the difference or the advantages of using a high risk population approach versus a population approach (i.e. Geoffrey Rose)

As mentioned previously in our response to reviewer 1 comments, additional text and references have been added. The final two paragraphs of the conclusion now discuss Rose’s high-risk and population strategies, applying these approaches to the study findings.