Author’s response to reviews

Title: Association between poor oral health and diabetes among Indian adult population: Potential for integration with NCDs.

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Author’s response to reviews:

Response to editor and reviewer comments

Editor Comments:

Please revise the manuscript according to the reviewers’ comments.

We would like to thank the reviewers for their positive feedback.

The manuscript has been revised as per the changes suggested (highlighted text) and a point-by-point response has been provided below.
Reviewer reports:

1. Sukirth Ganesan, BDS,PhD (Reviewer 1): This is a well-conducted study and within the limitations of the study, the results mandate an oral health care intervention in this high-risk population.

The authors have presented the intraclass correlation for the inter-rater aggregability. However, with the indices from DMFT and numerical scores from CPI, it is better to report both the ICC and Kappa statistic.

Response: Thank you for this suggestion. We have now included the kappa statistic for LOA. (Page 7, Study Procedures, Oral Health Assessment, Line 90)

The authors do mention about the adjusted prevalence with periodontitis, but the factors that were adjusted for is not clear. What are the factors that were adjusted? Was there any significance testing performed for Figure 2?

Response: We have adjusted the prevalence of dental caries and periodontitis for socio-demographic, lifestyle variables along with cleaning frequency and dental visits. A figure legend has been added to incorporate the same. (Page 21, Figures, Line 440-441) We did not perform any significance testing for figure 2 however 95% Confidence Intervals have been presented along with the sample estimates.

Line 173-174. Can the authors comment on the fact that never visited the dental facility is associated with zero scores for caries experience? Practically, shouldn't the D (in DMFT) be higher, if a person has never seen a dentist?

Response: We acknowledge and agree with the reviewer. However, there could be a possibility of “never-visiting” participants to have good oral health or they may never have experienced the need to visit a dental care facility. Care in LMICs is perceived to be curative rather than preventive in nature and a majority of people visit a health facility only after they experience pain/discomfort. The same reason has been mentioned in our discussion section. In our study, we found nearly 38% participants did not experience pain/discomfort in the last 1 year out of which 48% of them never visited any facility and 14% of them had zero decayed teeth.

2. Bethy Turton (Reviewer 2): Thank you for the chance to review this interesting article that examines the patterns of periodontal disease and dental caries as associated with diabetes. The sampling and data were very strong and there is a good chance that this paper could make a valuable contribution to the literature especially if they can strengthen the narrative by proactively highlighting the key ideas in their narrative.

There are three ideas that seem to be in this paper; that the association between perio and diabetes has not been investigated very extensively or with very high quality data sets among low and middle income countries; that oral diseases should be measured during any NCD survey;
that given the high prevalence of oral diseases there should be access to care to help manage them (universal access to care). It is not clear which of these points are the key point that the author wishes to convey and that could be compromising the readability of the paper. I would ask that the authors choose one key point and the subordinate the other points to create a stronger narrative. If the authors would like to make the integration of oral disease measurement and management with NCD the main point then I would like to make the following suggestions for authors to consider.

Consider making an opening statement about the high prevalence of oral disease when compared to other health conditions that are commonly measured. How does it compare to hypertension etc. This could lead on to justification of why diabetes was shown as a key NCD to demonstrate the point that is being made.

Response: We would like to thank the reviewer for acknowledging the strong data and sampling of the study. We fully agree with the reviewer that there are more than one emerging ideas and we should focus on one of them to make it stronger. As suggested, we have chosen one key point, which is the integration of oral disease measurement and management with NCDs. To complement the data on burden of oral diseases we have added a line comparing the total health loss from oral conditions compared with other common diseases. (Page 5, Background, Line 41-43)

It is also important to use data-points from the literature that are comparable to the methodology in the present study. In line 38 the authors give the figure of 7% as being the proportion of those with severe chronic periodontitis but in this study the authors only measure mild periodontitis and so using an altered disease definition in the analysis or in the introduction would help to create continuity in the narrative.

Response: We have cited the estimates in the introduction from the Global Burden of Disease Study data from 195 countries over 1990 to 2015 and it presents data only for severe form of periodontitis. To complement this information and to establish a continuity in the narrative we have added estimates on periodontitis and caries from a recent Indian community-based survey which includes both mild and severe periodontitis. (Page 5, Background, Line 39-41)

It is important to comment on the suffering created by oral diseases not just in terms of the cost to treat but also in terms of the reduced quality of life [line 48].

Response: We agree with the reviewer’s comment and the background section comprises of manifestations of oral conditions that compromise quality of life: pain, altered physiology-mastication and xerostomia. (Page 5, Background, Line 52-54)

Could emphasize the significance of this survey in cross-profession advocacy and cooperation and that survey’s such as this are important for recognizing oral disease among the NCD
paradigm and the need for pathways to universal health care access that includes management of oral disease.

Response: In the discussion section we suggest collaboration with other health professionals as one of the strategies to accelerate efforts in integrating oral health care with NCD management. (Page 14, Discussion, Line 258-260)

It is interesting that oral mucosal lesions were described here and that is great; however, it is hard to see how this fits with the narrative of the paper as those lesions are not included in later modelling. There should be more justification as to why these data were included.

Response: We had used the WHO step-wise approach and questionnaire to assess oral health, therefore oral mucosal lesions have been presented. We did not include them later in the modelling as the emphasis was on caries and periodontitis. We plan to present details results from oral mucosal lesions in a separate paper. Presentation of this result is linked with the Govt. of India’s NPCDCS which did not include any oral health component initially, but its recent expansion has screening, early detection, management and referral of oral cancer cases. However, results from studies like ours will help propagate integration of oral health as a whole in the NCD program.

If the authors want to make a stronger point about diabetes and periodontal disease then I suggest adding more material around describing the epidemiology and clinical presentation of periodontitis and diabetes both in a south Asian region and globally. Need a little more of the narrative around the comorbidity of caries and NCD. In contrast need to point out the biological plausibility of the pathway between Perio and Diabetes. These points can be used to build a stronger case for the common risk factor approach.

Response: We have added more information on the association between diabetes and periodontal disease citing results from meta-analysis and also elaborated on the pathways linking the two conditions. The discussion has been strengthened by adding a narrative on comorbidity of caries and diabetes. (Page 13 onwards, Discussion, Line 223-224; 228-233; 236-243; 245-250)

Other methodological issues are

Definition of periodontal disease - The definition of loss of attachment is not clear, how was this measured? Which anatomical landmarks were taken into account? What type of probing system? It seems that LOA was defined as >1mm and if I understand this correctly then there are a number of problems with that definition of disease as it relates to the association to periodontal disease. Firstly, a patient can have loss of attachment without gingivitis and be stable in which case the inflammatory pathway and the relationship to periodontal disease would be quite different. Secondly, it could be considered quite normal for older adults to have 1mm or more of loss of attachment and it may be worth considering an age adjusted definition of periodontal disease. Finally, and perhaps most importantly, it is acknowledged that measurements can be
very unreliable and so differences of up to 2mm between measurements might actually be
considered as reliable as you might hope to achieve. Therefore, I suggest adjusting the definition
of LOA to be loss of attachment >2mm (that is 5mm from the CEJ) in order to ensure that you
are identifying the real perio cases. In the key reference that the authors use to inform their
methodology (Page and Eke et al., 2007) then that would meet the 'moderate periodontitis'
category which would have a higher chance of being accurate than using the 'mild periodontitis'
category (≥3mm CAL) as the diagnostic variable. I suspect this would make your risk modelling
a little stronger as well.

Response: We thank the reviewer for this insightful comment. The extent of loss of attachment is
recorded using the CPI probe (with markings) and applying the following codes as per the WHO
Basic Survey Methods.

0 0–3 mm
1 4–5 mm (CEJ within black band)
2 6–8 mm (CEJ between upper limit of black band and 8.5 mm ring)
3 9–11 mm (CEJ between 8.5 mm and 11.5 mm ring)
4 12 mm or more (CEJ beyond 11.5 mm ring)
X Excluded sextant
9 Not recorded

LOA has been presented as mean score of that obtained from individual sextants in the ZIP table
rather than a threshold of 1mm.

We agree that a patient can have loss of attachment without gingivitis and be stable in which
case the inflammatory pathway and the relationship to periodontal disease would be quite
different. Secondly, it could be considered quite normal for older adults to have 1mm or more of
loss of attachment. Therefore, the prevalence of periodontitis has been age-adjusted. In the
definition of periodontitis (as per Page et al 2007) we have used the one provided for moderate
periodontitis: ≥2 interproximal sites with CAL≥4mm or ≥2 interproximal sites with
PD≥5mm.

CPI Score should not be reported as a mean score. It is a categorical definition which does not
have equal increments of disease with each increment in numerical category. That is to say the
difference between CPITN code 1 and CPITN code 2 is not equal to the difference between
CPITN code 2 and CPITN code 3. It is more helpful to present data as the proportion of
participants in each category or the authors might choose to use data on the proportion of
participants who are CPITN 3 or more.
Response: We agree with the reviewer and mean CPI scores have been replaced with proportion of participants with healthy gingiva, bleeding on probing and calculus deposits. (Page 11, Results, Line 171-172)

Multivariate modelling - it is not clear about what covariates are entered into the models? Line 141 the authors state that the poison model predicts the severity of condition for those who had scores of >0. Does this mean the severity of the diabetes condition or the severity of oral disease? Please clarify this within the methods section.

Response: we had missed this in the text, the variables presented in table 3 are adjusted for while looking at the association between DMFT/LOA scores and diabetes status. We have added a list of variables in the statistical analysis section (Age, gender, educational status, income, asset index, frequency of cleaning, service utilisation, consumption of fruits, deserts, sugary drinks, tobacco and alcohol consumption and BMI). The poison model predicts the severity of condition for those who had scores of >0. This indicates the severity of oral disease. The same has now been explicitly mentioned in the statistical analysis section. (Page 10, Statistical methods, Line 147-151)

Regarding the caries indicator, it is important to recognize caries as a cumulative measure of disease which means that those in the older age-group are likely to have a higher dmft. Therefore, the authors could consider age adjusting or using the significant caries index for each age-group and I would expect that this would aid in creating a more reliable model.

Response: We agree with the reviewer that DMFT score as a cumulative measure of disease and those in the older age-group are likely to have a higher DMFT. Table 2 and 3 also suggest that the mean DMFT score increases with age and so does the MCR for DMFT score. We have adjusted for age as one of the confounders in Table 3 (final ZIP model results).

In the conclusion the authors make a point about access to care, however, that was not part of the aim of the paper. Suggest limiting the statement to the stated aims and the importance of recognizing oral disease as a comorbidity to NCD and a driven by common risk factors to other NCD. Alternatively, consider making the narrative about both NCD and universal health care and that would make the present conclusion more relevant. This will depend on how the authors choose to strengthen the narrative.

Response: We have modified the conclusion as suggested by limiting the statement to the overall aim and the importance of recognizing oral disease as a co-morbidity to NCD driven by common risk factors. (Page 15, Conclusion, Line 281-284)