

Using Rasch measurement to quantify the perceived risks associated with the use of tobacco and nicotine-containing products

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Introduction and Objectives

The policy of tobacco harm reduction – making less harmful products available to smokers who would otherwise continue smoking – is recognized as an important strategy for reducing smoking-related harm. New products which may be less harmful alternatives to continued smoking become increasingly available (smokeless tobacco, e-cigarettes, heat-not-burn).

The assessment of the public health impact of such products must consider consumer risk perception as it might determine tobacco product uptake and use. However, there is currently no self-report instrument available that allows the quantification of perceived risks of different tobacco and nicotine-containing products.

A scale development project was thus undertaken to develop a new self-report instrument that quantifies perceived risks of tobacco and nicotine-containing products in adult smokers and adult non-smokers. Initial items were constructed based on a literature review, consumer focus groups and expert opinion [1]. Here we report the findings of psychometric evaluation using Rasch Measurement Methods (RMMs) as well as examples of application of the new instrument.

Methods

Administration

The Perceived Risk Instrument (PRI) was designed to be administered electronically in cross-national surveys to get an understanding of the perceived risk profile of different tobacco and nicotine-containing products for both adult smokers as well as never and former smokers.

Data

Data for the psychometric evaluation and item calibration across several countries:

- 2 web-surveys in the US (N=3660; aged 18-71 years)
- 1 web-survey in Japan (N=1618, aged 19-63 years)
- 1 web-survey in Italy (N=1623, aged 18-69 years)

Subsequent data from cross-sectional studies were used for assessing consumer risk perceptions of a novel heat-not-burn tobacco product (IQOS) and comparators (cigarettes, electronic cigarette, nicotine replacement therapy).

Analysis

- Comprehensive psychometric assessment using Rasch Measurement Methods (RMMs) from cross-national data.
- Inferential statistics to assess differences between subgroups of interest from cross-sectional studies.

Results

RMM psychometric evaluation supported the formation of an 18-item Perceived Health Risk scale and a 7-item Perceived Addiction Risk scale. In addition to the two unidimensional scales, two single items on Perceived Harm to Others (i.e., risk of secondhand smoke and risk for the unborn baby) were included as part of the Perceived Risk Instrument (PRI)™.

RMM analyses on Perceived Health Risk Scale

- Targeting: Person measurements are well covered with 87% of the breadth of perceived health risk observed in the cross-national sample (Figure 1)
- Reliability: Satisfactory person separation index (0.97)
- Appropriate 5-point response scale (no disordered thresholds) and all items had non-significant χ^2 values (Figure 2)
- Item Invariance: No differential item functioning (DIF) by smoking status, sex, age, education, country

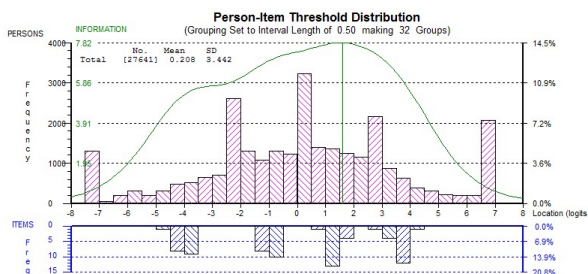


Figure 1: Person-Item Threshold Distribution of the Perceived Health Risk Scale showing matching of item thresholds (downwards) and respondents (upwards).

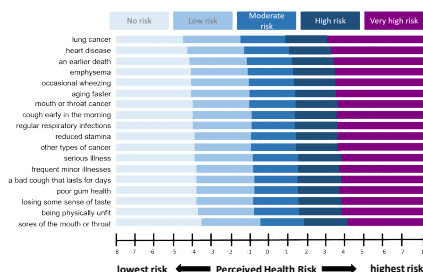


Figure 2: Threshold Map for all Items of the Perceived Health Risk Scale.

The 18 items of the Perceived Health Risk scale are ordered vertically from lowest to highest perceived health risk. Thus, a person endorsing degrees of health risk with the first item "having lung cancer", but "no risk" with all other items indicates low perceived health risk for this person. Alternatively, a person scoring "very high risk" to the last question ("having sores in the mouth or throat") indicates the highest level of perceived risk.

RMM analyses on Perceived Addiction Risk Scale

- Targeting: Person measurements are well covered with 79% of the breadth of perceived addiction risk observed in the cross-national sample (Figure 3)
- Reliability: Satisfactory person separation index (0.93)
- Suitability: Appropriate 5-point response scale (no disordered thresholds) and acceptable fit for all items (Figure 4)
- Item Invariance: No differential item functioning (DIF) by smoking status, sex, age, education, country

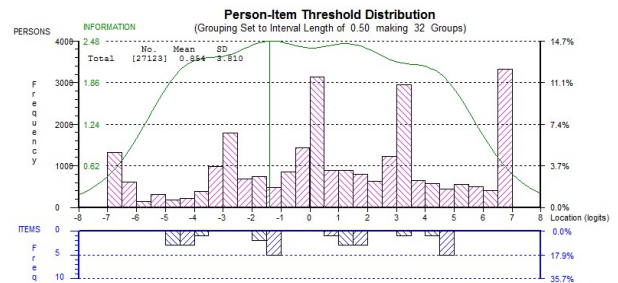


Figure 3: Person-Item Threshold Distribution of the Perceived Addiction Risk Scale showing matching of item thresholds (downwards) and respondents (upwards).

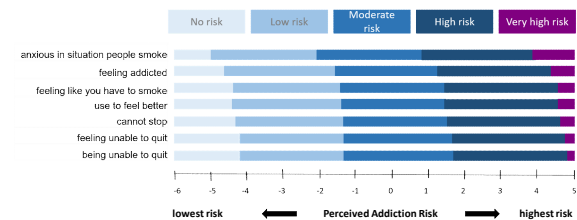


Figure 4: Threshold Map for all Items of the Perceived Addiction Risk Scale.

Examples of application of the PRI™

The use of RMMs to develop and test the scales of the PRI™ provides insight into how every possible score on the instrument is associated with the response categories (i.e., no risk, low risk, moderate risk, high risk, very high risk) on each item, lending concrete meaning to every score. In a recent cross-sectional study conducted by PMI and using the PRI to assess consumers' response to tobacco and nicotine-containing products [2], findings indicated that:

- Adult current and former smokers perceived cigarettes a high risk for health on all 18 items as opposed to adult never smokers who perceived cigarettes a very high risk for 7 items (lung cancer, heart disease, earlier death, emphysema, wheezing, aging faster, mouth throat cancer) and a high risk for the 11 remaining items (see Figure 5)
- Tobacco and nicotine products (i.e., cigarettes, electronic cigarettes, a novel heat-not-burn product (IQOS), and nicotine replacement therapy (NRT) products) could be differentiated on a continuum of perceived addiction risk, with cigarettes perceived high risk, IQOS and e-cigarettes a moderate risk and NRT products a low risk (Figure 6)

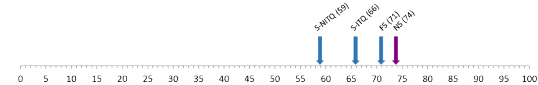


Figure 5: Illustration of comparison of smoking status groups mean scores on the "ruler" of the PRI Health Risk Scale for cigarettes. Data source: THS-PBA05-NOC-US study. Abbreviations: S-NITQ=smokers with no intention to quit smoking; S-ITQ=smokers with intention to quit smoking; NS=former smokers; NS=never smokers.

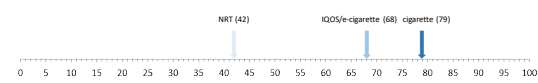


Figure 6: Illustration of comparison of tobacco and nicotine products mean scores on the "ruler" of the PRI Addiction Risk Scale. Data source: THS-PBA05-NOC-US study.

Conclusions

The PRI is a psychometrically robust instrument that may be used: (i) in clinical and population-based studies; (ii) for different types of tobacco and nicotine-containing products; and (iii) for different smoking status groups from various cultural background.

The ability to provide qualitative statements for each scale enhances the meaningfulness of scale scores and thus provides a clear base for the interpretation of the PRI™.

References:

- [1] Salzberger T, Chrea C, Cano S, Martin M, Atkinson M, Emilien G, Mainy N, Ramazzotti A, Weitkunat R, and Lüdike F. Perceived Risks associated with the Use of Tobacco and Nicotine-Containing Products: Findings from Qualitative Research. *Tobacco Science and Technology*, in press.
- [2] U.S. Food and Drug Administration, 2017. Philip Morris Products S.A. Modified Risk Tobacco Product (MRTP) Applications. (Retrieved October 17, 2017, from <https://www.fda.gov/TobaccoProducts/Labeling/MarketingandAdvertising/ucm546281.htm>).