Author's response to reviews

Title: Modeling repeated ordinal responses using a family of power transformations: application to neonatal hypothermia data

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Dear Editorial Board

I am very thankful of excellent commands given by the referees on our manuscript entitled "A family of random-effects models for repeated ordinal responses: application to neonatal hypothermia data".

Hereby, I would like to inform you that we revised our manuscript according to the reviewers' comments and made substantial changes on it. Please see the following replies to the reviewers' comments.

If there is anything else I have to do it, please do not hesitate to ask.

Yours truly,
Farid Zayeri.

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Reply to the Prof. Agarwal's comments:

Comment on the Title of the manuscript: The present work is an application of "parallel regression model for repeated ordinal outcome on a scale chosen power transformation on cumulative response probabilities". The title should reflect this (especially "power transformation" term).

Reply: The Title of the manuscript was changed to "Modeling repeated ordinal responses using a family of power transformations: application to neonatal hypothermia data".

Comment 1: The paragraphs 3 and 4 of the background section could be combined and shortened as these are elaborated in Method Section.

Reply: These paragraphs were combined and shortened.

Comment 2: In the Method Section, the "Notation" should come before subsection "Family of transformation for binary response data".

Reply: The Method Section was changed according to the reviewer's comment.

Comment 3: The subsections "Family. binary response data" and "Family. ordinal response data " should be combined and shortened.

Reply: These subsections were combined and shortened.

Comment 4: In the actual application, the authors are not considering any time-dependent covariates and repeated measurements on each subject are fixed number T. So the "Notation" subsection can be simply replaced by the following:

Yit : Response for subject i (i = 1,.., N) at time t ( t=1,..,T),

?tj = ?tj( xi) = Probability of ordered response j at the ith setting (subject) of values of P explanatory variable x ( j =1,2,..,J)

is the cumulative probability for response category j for individual i at time t.

x: ( x1,..,xP)' represents vector of P covariates.

The possible values for Yit are already defined earlier in Para 2 of Method section. The need for defining Yit as a vector is for the purpose of using SAS software. So this can be done when SAS codes are presented.

Reply: Unfortunately, we did not receive this comment properly (please see the highlighted parts of the above comment). However, the notations were simplified according to the reviewer's comment. In addition, please note that the environmental temperature factor is a time-dependent covariate in the actual application (please see the model in equation (5)), so we could not consider the covariate vector according to the reviewer's representation.

Comment 5: Now using the above formulation given in Step 4 and using Step 2 and Step 3, the subsections "Notation", "Family of transformations for binary response data", "Family of transformations for repeated ordinal response data" and part of
subsection "Maximum likelihood estimators and computer program" (containing equation (6) and (7)) should be combined and shortened. There are a lot of repetitions as these subsections are presented separately.

Reply: These subsections were combined according to the reviewer's comment.

Comment 6: A separate subsection "Computer program" can be made. In this, it should be explained "How the SAS procedure NLMIXED" is working?" "How the transformation parameter lambda is being estimated in this procedure?" These are not clear from SAS code given in Appendix.

Reply: A separate subsection entitled "Maximum likelihood estimators and computer programs" was provided according to the reviewer's comment. In this subsection, we briefly discussed about the estimating method and NLMIXED procedure in SAS software. The NLMIXED procedure estimates all the unknown parameters in the log-likelihood function. We denoted the unknown fixed-effect regression parameters by $b1, b2, \ldots, b8$ and the unknown transformation parameter ($\lambda$) by $b9$ in Appendix.

Comment 7: What is "apgar score?" (Para 1, Result Section).

Reply: A brief explanation about this medical term was added to the subsection "The study of hypothermia in the newborns" in the Method Section (paragraph 1, page 5).

Comment 8: What is meant by "different link functions" (line 1, Para 1, "Analysis of risk factors "section)? The link function is characterized by parameter lambda, which is, supposedly being estimated by the program.

Reply: This sentence was changed to "To evaluate the fit of the illustrated model and to identify …" (page 11, Analysis of risk factors subsection).

Comment 8 (continued): An alternative way could be to use a sequence of values of lambda, and then draw a graph of lambda versus "deviance" to decide about the proper choice of lambda for the given data. This would be helpful, since "different risk factors" are being obtained in "logit link function" and "complementary logit link function".

Reply: This graph was drawn for the neonatal hypothermia data (please see the Figure 1).

Comment 9: "Conclusions" section is inconclusive and could be omitted.

Reply: This section was omitted according to the reviewer's comment.
Reply to the Prof. Pulkstenis' comments:

**Major Compulsory Revision:** The authors should address the fact that their results indicate that neither the logistic nor complementary log-log link function fits the data as evidenced by lambda differing statistically from both 0 and 1. They should give suggestions as to how to make inference in this case. A decision rule as to which model to choose based on lambda and its associated standard error would be helpful to practitioners.

**Reply:** To address this fact, we added a brief explanation on page 14 (paragraph 3) and 15 in the Discussion Section (also, please see the Figure 1). If the estimate of Lambda is significant but not close to 0 or 1, a model with the estimated value of this parameter can be utilized. Otherwise, when the estimate of Lambda is not significant or the standard error of the estimate is too large, the traditional methods of choosing the link function (for example, fitting the ordinary cumulative models with the common link functions, such as logit, probit, complementary or negative log-log, separately and choosing the model with the best fit) may be preferable.