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**ARTICLE DETAILS**

| TITLE (PROVISIONAL) | The Independent Associations of Recorded Crime and Perceived Safety with Physical Health in a Nationally Representative Cross-Sectional Survey of Men and Women in New Zealand |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AUTHORS             | Lovasi, Gina; Goh, Charlene; Pearson, Amber; Breetzke, Gregory                                                                                                                                 |

**VERSION 1 - REVIEW**

| REVIEWER              | James Sallis  
|                       | UCSD, USA |
| REVIEW RETURNED       | 19-Oct-2013 |

**GENERAL COMMENTS**

The effects of crime on health is a topic of great significance. It is also a difficult topic to study, which has contributed to an unclear and contradictory literature. I commend the authors for conceptualizing multiple pathways of influence from crime/fear to health and for distinguishing objective records from perceptions. Another strength is evaluating a mediational hypothesis. The introduction could be strengthened by commenting on the consistency, or lack thereof, of relevant associations in the literature.

Methods are strong because the study uses data from a well-designed national survey. The New Zealand crime data appear to be more detailed and consistent than US data, allowing for these informative analyses. Statistical methods appear appropriate, such as adjusting for clustering within Census Area Units. The SF-12 is a well-validated measure of overall physical and mental health.

Results are clearly described, and it was helpful to specify effect sizes.

The Discussion is thorough and well written. The authors make useful interpretations and comparisons to prior literature. It is difficult to make sense of results in this topic of study. I was happy to see a comment near the end about the complication of studying crime and health across countries with widely varying crime rates. The tables were clearly presented.

| REVIEWER              | Dr Thomas Astell-Burt  
|                       | University of Western Sydney (Australia)  
|                       | University of St Andrews (United Kingdom) |
| REVIEW RETURNED       | 04-Jan-2014 |

**GENERAL COMMENTS**

This manuscript reports on an investigation of associations between recorded crime, perceived safety, and physical health. The study was set in New Zealand, using the General Social Survey 2010-
2011 linked with recorded crime rates from 2008-2010. Multivariate random intercept models were used for the statistical analysis. The study found participants felt less safe to walk at night in areas with higher crime rates; particularly crime involving a weapon. Participants reported poorer physical health if they lived in areas with higher crime rates; especially violent crime. Women were somewhat more affected by local crime than men. Regardless of the objective crime rate, perceived safety was an independent predictor of physical health.

I would like to congratulate the authors on an interesting and well-written manuscript. It addresses a pertinent social and health issue. I recommend publication after the authors have had the opportunity to consider and revise the manuscript according to the following points:

- I think there needs to be more detail in the introduction on the temporality of the links between crime, perceived safety and physical health (which may be different to mental health). Lower levels of physical activity were suggested, as were trauma resulting from victimisation or stress. Which pathway is this manuscript attempting to tease out and test?

- The authors suggest linking crime rates from 2008-2010 to the GSS in 2010-2011 is an advantage based on the proviso that exposure precedes outcome. Does the time-lag in this study design afford the authors to identify impacts of crime on physical health? What if contemporaneous exposure to objective crime is more important? What if areas changed?

- Was there any information on whether participants were resident in the neighbourhoods when the crimes took place?

- To what extent are the crime data reliably geocoded?

- Some explanation of why the crime rates were standardised per 100,000 population is needed. Could this create some very crime rates if areas have a high crime count and the local residential population is quite small? It would be useful to have some descriptives for each crime rate in addition to those given in Table 1 (e.g. min, max, skewness).

- Is the SF-12 physical health status an appropriate measure? Were there other measures that could be used to test the consistency of the results?

- Are crime with a weapon and crime at night variables mutually exclusive categories or do they involve double-counting of crimes in other categories? (violent, dishonesty, drug/antisocial)

- Feelings of safety at night are important, however, they could be very different to feelings of safety during the day. It is not clear whether the latter variable was available. Is the study design only concerned with perceived safety during the night as a predictor of physical health, or is this measure used as a proxy for daytime safety?

- What is the reasoning behind the testing for gender differences? Although evidence is provided in the introduction on previous studies reporting gender differences in health with respect to crime/perceived safety, it would be useful to have more elaboration
in the introduction of this manuscript on why variation by gender was investigated.

- For the analyses of recorded crime as a predictor of perceived safety, why were multilevel logistic regression models not used? (i.e. to keep consistent with later multilevel analyses)

- 1555 participants were excluded because of missing data. Given that this is about 16-18% of the original sample, it would be helpful to report whether people with particular characteristics, or from particular areas, were more likely to be excluded.

**VERSION 1 – AUTHOR RESPONSE**

REVIEWER 1: JAMES SALLIS

JS.1. The effects of crime on health is a topic of great significance. It is also a difficult topic to study, which has contributed to an unclear and contradictory literature. I commend the authors for conceptualizing multiple pathways of influence from crime/fear to health and for distinguishing objective records from perceptions. Another strength is evaluating a mediational hypothesis. The introduction could be strengthened by commenting on the consistency, or lack thereof, of relevant associations in the literature.

Thank you for recognizing the importance of this topic. We have modified the introduction to note briefly the inconsistencies in the literature, pointing readers to a review that discusses the inconsistencies in more depth.

“A recent systematic review highlighted the many inconsistencies in the literature on the link between officially recorded crime and perceived safety with physical activity.[12]"

JS.2. Methods are strong because the study uses data from a well-designed national survey. The New Zealand crime data appear to be more detailed and consistent than US data, allowing for these informative analyses. Statistical methods appear appropriate, such as adjusting for clustering within Census Area Units. The SF-12 is a well-validated measure of overall physical and mental health.

Thank you. We share in your appreciation of the quality of data available through Statistics New Zealand and the New Zealand Police (please see Acknowledgments).

JS.3. Results are clearly described, and it was helpful to specify effect sizes.

Thank you.

JS.4. The Discussion is thorough and well written. The authors make useful interpretations and comparisons to prior literature. It is difficult to make sense of results in this topic of study. I was happy to see a comment near the end about the complication of studying crime and health across countries with widely varying crime rates. The tables were clearly presented.

Thank you. We agree that the literature, and perhaps the underlying web of causation, is complex to understand and appreciate the opportunity to add our perspective.

REVIEWER 1: THOMAS ASTELL-BURT

This manuscript reports on an investigation of associations between recorded crime, perceived safety, and physical health. The study was set in New Zealand, using the General Social Survey 2010-2011
linked with recorded crime rates from 2008-2010. Multivariate random intercept models were used for the statistical analysis. The study found participants felt less safe to walk at night in areas with higher crime rates; particularly crime involving a weapon. Participants reported poorer physical health if they lived in areas with higher crime rates; especially violent crime. Women were somewhat more affected by local crime than men. Regardless of the objective crime rate, perceived safety was an independent predictor of physical health.

I would like to congratulate the authors on an interesting and well-written manuscript. It addresses a pertinent social and health issue. I recommend publication after the authors have had the opportunity to consider and revise the manuscript according to the following points:

TA.1. I think there needs to be more detail in the introduction on the temporality of the links between crime, perceived safety and physical health (which may be different to mental health). Lower levels of physical activity were suggested, as were trauma resulting from victimisation or stress. Which pathway is this manuscript attempting to tease out and test?

The analyses presented are not designed to distinguish among causal pathways, but we have added briefly to our discussion of how crime and perceived safety problems could affect physical health.

“There are several causal pathways by which local crime rates can affect health, including trauma resulting from victimization or chronic stress[9] and anxiety related to a perceived threat.[10] Stress pathways could involve mental health, sleep duration, or stress coping behaviors such as tobacco use or alcohol intake. Other behavioral pathways could also play a role if outdoor physical activities such as walking in the neighborhood were restricted to minimize victimization risk, adversely affecting physical health.[11-13] “

TA.2. The authors suggest linking crime rates from 2008-2010 to the GSS in 2010-2011 is an advantage based on the proviso that exposure precedes outcome. Does the time-lag in this study design afford the authors to identify impacts of crime on physical health? What if contemporaneous exposure to objective crime is more important? What if areas changed?

This issue of temporality is an interesting one that our cross-sectional design is not well-suited to address. We have moved the statement about temporal correspondence to the methods section, so that this is more clearly an explanation and justification of our measurement choice, rather than a statement of a main advantage of the study. In addition, we have added a statement to the discussion highlighting the need for future work to clarify the temporal relationship of crime rate changes with perceived safety:

“Future longitudinal research should consider how short-term fluctuations and long-term trends in crime rates and other neighborhood shifts alter individuals’ perceptions of neighborhood safety.”

TA.3. Was there any information on whether participants were resident in the neighbourhoods when the crimes took place?

Unfortunately, we did not have residential history available to assess this. However, as noted in our response to the previous comment, longitudinal studies have an opportunity going forward to address temporality more thoroughly.

TA.4. To what extent are the crime data reliably geocoded?

The limiting factor on the geographic resolution of our analysis was the level of geographic information in the survey data. Crime incidents were geocoded to the meshblock level, then
aggregated to the CAU. We do not have further details on the geocoding reliability, but have clarified that we received the data at the meshblock level:

“The data included over 360,000 incidents of crime recorded nationally, which have been geocoded and aggregated from the meshblock level to the census area unit (CAU).”

TA.5. Some explanation of why the crime rates were standardised per 100,000 population is needed. Could this create some very crime rates if areas have a high crime count and the local residential population is quite small? It would be useful to have some descriptives for each crime rate in addition to those given in Table 1 (e.g. min, max, skewness).

The reviewer correctly notes a problem with using residential population as the denominator. We agree that this is not an ideal reflection of the risk to a given person living in that neighborhood, since non-residents were also at risk as potential crime victims. Unfortunately, alternatives (using simple counts, or standardizing to counts per land area) likewise reflect risk imperfectly. We’ve selected an approach that is common in the literature, and potentially relevant to perception of risk. Crimes occurring in an area where the local residential population is quite small may attract more attention and disproportionately undermine the residents’ sense of safety.

In regards to skewness, there is indeed considerable skew for the crime rates. We have added a column to table 1 that illustrates the shape of the distribution using 25th, 50th, and 75th percentiles. For the least common category of crime, crime with a weapon, these percentiles were all zero, so the 90th percentile is provided as a footnote to the table.

TA.6. Is the SF-12 physical health status an appropriate measure? Were there other measures that could be used to test the consistency of the results?

As noted above in JS.2 SF-12 is well-validated. Certainly other measures would be of interest for disentangling the potential pathways of interest. For example, objectively measured physical activity would help to address a key behavioral pathway, but was not available for this population. The requirement to conduct analyses on-site in a secure data lab limited our exploration of alternative outcomes – the physical health scale derived from the SF-12 items was selected over alternatives such as considering individual items, the mental health scale, and “overall life satisfaction” based on a single question.

TA.7. Are crime with a weapon and crime at night variables mutually exclusive categories or do they involve double-counting of crimes in other categories? (violent, dishonesty, drug/antisocial)

Thanks for the opportunity to clarify. We have made selected edits to the results section in an effort to make it clearer that, as stated in the methods section, “Crime data were categorized by type (violent, property, dishonesty, or drug and antisocial), whether a weapon was involved, and whether the offence occurred at night (defined as between 8pm and 7:59am).” This resulted in 4 mutually exclusive categorizations by type, two mutually exclusive categorizations by weapon use (crime without a weapon was omitted for brevity), and two mutually exclusive categories by time of day (crime during the day was omitted for brevity). Crime of any type could have occurred with a weapon or not, and during the day or night.

TA.8. Feelings of safety at night are important, however, they could be very different to feelings of safety during the day. It is not clear whether the latter variable was available. Is the study design only concerned with perceived safety during the night as a predictor of physical health, or is this measure used as a proxy for daytime safety?
Feelings of safety during the day were also covered by the questionnaire. An alternative approach would be to combine these two measures as was done by two of the coauthors in another publication which has been added as a reference (Breetzke, Gregory D., and Amber L. Pearson. "The fear factor: Examining the spatial variability of recorded crime on the fear of crime." Applied Geography 46 (2014): 45-52.) However, we selected to focus a priori on the single question about safety during the night for its simplicity and greater variation; the proportion of New Zealand residents concerned about safety during the day is quite low, and may reflect concerns about traffic hazards or falls that are less closely related to the construct of interest for this paper.

TA.9. What is the reasoning behind the testing for gender differences? Although evidence is provided in the introduction on previous studies reporting gender differences in health with respect to crime/perceived safety, it would be useful to have more elaboration in the introduction of this manuscript on why variation by gender was investigated.

We have further integrated this into the introduction.

“Men and women have been shown to differ in their perceived risk of victimization and fear depending on the type of crime.[26] They have also been observed to vary in their likelihood of exercise associated with perceived safety. [25] It has also been suggested that women might be more exposed to their local area than men,[27] which may contribute to the differences in associations with officially recorded crime and self-reported perception of safety on health.”

TA.10. For the analyses of recorded crime as a predictor of perceived safety, why were multilevel logistic regression models not used? (i.e. to keep consistent with later multilevel analyses)

We agree that consistency would be preferable. We have elected to change in the direction of making all analyses cluster robust, to allow for a marginal interpretation of results and robust standard errors. Results in Tables 4 and 5 have been updated accordingly, with the conclusions generally remaining unchanged.

TA.11. 1555 participants were excluded because of missing data. Given that this is about 16-18% of the original sample, it would be helpful to report whether people with particular characteristics, or from particular areas, were more likely to be excluded.

A complete case analysis was conducted in light of time constraints in the secure data lab. The analytic sample was restricted to participants with complete data for all tables. We have added to the methods section that

“Compared to the full sample, participants in our analyses were somewhat more likely to be male, young, educated, or employed.”

Missing data is also highlighted in our discussion of study limitations.

“Missing data was also an important limitation. In particular, the large number of participants who selected “Not applicable”, “Don’t know” or “Refused” in response to the question on perceived safety (N=1092) may have included those who already avoided walking home at night due to safety concerns or health limitations, and this could lead to a biased estimate of the associations between crime rates, perceived safety, and health status.”

TA.12. I hope these comments are helpful. Thanks again.
Thomas Astell-Burt
| REVIEWER | James F Sallis  
| University of California, San Diego  
| USA |
| REVIEW RETURNED | 12-Feb-2014 |
| GENERAL COMMENTS | The authors were highly responsive to reviewer comments. Small but important clarifications and additional information were provided. Some analyses were recomputed using more rigorous methods. The manuscript was initially very good, but it has been improved. |