Author’s response to reviews

Title: Association between Migration and Cognitive Status among Middle-Aged and Older Adults: A systematic review

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Author’s response to reviews:

RE: BGTC-D-17-00003

Association between Migration and Cognitive Status among Middle-Aged and Older Adults: A systematic review

Your manuscript "Association between Migration and Cognitive Status among Middle-Aged and Older Adults: A systematic review" (BGTC-D-17-00003) has been assessed by our reviewers. They have raised a number of points which we believe would improve the manuscript and may allow a revised version to be published in BMC Geriatrics.

We would like to thank the editor and the reviewers for their careful consideration of our manuscript. We have revised the manuscript according to the suggestions, and we believe these revisions have substantially improved the quality of our work. Below, we describe point-by-point how we addressed each comment. We highlighted the changes in yellow in the revised manuscript.

Reviewer #1:

ABSTRACT:

1. Title: Association between Migration and cognitive Status among Middle-aged and Older adults: A systematic review.

Needs revision to be more succinct without the use of word synthesis (e.g., Thesis, antithesis and synthesis are the words which the reader knows during the ongoing process of an article). It could be “To find an association of migration and cognitive function among migrant and non-migrant population.”
Response: We appreciate the reviewer’s comment. However, since this is not a paper using empirical data, we want to make it clear that this is a systematic review paper.

2. Method:

The author may incorporate the word systemic review and meta-analysis.

Response: Thank you for the suggestion. We incorporate the word “systematic review” in the methods section. However, we didn't conduct meta-analysis because of the heterogeneity in study design, definitions of migration, and outcome measures used. Therefore, we thought completing a meta-analysis would be inappropriate.

3. Findings:

Show discrepancies regarding distribution of 25 studies, which were extracted from different sources and distributed among the countries.

Response: Thank you for pointing it out. We have corrected the numbers.

4. Conclusion:

Has a discrepancy between abstract and main manuscript’s conclusion.

Response: Thank you for pointing this out. We’ve changed the conclusion in the abstract and now it is consistent with the conclusion in the main manuscript.

5. Keywords:

Should have been:

“Cognition, Memory disorder, Dementia, Emigration, Immigration.”

Response: Thank you very much for this suggestion. We changed our key words accordingly.

Introduction:

It needs major revision.
It starts with the definition of migration and then fails to clearly delineate the global burden.

Text quoted at [4] fails to define its relevance because of its wordiness.

Then rationale of an article was defined followed by associated risk factors of migration and impact on personal life and environment.

The article fails to follow logical progression of thought in defining the aim and purpose of the study e.g., association of migration and cognition among immigrants or emigrants etc.

It ends suddenly with an aim of study and impact of migration on aging population.

Response: Thank you for the suggestions. We revised the introduction by strengthening the importance of the study. We also added information about a potential pathway, through SES, behavioral, and psychosocial, that links migration and cognitive function. Furthermore, we added a figure (Figure 1) to illustrate this potential pathway. We believe that these changes would underscore the significance of the study, make the introduction more concise, as well as help with the flow of the information.

“An increasing number of migrants are entering into old age, and many of them suffer from deterioration of health outcomes, including cognitive decline, in later life [1,2]. Understanding the association between migration and cognitive function would provide better knowledge of risk factors related to cognition and help develop strategies and programs to healthy aging among migrant populations.

Migration is a major life event and its associated changes (see Figure 1), including changes in socioeconomic status (SES), lifestyle, and environment, may have a significant impact on health status in later life [3,4]. A number of studies have shown that adulthood SES, such as education, income, and occupation, are protective factors in cognitive decline [5–8]. Migration may result in an improvement in an individual’s SES. For example, rural-to-urban migrants tend to have more exposure to education opportunities, which may positively influence their cognitive function in late life [9]. Moreover, these positive effects may lead to improvement in access to care and better management of chronic conditions, which could contribute to better cognitive function over time [10].

Behavioral changes have been observed in the migrant population as well. When migrating from a rural to an urban setting, or from a low and middle-income country to a high-income country, westernized life styles are often adopted [11–13]. Migrants are thought to be adopters of high-risk lifestyle that attributes calorie-intensive dietary patterns and physical inactivity [14]. They are often exposed to mechanized or sedentary employment and tobacco use [15–17]. These high-risk lifestyles are associated with the development of chronic diseases, including cardiovascular diseases, and poor cognitive function [18–20].
In addition, migrants often experience stressors during and after the migration process [21]. The separation from family is likely to be associated with reduced level of social support and size of social network. The perceived discrimination and a lack of sense of belonging in their destination may contribute to social isolation and development of depressive symptoms [22,23], which can affect late-life cognitive function [24].” (Page 3-4)

Method:

It’s a systemic review and meta-analysis.

Response: As we mentioned earlier, we didn't conduct meta-analysis for this study because of the heterogeneity of these previous studies with regard to study design, definitions of migration, and outcome measures used. Therefore, we thought completing a meta-analysis would be inappropriate.

The article fails to describe the [Mesh term] search used for meta-analysis.

Response: Thank you for your suggestions. We added the Mesh terms that we used for this systematic review:

“….using the following terms: ("Memory Disorders"[Mesh] OR "Cognition"[Mesh] OR "Cognition Disorders"[Mesh] OR "Dementia"[Mesh]) AND ("emigration and immigration"[MeSH Terms] OR ("emigration"[All Fields] OR "immigration"[All Fields]) OR "emigration and immigration"[All Fields]) OR ("emigrants and immigrants"[MeSH Terms] OR ("emigrants"[All Fields] OR "immigrants"[All Fields]) OR "emigrants and immigrants"[All Fields]) OR "residential mobility"[MeSH Terms] OR "transients and migrants"[MeSH Terms] OR "migration"[All Fields] OR “migrant*”[All Fields] OR “mass-migration”[All Fields] OR "Human Migration"[Mesh] OR "Population Dynamics"[Mesh] ). Four additional datasets (EMBASE, Global Health, PsycInfo, and CINAHL) were also searched using similar terms.” (Page 4-5)

Flow diagram shows discrepancy regarding extraction of 25 articles that were included for the final analysis of the study that comprising of 22 and 3 more articles added later from the reference lists. However, these 25 articles were arrived at one step earlier in the flow diagram (163-138=25).

Response: Thank you for pointing it out. We revised the flow chart to make it consistent with the final number.
The results failed to apply:

1. The Level of evidence from the oxford centre for EBM e.g., Ia or Ib, etc.
2. Grading of recommendation: A, B, C,D
3. Quality of evidence: Good, fair or poor.
4. Strength of recommendation: A,B,C,D

The statistical means in arriving at the conclusion fixed-effect or a random-effect model should have been used (e.g., non application of forest plot, Z-score, dependent or independent variable and/or meta-regression etc.)

Assessment of reporting biases should have been described.

Response: Thank you for the great suggestions. However, since we are unable to conduct a meta-analysis because of the heterogeneity in study design, definitions of migration, and outcome measures used, we thought using the guidance from the Oxford Center for EBM would be inappropriate. Instead, we applied another set of criteria that has been widely used in previous studies to assess the strength of the included studies. Based on the evaluation, we discussed the quality and strength of current evidence on the relationship between migration and cognitive function.

“Assessment of the quality of the eligible studies

Each of the studies was assessed using a set of criteria developed earlier, including sample selection, sample size, validated assessment of outcome, attrition, conflict of interests report, and analytic approach [54,55]. The evaluation of each article suggested methodological deficiencies in this area of research. The most problematic aspects included baseline comparability (e.g. significant differences in sample characteristics between migrants and non-migrants, n = 25), inadequate assessment of cognitive function (e.g. only used a screening tool such as MMSE to measure cognitive function, n = 17), lack of longitudinal studies (n = 16), inadequacy in addressing incomplete data (e.g. no information on missing data management, n =16), and high dropout rate (e.g. dropout rate = 35%, n = 19). Therefore, the current evidence was inconclusive to establish a causal relationship between migration and cognitive function. Detailed results are available from the authors upon request.” (Page 11)
Discussion:

Though critically applied but failed to detect various forms of bias and hadn’t applied the validity item scores for each article.

The effect of bias on the results of the study should have been analyzed.

Response: Thank you for the comments. Although we are not able to conduct a meta-analysis, we added more discussion related to the quality of the included articles.

“...Only 8 articles used validated instrument to measure cognitive function and the MMSE [44] is the most frequently used measure in literature especially among population-based studies....” (Page 15)

“Evaluation of the study quality suggested that there were methodological deficiencies in the current literature about migration and cognitive function. Only 9 studies applied longitudinal design [29–32,34,35,46,49,50], 9 adequately addressed incomplete data [30–32,45,46,48–50,53], or 6 had a dropout rate <30% [28,31,32,46,49,50]. These deficiencies are likely to produce biased results and limit the generalizability of the study findings. From a life-course perspective, the impact of migration or migration related changes can accumulate throughout the life-course. Therefore, more longitudinal studies using validated measures are essential to establish a strong association between migration and cognitive function.” (Page 15-16).

“Still, only adjusting for these covariates may not be sufficient. Results from our quality assessment indicated that migrants and non-migrants had relatively different characteristics. It is possible that some differences in level of cognition between migrants and non-migrants are likely to be explained by confounding variables other than migration status. Thus, using more sophisticated statistical methods should be encouraged to adjust for confounding factors. For example, using propensity scores, researchers are able to balance the distributions of observed covariates between treatment conditions (e.g. rural residents and rural-to-urban migrants) so that a direct comparison between matched treatment conditions becomes valid [61]. Another solution is to use instrumental variable analysis to minimize the unmeasured confounding factors [62]” (Page 16)

Conclusion:

It should have been drawn to the initial question i.e., patient population, intervention, control/comparison and outcome. The aforementioned objections raise significant doubt regarding the conclusion and can’t be relied upon.

Response: Thank you for the suggestions. Because all the eligible studies were observational studies and the heterogeneity in study design, definitions of migration, and outcome measures
used, we were not able to conduct a meta-analysis and draw conclusion based on that. We concluded that the current evidence of the association between migration and cognitive function is weak and inconclusive. The quality of the included studies suffered from methodological deficiencies. We suggested further studies are needed using more vigorous study design and validated instruments.

“Overall, the evidence from current studies regarding the association between migration and cognitive function is weak and inconclusive. Findings were inconsistent across studies, and the association ranged from a negative association, to no association, to a positive association (albeit, in only one study). The quality of current literature suffered from methodological deficiencies, with limited studies applied longitudinal design, used validated outcome measures, addressed potential selection bias adequately. Additional research is needed to examine the linkages using more vigorous study design and validated instruments.” (Page 17)

Discretionary revisions:
The text needs correction of minor grammatical errors in introduction page 3, line 8th; page 11, line 5th & line13; page14 line 18 and in authors contribution to improve the manuscript.

Response: Thank you for pointing these out. We have made language edits throughout the manuscript.

Reviewer 2:
In this manuscript, the authors have performed a systematic review of published studies that address the relationship between migration and cognition. Their primary conclusion is that this literature remains relatively muddled, as some studies suggest that migrants have poorer cognition than non-migrants (in either the sending country or the hosting country), but others suggest that there is no difference between migrants or non-migrants. The review is comprehensive in its scope, and the authors address a number of the key issues regarding this question. However, the review itself feels a little unsatisfying and primarily descriptive, partially because of the inconsistent results, but also because the underlying hypothesis is unclear. Did the authors have an explicit theoretical basis for expecting migrants to have better or worse cognition (they appear to hint at the latter)? Are there common methodologies and/or themes that underlie the studies that showed migrant/non-migrant differences relative to those that showed no such differences? A more critical approach to the studies might help readers more successfully navigate these contradictory findings.
Response: Thank you for the suggestions. We revised the manuscript by adding three potential pathways (SES, behavioral, and psychosocial) that link migration and cognitive function in the introduction (new Figure 1). We believe that these changes would help showing a theoretical basis of the association between migration and cognitive function. We also added more discussion about the evaluation of study design.

“An increasing number of migrants are entering into old age, and many of them suffer from deterioration of health outcomes, including cognitive decline, in later life [1,2]. Understanding the association between migration and cognitive function would provide better knowledge of risk factors related to cognition and help develop strategies and programs to healthy aging among migrant populations.

Migration is a major life event and its associated changes (see Figure 1), including changes in socioeconomic status (SES), lifestyle, and environment, may have a significant impact on health status in later life [3,4]. A number of studies have shown that adulthood SES, such as education, income, and occupation, are protective factors in cognitive decline [5–8]. Migration may result in an improvement in an individual’s SES. For example, rural-to-urban migrants tend to have more exposure to education opportunities, which may positively influence their cognitive function in late life [9]. Moreover, these positive effect may lead to improvement in access to care and better management of chronic conditions, which could contribute to better cognitive function over time [10].

Behavioral changes have been observed in the migrant population as well. When migrating from a rural to an urban setting, or from a low and middle-income country to a high-income country, westernized life styles are often adopted [11–13]. Migrants are thought to be adopters of high-risk lifestyle that attributes calorie-intensive dietary patterns and physical inactivity [14]. They are often exposed to mechanized or sedentary employment and tobacco use [15–17]. These high-risk lifestyles are associated with the development of chronic diseases, including cardiovascular diseases, and poor cognitive function [18–20].

In addition, migrants often experience stressors during and after the migration process [21]. The separation from family is likely to be associated with reduced level of social support and size of social network. The perceived discrimination and a lack of sense of belonging in their destination may contribute to social isolation and development of depressive symptoms [22,23], which can affect late-life cognitive function [24].” (Page 3-4)

“…Only 8 articles used validated instrument to measure cognitive function and the MMSE [44] is the most frequently used measure in literature especially among population-based studies….” (Page 15)
“Evaluation of the study quality suggested that there were methodological deficiencies in the current literature about migration and cognitive function. Only 9 studies applied longitudinal design [29–32,34,35,46,49,50], 9 adequately addressed incomplete data [30–32,45,46,48–50,53], or 6 had a dropout rate <30% [28,31,32,46,49,50]. These deficiencies are likely to produce biased results and limit the generalizability of the study findings. From a life-course perspective, the impact of migration or migration related changes can accumulate throughout the life-course. Therefore, more longitudinal studies using validated measures are essential to establish a strong association between migration and cognitive function.” (Page 15-16).

“Still, only adjusting for these covariates may not be sufficient. Results from our quality assessment indicated that migrants and non-migrants had relatively different characteristics. It is possible that some differences in level of cognition between migrants and non-migrants are likely to be explained by confounding variables other than migration status. Thus, using more sophisticated statistical methods should be encouraged to adjust for confounding factors. For example, using propensity scores, researchers are able to balance the distributions of observed covariates between treatment conditions (e.g. rural residents and rural-to-urban migrants) so that a direct comparison between matched treatment conditions becomes valid [61]. Another solution is to use instrumental variable analysis to minimize the unmeasured cofounding factors [62]” (Page 16)

A number of other, more minor issues are detailed below.

1. In the Introduction (p. 3), the authors state that migration is "one of the three demographic components used to assess population changes." It might be useful to know what the other two are?

Response: Thank you for the suggestions. We added the other two demographic components (birth and death) in the sentence.

“Migration, defined as geographic movement of people across a specified boundary for the purpose of establishing a new permanent or semi-permanent residence, is one of the three demographic components (i.e. birth, death, and migration) used to assess population changes” (Page 3)

2. In the Results (p. 10), the authors devote a section specifically to migrant studies among Mexican-American populations. However, since several of these results have already been presented in the preceding sections, this section feels a bit redundant.
Response: This is a good point. We deleted the section that focused on Mexican-American populations. (Page 11)

3. There are a number of typographical errors in Table 1, most notably in the rows describing Al Hazzouri, Black, and Graves studies. Also, the authors refer to the Lawton et al., 2015 study as examining Mexican-Americans. Although the vast majority of the participants in the SALSA database are of Mexican descent (89%), the remainder have other countries of origin. It would also be useful to have the studies listed in Table 1 keyed to their numbering in the References section.

Response: Thank you for pointing these out. We updated the order of the articles and made changes accordingly.

4. I agree with the authors that the key issues mediating cognitive performance in immigrants versus non-immigrants are likely to be language of testing and socioeconomic status (SES). Is there enough information across studies to determine if this is a key feature that affects whether there is a migrant effect? Specifically, are the studies that show a difference with migration ones that do not account for language of testing and/or SES?

Response: This is a really good point. Only 3 out of the 25 articles did not control for SES or language of testing. Results from these 3 studies [38,40,41] showed differences in cognitive function between migrants and non-migrants, which means there could be a migrant effect. However, as we described in the introduction, migration and cognitive function could be linked through changes in SES, psychosocial, or behavioral factors. To fully explore whether there is a migrant effect, as we discussed in the revised manuscript, future studies should apply advanced statistical methods such as propensity score matching or instrumental variables to account for confounding factors. In addition, future research should include important migration related confounding variables, such as SES, behavioral, psychosocial variables, and reasons for migration.

“Still, only adjusting for these covariates may not be sufficient. Results from our quality assessment indicated that migrants and non-migrants had relatively different characteristics. It is possible that some differences in level of cognition between migrants and non-migrants are likely to be explained by confounding variables other than migration status. Thus, using more sophisticated statistical methods should be encouraged to adjust for confounding factors. For example, using propensity scores, researchers are able to balance the distributions of observed covariates between treatment conditions (e.g. rural residents and rural-to-urban migrants) so that
a direct comparison between matched treatment conditions becomes valid [61]. Another solution is to use instrumental variable analysis to minimize the unmeasured cofounding factors [62]. Additionally, several other factors that are associated with cognitive function and migration were rarely included in the literature. For example, some studies found social isolation to be a risk factor for cognitive impairment and cognitive decline [26,63,64], and many migrants face the challenge of decreasing social network. In addition, studies have shown that stressful life events are associated with increased dementia risk [65,66]. However, none of the included studies controlled for these psychosocial factors, which should be considered in future research.” (Page 16)

5. A strength of this review is that it looks at migrants versus non-migrants in both sending and hosting countries. I would presume there might be other data that document that migrants have poorer SES than non-migrants in either situation? And that the migrants who return may be more economically successful than those who do not? Such information would help support the idea that SES is the main driver of the difference between migrant and non-migrant cognitive performance.

Response: This is an excellent point. We added more information about the SES differences between migrants and non-migrants.

“Several studies reported that immigrants tended to have a lower level of education and more financial strains than residents in hosting countries [32,33,46,48,53]. In addition, migrants didn't necessarily have better SES compared to non-migrants in the sending countries, which might due the incomparability in SES measures between hosting and sending countries [47,53]. …… Studies that focused on immigrants from Japan showed no significant difference in SES between Japanese immigrants and Japanese Americans [50,51]. One study that compared Mexican-return migrants with Mexicans found better SES among Mexican-return migrants [53]. However, this SES advantage didn't translate to better cognitive function, which we speculate that those returned to Mexico were in poor health status [57].” (Page 13)

6. In the Introduction (p. 3), the authors raise an important point about stressors related to migration being an important consideration regarding long-term cognitive outcomes. I am curious about whether the studies that compared migrants from different countries showed a consistent difference between persons of color versus Caucasians, particularly in the European studies? Could the stresses of everyday overt and/or covert racial biases be differentially affecting such populations?

Response: this is a great point. Although Livingston et al. reported both the ethnicity and country of birth, cognitive function was only examined by country of birth. Other studies that compared
migrants from different countries didn't not report the stress level by racial/ethnicity. Thus, we were not able to evaluate whether the stresses of everyday covert racial biases be differentially affecting the migrants from different countries. This is a good suggestion for future research.

7. One of the most challenging aspects of examining cognition in migrants versus non-migrants is that these groups are likely to differ across multiple demographic variables. Although virtually all of the studies included in this review attempt to statistically adjust for these differences, residual confounding may limit the effectiveness of this approach. As such, one remains concerned that any differences in cognition between migrants and non-migrants are likely to be driven by confounding variables other than migration status. This point is alluded to, but not explicitly stated by the authors.

Response: Thank you for the suggestions. We added more discussion about this methodological deficiency in the discussion section.

“Still, only adjusting for these covariates may not be sufficient. Results from our quality assessment indicated that migrants and non-migrants had relatively different characteristics. It is possible that some differences in level of cognition between migrants and non-migrants are likely to be explained by confounding variables other than migration status. Thus, using more sophisticated statistical methods should be encouraged to adjust for confounding factors. For example, using propensity scores, researchers are able to balance the distributions of observed covariates between treatment conditions (e.g. rural residents and rural-to-urban migrants) so that a direct comparison between matched treatment conditions becomes valid [61]. Another solution is to use instrumental variable analysis to minimize the unmeasured confounding factors [62].”

8. Are there specific features about reason for migration that the authors think should be integrated into future studies? If so, the manuscript might benefit from further elaboration on this point. The most obvious would appear to be economic versus education versus refugee status, and one might expect differing levels of cognitive performance in each of these groups.

Response: Excellent point. We elaborated the point that reasons for migration should be integrated into future research.

“However, no studies included information on participants’ reasons for migration (e.g., education, family reunion, economic condition, and political asylum). Refugees and people who migrated for the purpose of better education are likely to have different SES, psychosocial distress, and/or health status which may affect the level of cognitive function. Therefore, without
knowing the whole picture of the migration process, it would be difficult to identify what the changes occur during this process that might influence an individual’s cognitive function.” (Page 14).