Author's response to reviews

Title: Individual and Social Determinants of Multiple Chronic Disease Behavioral Risk Factors Among Youth

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Author's response to reviews: see over
Dear Editor,

Thank you for providing us the opportunity to revise and resubmit our paper for further consideration in BMC Public Health. We appreciate the reviewers’ comments as well as their suggestions for improving this manuscript. Please see below our responses to the comments received.

Sincerely,

Arsham Alamian and Gilles Paradis

Reviewer 1:

1) In the title and anywhere else (where appropriate) in manuscript replace the word ‘Youth’ with ‘Adolescents’ as the study participants were 10-11 years of age.

We thank the reviewer for this comment. However, we would like to provide the following explanation for our using of the word “youth” in the manuscript. There are no universally agreed chronological age-based definitions for “children”, “adolescents” or “youth”. For example, the World Health Organization (WHO) defines “children” as persons aged 0-9 years (http://apps.who.int/medicinedocs/es/d/Jh2942e/7.html) and “adolescents” as persons aged 10-19 years. However, the WHO also uses the term “young” for persons aged 10-24 years (www.who.int/features/factfilesadolescent_health/en/index.html). The National Longitudinal Survey of Children and Youth (NLSCY) which was used for the purposes of this study uses the term “children” for those aged 10-11 years as per the NLSCY definition. The term “adolescents” was used for persons aged 12-17 years as per the definition used by other authors (Shields M. Health Rep 2006, 17(3):27-42; Janssen I et al. Obes Rev 2009, 10(1):51-57). The term “youth” refers to both children and adolescents in the manuscript, as it has been used in other studies to refer to persons aged 0 to 17 years (Grigsby-Toussain DS et al. Diabetes Care 2010, 33(5):1065-1068; Vehik K et al. Diabetes Care 2007, 30(3):503-509).

In this manuscript, the term “children” was used for persons aged 10-11 years as per the NLSCY definition. The term “adolescents” was used for persons aged 12-17 years as per the definition used by other authors (Shields M. Health Rep 2006, 17(3):27-42; Janssen I et al. Obes Rev 2009, 10(1):51-57). The term “youth” refers to both children and adolescents in the manuscript, as it has been used in other studies to refer to persons aged 0 to 17 years (Grigsby-Toussain DS et al. Diabetes Care 2010, 33(5):1065-1068; Vehik K et al. Diabetes Care 2007, 30(3):503-509).

2) In the Abstract there is no need to mention all the variables; mention the software used for analysis and provide some numbers/numeric and level of significance to show the results.

This change was made.

3) In the Methods (data collection paragraph) mention explicitly if the weight was perceived by parents. There is no need to mention the whole question statements, if the study questionnaire is attached with the manuscript.
In the NLSCY, the person most knowledgeable (PMK) about the child was asked (through the child questionnaire) to indicate the child’s (persons aged 10 years or younger) weight in kilograms and grams. Adolescents aged 12 years or more self-reported their (height) and weight as previously stated in the Methods section of the manuscript. Nevertheless, we have now added the following sentence on page 7 of the manuscript:

“Specifically, the PMK was asked to indicate the child’s height in meters and centimetres, and to report the child’s weight in kilograms and grams.”

Please note that the NLSCY comprises multiple large questionnaires (each being between 300 to 600 pages) including a child, an adolescent, and a parent questionnaire. As a result, we chose to include the specific questions used for the purposes of this analysis.

4) Some cited references need to be updates. For example: 3,7,19,20,44,

This change was made.

Reviewer 2:

Below are our answers to the compulsory changes (except where noted as discretionary changes) requested by Reviewer 2:

MCR: Major Compulsory Revisions
MER: Minor Essential Revisions
DR: Discretionary Revisions

1) Typo: However, of all integrative theories, the Theory of Triadic Influence seems to be the most comprehensive one because not only it addresses determinants of different types, such as individual and social characteristics, but it also attempts to explain how different types of variables influence multiple behaviors. (background, par. 3). MER

We have rewritten this sentence as follows:

“However, of all integrative theories, the Theory of Triadic Influence seems to be the most comprehensive as it proposes a framework for mapping out the relationships between determinants of different types (including individual and social characteristics) and the occurrence of both single and multiple behaviors”.

2) Background par. 3: change contrary to “as opposed to” DR

This change was made.

3) More background regarding link between behaviours and chronic diseases would be helpful. What is being referred to as “chronic disease” here? MCR
We have addressed this comment by adding two new paragraphs to the Background section of the manuscript on pages 3 and 4 as follows:

“Chronic (long-lasting) diseases including heart disease, stroke, cancer and diabetes are by far the leading cause of death worldwide [1]. Behavioral risk factors including tobacco smoking, alcohol drinking, physical inactivity, sedentary behavior, and obesity are major determinants of adult chronic diseases morbidity and mortality [2, 3]. For instance, nearly 80% of incident cases of cardiovascular disease and type 2 diabetes are attributable to physical inactivity, tobacco smoking and unhealthy diet alone [1]. About 35% of all cancers are also preventable by reducing or avoiding exposure to risk factors such as tobacco use, physical inactivity, poor diet, alcohol use or being overweight or obese [4].

Chronic disease behavioral risk factors originate in childhood and adolescence [5-9], and cause significant negative health and social consequences throughout the life course [2, 10, 11]. In particular, physically inactivity has been linked to an unfavourable cardiovascular disease risk profile including obesity [12], insulin resistance [10], and high blood pressure [13]. Sedentary behavior has been associated with being overweight as it involves a decrease in energy expenditure and an increase in energy intake through consumption of high-fat and low-nutrient foods [14]. Smoking at a young age has been associated with emotional and psychological problems, engaging in risky behaviors such as violence and sexual activity, and an increased risk for lung cancer later in life [15, 16]. Underage alcohol drinking has been suggested to increase rates of suicide and homicide, and even death from alcohol poisoning [17]. Lastly, obesity during childhood has been linked to increased risk of dyslipidemia, hyperinsulinemia, hypertension, and a number of psychosocial problems [18, 19].”

4) In abstract it says data is collected biannually (twice a year). Do you mean biennially (every two years)? MER

We thank the reviewer for this comment. Yes, we meant biennially and the change was made.

5) Does the NLSCY include any other risk behaviours of interest? If so, what’s the justification for this group of risk behaviours? MCR

This study focused on determinants of risk factors for chronic diseases related to lifestyle such as cardiovascular disease and diabetes. The NLSCY did include other measures of risky or problem behaviors such as non-use of seat belts, unsafe sexual behavior and aggression, but these risk behaviors were not included in this study as they are unlikely to influence the chronic diseases that we were interested in. In addition, the occurrence and determinants of risky or problem behaviors (such as delinquency, non-use of seatbelts, drinking and driving, unsafe sexual behavior, substance abuse, aggression and violence) have been already investigated in several studies conducted among youth (Ellickson PL et al. J Adolesc Health 2001, 28(6):465-473; Willoughby T et al. J Consult Clin Psychol 2004, 72(6):1022-1037; Ohene SA et al. Matern Child Health J 2005, 9(1):91-100; van Nieuwenhuijzen M et al. Prev Med 2009, 48(6):572-578).
Cigarette smoking, physical inactivity, sedentary behavior, alcohol drinking and overweight/obesity were included in the study because they are the leading causes of chronic diseases (including cardiovascular disease, type 2 diabetes and cancer) morbidity and mortality worldwide. This has been addressed in our response to Reviewer 2, comment #3 above.

6) Justification for “ever smoking and drinking” rather than amount of use. (For other risk factors, justifications based on official guidelines or cutoffs are offered). MCR

There are several reasons for use of “ever smoking” and “ever drinking” in this study. First, in the NLSCY, children aged 10 and 11 years old were only asked if they had ever drunk alcohol. Second, according to several studies, any cigarette use places the individual at greater risk for subsequent use and children who begin smoking at an early age are more likely to develop severe nicotine addiction than those who start later (O’Loughlin J et al. *Ann Epidemiol* 1998, 8(5):308-318; Pierce JP et al. *Am J Public Health* 1996, 86(2):253-256). Similarly, longitudinal studies have shown that children who start drinking (more than just a few sips) as early as 11 years of age are at increased risk of becoming problem and heavy drinkers later in life (Warner LA et al. *Subst Use Misuse* 2003, 38(14):1983-2016; DeWit DJ, *Am J Psychiatry* 2000, 157(5):745-750). Finally, use of a lifetime measure of smoking/drinking (i.e., ever smoking/drinking) has been shown to be both meaningful and informative in a primary prevention context (Thomas RE et al. *Cochrane Database Syst Rev* 2007(1):CD004493), and has been used in other studies of multiple behavioral risk factors among youth (Lawlor DA et al., *Psychosom Med* 2005, 67(6):862-868, Tercyak KP et al. *J Pediatr Psychol.* 2009 Jun;34(5):457-469).

We have now added the following details with regard to the use of “ever smoking” and “ever drinking” on pages 8 and 9 of the manuscript:

“Cigarette smoking was assessed using a closed question adapted from the HBSC survey asking youth about their past experience with tobacco smoking [41]. Previous research has indicated that any cigarette use places the child at greater risk for subsequent use and children who begin smoking at an early age are more likely to develop severe nicotine addiction than those who start later [47, 48]. Thus, we used Health Canada’s definition of ever smoking, that is, having ever tried a cigarette, even a few puffs [49], in Cycles 4, 5 and 6.

Alcohol drinking was assessed using two closed questions inquiring about past experience with alcohol consumption [41, 50]. Longitudinal studies have shown that children who start drinking (more than just a few sips) as early as 11 years of age are at increased risk of becoming problem and heavy drinkers later in life [51, 52]. Thus, we defined alcohol drinking as ever drinking, that is ever having had at least 1 alcoholic drink, as suggested by others [53], in Cycles 4, 5 and 6.”

7) Some further explanation for the 4 multivariate models and the specific purpose of each would be helpful. MCR

The 4 multivariate models were constructed to assess the independent contribution of each block of individual/social distal and ultimate variables on the rate of occurrence of multiple behavioral risk factors, as previously stated on page 10 of the first version of the manuscript. To comply
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with this comment, we have now added further details regarding the purpose of each of the 4 multivariate models on page 12 of the manuscript as follows:

“Specifically, Model 1 assessed the contribution of individual distal variables; Model 2 assessed the contribution of individual ultimate variables controlling for the effects of individual distal variables; Model 3 assessed the contribution of social distal variables controlling for the effects of individual distal and individual ultimate variables; and Model 4 assessed the contribution of social ultimate variables controlling for the effects of social distal, individual distal, and individual ultimate variables (i.e., all covariates).”

8) Descriptive findings, 2nd para: clarify time period when discussing prevalence increasing “over time”. MER

This change was made.

9) Would be useful to include correlations between risk behaviours. Relatedly, some description regarding the details of the multiple risk factor score would be helpful. For example, are there patterns regarding which risk behaviours are most likely to be present in those presenting with fewer than the maximum number of risk behaviours? DR

The purpose of this study was to investigate the longitudinal contributions of blocks of individual/social distal and ultimate variables on the rate of occurrence of multiple behavioral risk factors among youth, as per our conceptual framework. The degree and strength of clustering, as well as patterns, of the five behavioral risk factors considered in this study were previously investigated and reported in another manuscript by us (Alamian and Paradis. Prev Med 2009, 48(5): 493-499).

10) Should mention some limitations to using a risk factor score in limitations section. MCR.

The following details with regard to the limitations of using a risk factor score were added to the manuscript on page 19:

“Lastly, the five behavioral risk factors under study were summed to create a multiple risk factor score. To construct this score, each behavior was dichotomized, the practice of which necessarily entails some loss of information. However, since behaviors under study were measured on different scales, dichotomization according to national/international cutoff points was judged appropriate. Also, some authors have questioned the use of additive indices where risk factors are attributed equal weights [75, 76]. In contrast, other experts have shown that use of equally weighted risk factor indices results in the identification of very similar at risk populations than those identified by unequally weighted risk factor indices [77, 78].”
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Below are our answers to some other unnumbered discretionary suggestions noted by Reviewer 2, and to which we elected to respond:

**However, there are some limitations to adopting a theory-based approach, as they often relate poorly to the real world. The use of ultimate, distal and proximal for various factors is highly dependent on the model, and often fails to recognize interactions between levels of influence. Some discussion of these limitations is warranted.**

We concur with the reviewer that there are limitations to adopting a theory-based approach. However, the Theory of Triadic Influence does recognize interactions between the levels of influence, as shown by the dotted arrows in Figure 1. We have now added the following details to the manuscript on page 18:

“First, adopting a theory-based approach has its drawbacks as it often relates poorly to the real world. For example, the ultimate tier of influence may comprise additional factors (such as factors related to the broader socioeconomic context of youth) not included in the study. Also, the mechanisms by which distal and ultimate factors influence multiple behaviors may be more complex than what is depicted in the conceptual framework of the study. Nevertheless, the Theory of Triadic Influence does recognize that there are possible interstream pathways between different levels of influence. For example, the child’s age (an individual ultimate variable) might have its primary influence on the child’s sense of self (an individual distal variable) but it might also, to a lesser degree, influence how well the child bonds with others (a social distal variable) [39].”

The following sentence was also added to the legends of Figure 1:

“Dotted arrows represent possible interstream pathways between the ultimate and the distal variables.”

**Further, though the Triadic influence model is used to organise risk factors into categories, little is mentioned in regards to the expected relationship between each of the three levels of influence and risk behaviour. There seems to be little in regards to hypotheses regarding which categories will have the strongest link to risk behavior.**

We have now added more details regarding the expected relationship between the tiers of constructs (levels of influence) and behavioral risk factors as well as our specific hypotheses to the Background section of the manuscript on pages 5 and 6.

**Additionally, it would be useful to see more discussion regarding how the findings might relate to other theories of risk behaviour. For example, does this evidence support the hypotheses of the Triadic influence model and suggest the theory is a better explanation for risk behaviours than others?**

The objective of this study was to assess the contribution of blocks of individual/social distal and ultimate variables on the rate of occurrence of multiple chronic disease behavioral risk factors, as
per our conceptual framework and based on the Theory of Triadic Influence. Other theories of risk behavior do not specifically address determinants of multiple behaviors and/or do not attempt to explain how determinants of different types influence the occurrence of multiple behaviors. This was the main reason why we chose the Theory of Triadic Influence to guide our studying of determinants of multiple behavioral risk factors. In addition, comparing and contrasting theories of health behavior was deemed beyond the objectives of this study.

We have added the following sentences on page 15 of the manuscript with regard to the link between the study results and the hypotheses:

“As expected, both distal and ultimate variables contributed to the likelihood of the occurrence of multiple behavioral risk factors during follow-up. However, contrary to our expectation, the log-likelihood ratio statistic indicated that distal variables, particularly social distal factors, contributed more to the longitudinal Poisson model than ultimate variables.”

More background information would also be helpful in determining what precisely is meant by chronic diseases, and the link between risk behaviours and chronic disease. Obviously, the authors were limited in regards to the risk behaviours that they could examine based on what was included in the survey data, but a wider exploration risk behavior in general, and multiple risk behaviour in particular, what it entails and what the key outcomes of interest are would be warranted.

This comment was addressed in our response to Reviewer 2, comment #3 above.

The purpose of each Poisson model is difficult to discern and perhaps further explanation is needed. Most of the intended audience cannot be expected to have a firm grasp on the use of Poisson models.

This comment was addressed in our response to Reviewer 2, comment #7 above.

However, there are some limitations in the summation of number of risk behaviours to generate a risk score. This necessarily entails a loss of data and it is unclear which risk behaviours characteristically comprise the overall risk score and whether different combinations of risk behaviours, even where absolute number of risks are equal, can be considered functionally equivalent.

This comment was addressed in our response to Reviewer 2, comment #10 above.

Perhaps more discussion of the link with findings on existing intervention literature could be included. Do effective interventions tend to focus on what would be considered distal social variables? My impression is that they do, which supports the findings, and warrants discussion.

According to a recent article, there is limited evidence regarding the effectiveness of interventions addressing multiple behaviors, particularly among youth (Prochaska JJ, Spring B,
Nigg CR. *Prev Med* 2008, 46(3):181-188). The bulk of evidence with regard to interventions targeting multiple behaviors comes from studies conducted among adults with existing conditions such as cardiovascular disease and diabetes. Nevertheless, there is some evidence of the effectiveness of interventions targeting distal factors (such as parental and peer behaviors and parental involvement) for preventing smoking, unhealthy diet consumption and obesity in children and adolescents. We have now added this detail to the manuscript on page 16.