Author’s response to reviews

Title: Assessing the Construct Validity and Reliability of the Parental Perceptions on Antibiotics (PAPA) Scales

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Author’s response to reviews: see over
**Editor:**
Editors comments have been addressed as following:

- **Copyediting:**
  - Editing services have been made using Epiphany editing.

- **Competing Interests:**
  - Competing interest section has been added to the manuscript: “The article processing fees are paid by Queensland University of Technology, Australia. There are no other competing interests relating to this research.”

- **Authors’ Contributions:**
  - Authors contribution has been added to the manuscript according to the information provided in the instructions for authors: “AA and CH substantially participated in the conception and design of the study, and performed the statistical analysis and interpretation. AA and AY conducted data acquisition and AA drafted the manuscript. XH, JS, AY and CH helped to draft the manuscript and revising it critically for important intellectual content. All authors read and approved the final manuscript.”
Reviewer 1:

Responses to the first reviewer’s comments are as follows:

Major Compulsory Revisions

- This comment touches on a conceptual issue that is evident in many parts of the paper, starting with the title. Construct validity, the question of whether a scale measures what it purports to measure, is determined based on accumulated evidence from multiple studies. A single confirmatory factor analysis, no matter how well the data fits the model, does not establish construct validity; a CFA is one step toward the establishment of construct validity. Thus, you overclaim when you say that your results confirm the construct validity of the PAPA. What you have done is provide evidence of the psychometric properties and validated the scale structure.

- The title has been changed to: "Assessing the Psychometric Properties of the Parental Perceptions on Antibiotics (PAPA) Scales"

- In light of (1) above, consider re-naming the paper, perhaps 'Confirmatory Factor Analysis of the PAPA.'

- The title has been changed to: “Assessing the Psychometric Properties of the Parental Perceptions on Antibiotics (PAPA) Scales”

- In the body of the text, when you refer to ‘demonstrating the construct validity’ of the PAPA, revise to say that you are validating the scale structure, providing evidence toward establishing construct validity, etc.

- First paragraph has been changed in the introduction section:
  - Old: “The developed instrument (PAPA scales) needs to undergo further validation – namely construct validation – to be considered fully valid and reliable for use in future research.”
  - New: “The developed instrument (PAPA scales) needs to undergo further analysis of its psychometric properties to be considered fully valid and reliable for use in future research.”

- Second paragraph has been changed in the introduction section:
  - Old: “The aim of this study is to investigate the psychometric properties of the PAPA scales and to demonstrate construct validity of the PAPA instrument.”
• New: "The aim of this study is to investigate the psychometric properties of the PAPA scales and to demonstrate preliminary evidence of construct validity of the PAPA instrument.

• Convergent and discriminant validity are likewise not demonstrated by a single study of a single measure. At most, the statistical analyses that you ran provide preliminary evidence of convergent and discriminant validity.

• One paragraph has been changed in the results section:

  • Old: “The AVE of the constructs in the study were measured and compared to the inter-factor correlations [1]. Convergent validity was determined when the AVE of each construct was higher than its correlation with other constructs. While discriminant validity of the PAPA scale was determined by assessing the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), both were found to be lower than the Average Variance Extracted (AVE) for all of the constructs in the scale [2]. Convergent and Discriminant validities results are available in Table.3.”

  • New: “The AVE of the constructs in the study were measured and compared to the inter-factor correlations [1]. Preliminary evidence of Convergent validity was determined when the AVE of each construct was higher than its correlation with other constructs. While discriminant validity of the PAPA scale was preliminarily determined by assessing the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), both were found to be lower than the Average Variance Extracted (AVE) for all of the constructs in the scale [2]. Convergent and Discriminant validities results are available in Table.3.”

• Clarify the model that you originally tested in CFA and how you revised the model based on the results of the analysis. I believe that your a priori model had 6 factors, but you report that you tested a 5-factor model. Your measures and statistical analysis sections should describe the a priori model. The results section should describe the model you retained (e.g., one factor eliminated due to low loadings, several items deleted because...) Consider including two figures, one of the a priori model and one of the final model.

• Added to the manuscript (in the Methods section):
  “After the development of the instrument [3], parallel analysis and exploratory factor analysis using principal axis factoring was conducted to determine the
number and nature of the underlying factors in the instrument [4]. Six factors were produced from the analysis: knowledge and beliefs, behaviors, sources of information, adherence, awareness about antibiotics resistance, and parents’ perception regarding doctors’ prescribing behaviors. Also, the instrument’s reliability was established with Cronbach’s alpha= 0.78. The constructs produced in the priori model coincide with the constructs contextually available in the relevant literature [4].”

- A paragraph has been modified in the Statistical analysis section to include the highlighted part:
  “After conducting the EFA analysis using Statistics Package for Social Sciences (SPSS v19: [38]), the resulting constructs from the EFA using Principal Axis Factoring [33] were validated using Confirmatory Factor Analysis (CFA) in AMOS and Stata/SE v12. Only five out of the six initial factors were in the final CFA model. This study assesses the CFA using a different dataset from the one used in EFA (sample size \( n = 1111 \)).”

- In the Statistical Analysis section, provide additional information about your model and your CFA technique. Is Generalized Least Squares a model of CFA? Or did you use a different method such as structural equation modeling? Were factor loadings set to 0 or 1 or another value? Did you specify correlated or uncorrelated factors? Correlated or uncorrelated errors?

- **For editor:**
  - We fit a CFA using Structural Equation Modelling with Generalized least squares used the estimate model betas. We fit an oblique model and constrained the lowest numbered item (arbritary), within each factor, to 1.
  - Correlated and uncorrelated factors were specified in the EFA by choosing the rotation (i.e. an oblique (promax) rotation was used because at least some of the factors in the model were correlated)
  - We decided on an oblique model after comparing: principal axis factoring models with orthogonal (Varimax) with a PAF model with oblique (Promax). The latter of these two models was clearly more realistic (and revealed substantial correlations among many of the factors)

- **Added to the manuscript (in the methods section):**
  **The priori model:**
  The PAPA scale has previously undergone exploratory factory analysis, and results are reported elsewhere [4]. An Oblique (Promax) model was chosen after
comparing: principal axis factoring models with orthogonal (Varimax), with a principal axis factoring models with oblique (Promax). The latter of these two models was clearly more realistic and revealed substantial correlations among many of the factors.”

Did any items load significantly on more than one factor? How did you handle those items?

To editor: None of the items in CFA loaded significantly on more than one factor.

To editor: In the EFA, there was some evidence of minor cross-loadings. However, we decided that a loading of lower than 0.35 was not substantial and no cross-loadings were observed with loadings higher than this cutoff.

Added to the manuscript (in the results section): “No substantial cross-loadings (beta > 0.35) were observed in either the EFA (Alumran et al., 2013a), nor the CFA”.

Do the scales relate to one another in the way that your theory would predict? For example, are the significant correlations the ones you expected? Why or why not? Add this to the discussion section.

To editor: the correlations are between: 1) Knowledge and beliefs and Adherence, 2) Knowledge and beliefs and behaviors, 3) seeking information and awareness about antibiotics resistance, 4) and adherence and behaviors

Added to the manuscript (in the discussion section): “some correlations were found within the psychosocial factors in the present study. For instance, parents’ knowledge and beliefs was correlated with antibiotics adherence, which is similar to results from other studies [5]. However, the absence of validated instruments for measuring constructs underlying antibiotic use means there is little empirical evidence regarding theory, making theory in this area is somewhat speculative. In addition, some of these correlations can be speculated based on common sense, such as the correlation between antibiotic adherence and behavior, and the fact that parents who seek more health-related information have better awareness about antibiotic resistance.

I don’t understand your discussion of common method bias (Results paragraph 4). Please clarify what you were testing and how the result was interpreted.

Paragraph has been modified in the manuscript to include an explanation of the common method bias: “Common Method Bias was evaluated using Harman’s single factor test [6] which determines if the majority of the variance can be explained by a single factor. Common method bias occurs if there is a systematic
source of measurement error [7]. In our model, the variance of a single factor was 18.36% indicating there is no common method bias.”

- It is possible (although perhaps difficult) to directly measure antibiotic overuse in children. Do parents give children antibiotics when they are ill with viruses? And can your scale identify the parents who engage in this behavior? Whatever its psychometric properties, PAPA is not useful unless it correlates with this behavior of interest. You touch on this in the last 2 paragraphs of the discussion section, but perhaps a more explicit exploration of this idea is necessary – how would you design additional studies to test the validity of PAPA?

- To editor: It is difficult and/or impractical in across-sectional study of this type to measure the ‘overuse’, i.e. parents’ use of antibiotics in their children to treat viral infections. This would require bacterial culture tests to check the type of infection.

- To editor: There is a question in the PAPA asking about the frequency of antibiotics used in the last year for the youngest child in the family. Future research could test this outcome in relation to the parent-related psychosocial scores from the PAPA. However, there still remains the difficulty in linking a verifiable viral URTI event to an AB event.

- Conclusion: Be careful not to overstate your results. Your study has validated a 5-factor structure of the PAPA and established its psychometric properties – no more, no less. You can’t know that PAPA will be important in worldwide research until you (or other scientists) establish that it correlates to problematic antibiotic use.

- One paragraph has been changed in the conclusion section:

- Old: “This study demonstrated the validity and reliability of an instrument that measures the psychosocial factors associated with the parental use of antibiotics in children. This is the first fully validated instrument that measures these factors to our knowledge and, as such, is likely to provide high utility in future worldwide research to assess the psychosocial factors influencing the parental use of antibiotics in children. Discovering these influencing factors will assist decision-making processes with regards to the best interventions and policy formulations targeted to reduce antibiotic overuse within the community. This, in turn, will reduce the burden of antibacterial resistance, thereby leading to a decrease in
the burden of severe infectious disease caused by antibacterial resistance strains.”

- **New:** “This is the first study that validated a 5-factor structure of the PAPA instrument and established its psychometric properties. The PAPA instrument measures the psychosocial factors associated with the parental use of antibiotics in children. The worldwide effectiveness of the PAPA instrument can be established when the instrument correlates to problematic antibiotic use. Discovering the factors influencing factors will assist decision-making processes with regards to the best interventions and policy formulations targeted to reduce antibiotic overuse within the community. This, in turn, will reduce the burden of antibacterial resistance, thereby leading to a decrease in the burden of severe infectious disease caused by antibacterial resistance strains.”

**Minor Essential Revisions**

- In Background paragraph 7, provide a brief description of the previous studies of PAPA.

- **To editor:** If you mean the early phase development, we have included that in the methods. However, if you mean previous studies using PAPA for the study of antibiotic use, or other studies exploring its psychometric properties then we would like to reiterate that this is a new instrument developed for the purposes of measuring the psycho-social constructs underlying antibiotic use and that it was developed as there is no previously validated (that goes beyond content validation) that has been developed for this purposes.

- Please specify in the methods section the language in which participants completed the survey.

- Language of the survey has been added to the manuscript: “The Arabic questionnaire was distributed to parents of children younger than 12 years old in primary schools in the Eastern Province of Saudi Arabia in September 2012 to January 2013”

- To improve readability of the Measures section, provide a brief description of each subscale with one sample item. Then list all items of the PAPA in the appendix; specifying which scale each item belongs to.
• To editor: The measures section has been decreased to include only one item from each scale as an example. And the rest of the items are included in an appendix (appendix A).

• Explain what high scores and low scores on the measure mean (e.g., high scores reflect more accurate knowledge of antibiotic resistance). Are any items reverse-coded?

• A paragraph has been added to the statistical analysis section: “A higher score in the ‘Knowledge and Beliefs’ scale means better accurate knowledge regarding antibiotic use; a higher score in the ‘Behaviors’ scale means better judicious behavior regarding antibiotics use; a higher score in the ‘Adherence’ scale means better adherence to appropriate antibiotic doses; a higher score in the ‘Seeking Information’ scale means more eagerness to seek health-related information; and finally a higher score in the ‘Awareness about Antibiotics Resistance’ scale means better awareness regarding antibiotics resistance. All items worded negatively have been reverse coded for the purpose of analysis.”

• It might be useful to include a table reporting means and SDs for individual items

• Table 1 in the manuscript has been modified to include the means and SDs for individual items.

• Added to the manuscript (in the results section): “The means and standard deviations of the individual items in the instrument are presented in Table 1, where 1 is for ‘Strongly disagree or never’ and 5 is for ‘strongly agree or always’ depending on the nature of the question.”

**Discretionary Revisions**

• Consider restructuring the Background section by putting paragraphs 4-5 above paragraph 2.

• Change has been made.

• Ask a native English-speaking colleague to review the manuscript for readability and usage.

• Done

**Reviewer 2:**

The second reviewer did not ask for any revision.
Reviewer 3:
Responses to the third reviewer’s comments are as follows:

Major Compulsory Revisions

- You state: "Most infections of the upper respiratory tract are viral in nature and neither require, or are effectively treated by, antibiotics [14]. The use of antibiotics to treat viral URTIs is considered an overuse/misuse of antibiotics [4, 15-18]." To me this is an example of misuse rather than overuse- please provide a clearer definition of overuse and misuse.

- The statement has been changed to: “The use of antibiotics to treat viral URTIs is considered a misuse of antibiotics”

- To editor: Antibiotic misuse is sometimes called overuse, abuse [8], or inappropriate use [9], preliminary relates to the use of antibiotics for treating non-bacterial infections.

- Please state the objective of PAPA measurement: is it parental perception or is it psychosocial factors affecting use? Please also specify the differences between the terms perception, beliefs, attitudes, behavior and clarify which of these the PAPA instrument addresses.

- To editor:
  - The PAPA instrument measures the parent-related psychosocial factors affecting their antibiotics use in children.
  - The differences between the terms: perception, beliefs, attitudes, and behavior
    - Perceptions: the way in which something is regarded, understood, or interpreted
    - Beliefs: an opinion or conviction
    - Attitudes: the way a person views something or trends to behave towards it, often in an evaluative way
    - Behaviors: the way in which one acts or conducts oneself
  - The PAPA instrument addresses the parental perceptions on antibiotics, which includes their beliefs, attitudes, and behaviors.

- Please explain the recruitment of the sample - is it representative?

- To editor: It’s a representative sample since parents were recruited from primary schools parental meeting, attending these meeting are considered a social obligation in Saudi Arabia
• Added to the manuscript: “Attending these meetings is considered a social obligation in Saudi Arabia, thus making the sample a representative one of the Saudi population and achieving external validity.”

• An information about the PAPA instrument development would be helpful; the mere reference to a published paper is not enough.

• A paragraph has been added in the methods section, before the statistical analysis section: “The PAPA instrument was developed using a content evaluation panel of expert from Australia and Saudi Arabia, the panel of experts were used to conduct the brainstorming process [25]. The instrument’s items were derived from relevant literature, followed by a three-round Delphi Process using the content experts. Experts in the study are knowledgeable in areas such as: pediatrics, infectious diseases, epidemiology family medicine, psychology and counseling, and social sciences.”

• Given the sample size it would have been possible to use cross-validation techniques, why was this not done?

• To editor: Given the nature of 'gender issues' in a Saudi Arabian context we initially thought that there would be substantial differences in factor structure between fathers and mothers, and/or parents of sons, and parents of daughters (based on 'study child”), or some other possible risk factor. If this had been the case it would have necessitated a subgroup analysis (employing smaller sub-samples). It was for this reason why we developed this study with a descent sample size. The results revealed that although there were differences in the average scale scores between fathers and mother, there was no discernable difference between the structure of factors between these two groups.

• The socioeconomic and clinical information is referred to as criteria, which are measured by the instrument. However these appear to be descriptors, which are not part of the construct measured - please explain.

• To editor: The constructs measured are the psychosocial construct only. The rest of the variables are considered covariates.

• Reliability information is lacking and needs to be provided.

• Each scales reliability score (Cronbach’s Alpha) is available in the scale description in the methods section.

• How did you handle missing data?
• This is mentioned in the manuscript: "Expectation Maximization Technique [10] was used to impute missing values for the purpose of CFA, and all continuous figures have been rounded up to the nearest integer”
• Please provide legends for the tables and explain abbreviations.
• Legends have been added to the tables requiring legends
• Abbreviations have been added
• There are two Figures, which seem identical - and lack specific information (e.g. strength of association as expressed by adequate coefficients)
• To editor: The graph was included only as a visual aid to facilitate the structure of the PAPA instrument. I think the table is a much more useful tool for presenting the coefficients, and it allowed comparison with EFA loadings
• Are there any data about the actual use of antibiotics and the PAPA scale scores?
• To editor: Yes, but these are not within the scope of this article.
• In parts there seems to be inconsistency in the use of the English language, please check again.
• To editor: An editing service has been done using “Epiphany editing”
Referee:

Responding to the referee’s comments:

(1) When fitting the CFA model, ‘Generalized least squares’ (GLS) method was used (p.10). In general, the default estimation method for CFA model is maximum likelihood (ML). Is there a particular reason that GLS was chosen?

- Added in the manuscript: "We initially tried fitting our CFA model using Maximum Likelihood Estimation, but noticed that Generalized Least Squares provided a superior fit."

(2) It will be helpful to present and comment on the descriptive statistics, including the inter-correlation coefficients of the original variables (the 35 items), before any modeling. Descriptive statistics will provide a sense of what the original data look like.

- To editor:
  - This table will have to be very huge and with little benefit to this article.
  - Initially inter-item correlations were investigated and are presented elsewhere.

(3) In addition, there might be two typos: p. 12, the bAAB4 was cited as 1.86 (I guess it should be .186); p. 3, “Most infections of the upper respiratory tract are viral in nature and neither require, or are effectively treated by, antibiotics.” The ‘or’ should be ‘nor’?

- To editor: Typos have been modified
References: