Perceived acceptability towards self-sampling for Human Papillomavirus (HPV) using Rasch measurement model: study revisited

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Abstract. Self-sampling for Human Papillomavirus (HPV) among the community has not been extensively tested for its acceptability. The HPV self-sampling test could be widely used to compliment the conventional Pap smear test for cervical cancer screening if the community accept this method. This revisited study aims to investigate the response patterns of patients’ perceived acceptability towards self-sampling for HPV using the Rasch measurement model. A secondary survey data comprised of selected 158 female out-patients at an urban and rural health clinic were obtained from the previous HPV acceptability study. Respondent’s profiles were examined with respect to locality, race, total delivery and family history of cervical cancer. The results of the analysis are segmented into three parts - reliability and validity of the survey instrument, descriptive and exploratory analysis, and probabilistic outcome of issues that could affect the use of HPV self-sampling. Reliability index of the acceptability items was moderately good and upon validity checking of the items, reliability was further improved. Three issues (iss3, iss1, and iss2) were observed to be the most difficult to endorse or agree by the respondents. These relates to issues about ‘not being able to take a good sample’, ‘fear of dropping the brush/equipment to collect the sample’ and ‘worried about hurting oneself’. This study also found that highly educated Malay patients from the urban locality have higher probability outcomes of acceptability towards HPV self-sampling compared to patients from the rural locality.

1. Introduction
The National Cervical Cancer Guidelines 2003 recommends that all sexually active women age between 20 to 65 years should undergo Pap smear screening annually for two consecutive years, and if the Pap smear result is normal on both occasions, they can proceed with the screening test once every three years [1]. Although the benefits of cervical screening were extensively promoted by public healthcare provider, Malaysia’s Pap smear uptake is still low as compared to developed countries [2]. The key success of a screening programme really depends on the uptake [3]. The screening rate for
cervical cancer was as low as 43.7% in 2006, even though the screening rate was increasing (has increased) from 26% as reported in National Health and Morbidity Survey II, 1996 (NHMS II) [4]. It is still far from the goal standard of screening rate, which is 80% of coverage as currently achieved by developed countries. In order to increase the coverage and to overcome the barriers towards Pap smear screening, self-sampling for high-risk human papillomavirus (HPV) has introduced as alternative approach. The use of HPV self-testing has the potential to address barriers to screening and possible to reach women who at risk. HPV self-sampling significantly improved the participation of women who did not routinely attend cervical cancer screening programs [5]. At present, HPV self-sampling test is yet been used in Malaysia.

2. Literature Review

2.1. Acceptability on HPV self-sampling

There were some demographic differences in attitudes toward self-sampling in Asian women [3]. Study conducted by [6] among urban Malaysian women reported that about 70% of the participants prefer self-sampling over the pap smear test. Age, ethnicity and previous Pap test experience were found significantly associated with preference for self-sampling. Older women from Chinese ethnicity were less likely to prefer self-sampling. The use of self-sampling may lead to higher acceptability to screening [7]. This could also benefit women in Malaysian rural to perform screening for cervical cancer [8]. Qualitative study which was conducted by [9] among Muslim women in London found that most of the women preferred to see a clinician even though they acknowledged that self-sampling might overcome barriers to participation for cervical cancer screening. The study conducted among women in rural China found that the self-collection was highly acceptable and those self-collection and clinician collections were equally comfortable and convenient [10]. However, the participants still preferred clinician collection due to lack of trust on the self-collection’s result. Another study [11] conducted among urban and rural population in Madagascar highlighted that acceptability of self-sampling for HPV testing was similarly excellent for both groups despite their disparities in terms of socio-demographic factors and knowledge about cervical cancer.

2.2. Concepts of Rasch measurement model

Rasch model performs the assessment based on the response of a sample of respondents to a set of measurement scale. In Rasch, each person is categorized based on ability, while items are categorized based on difficulty. The categorization is resulted from the interaction between person ability and item difficulty, which utilizes log odd values. Rasch transform responses into log odd values based on the probability of success, which depends on the differences between person ability and item difficulty. The value enables the person ability and item difficulty to be mapped in a logit ruler. The mapping is based on two assumptions: 1) a more developed (or able) person has greater likelihood of endorsing all items, and 2) easier items have greater likelihood to be endorsed by all respondents. Based on these two assumptions, Rasch model predicts the location of items and persons in a map. The logit value to be mapped in a log ruler and it can be displayed as Person-Item Distribution Map (PIDM) or Wright Map. Other key concepts include summary statistics for person and item category, fit statistics, item characteristic curve and scalogram. Besides that, Rasch is also capable of analyzing the effectiveness of rating scale design [12,13].

Rasch Polytomous model was used to measure respondents’ perceived acceptability towards HPV self-sampling based on the data collected using the instruments. Perceived ability was measured using a 5-point Likert scale items ranging from (1) strongly disagree, to (5) strongly agree. The Rasch Polytomous model estimates the probability that a person will choose a particular response category or an item as:

\[
Pr\{X_{ni} = x\} = \frac{\exp \sum_{k=0}^{m} \beta_{nk} \exp \sum_{j=0}^{l} \beta_{nj} \exp \sum_{i=0}^{n-1} \beta_{ni} \exp \sum_{r=0}^{r-1} \beta_{nr}}{\sum_{k=0}^{m} \sum_{j=0}^{l} \sum_{i=0}^{n} \sum_{r=0}^{r} \exp \sum_{k=0}^{m} \beta_{nk} \exp \sum_{j=0}^{l} \beta_{nj} \exp \sum_{i=0}^{n-1} \beta_{ni} \exp \sum_{r=0}^{r-1} \beta_{nr}}
\]
Where $\delta_i$ is the difficulty of item $i$ and $\tau_k$ is the $k^{th}$ threshold location of the rating scale which is in common to all the items. $m$ is the maximum score and is identical for all the items. $\tau_0$ is chosen for computational convenience. The Rasch analysis places persons ($\beta_n$) and items ($\delta_i$) on the same measurement scale where the unit of measurement is the logit (logarithm of odds unit). The person’s likely score is defined by the interaction between the person’s measure, the item’s difficulty, and the score’s category threshold.

3. Methodology
The study used a secondary survey data through a study conducted by a group of researchers at the Department of Population Health and Preventive Medicine (PHPM), Faculty of Medicine, UiTM Shah Alam. The survey was held between April 2015 and March 2016 at selected health clinics which are divided into types of locality; urban and rural. The respondents comprised of eligible patients who fulfilled the inclusion criteria (female, aged 20 to 65 years old, Malaysian citizen, married women, non-pregnant) selected at random at the health clinic premises. However, in the revisited study, only 158 samples were selected. Respondents’ profiles were identified based on locality, race, total delivery and family history.

The instrument used was adopted from another study [14] and some modifications have been made to the instrument after several discussions with the experts and it has been pre-tested. The instrument of the acceptability towards HPV self-sampling was compartmentalized into three domains, namely, Perception, Best Aid and Issue. The Perception domain consists of 4 items, Best Aid domain consists of 4 items and Issue consists of 10 items. Figure 1 shows the validation and analysis process of the instruments and data in this study. These three dimensions will be subjected to validation using fit statistics, and Item Characteristics Curve (ICCs). Person and item reliability index and separation index will also be used in the measurement process. Fit statistics are portrayed based on item fit, person fit and also misfit for items and responses. Seven items from the Issue domain with negative statements were reversely coded. It is important and necessary to reverse code the negative statements so the results are not misinterpreted.

![Figure 1. Overview of validation and analysis process using Rasch measurement](image)

4. Results and Discussion
4.1. Reliability and Validity
Results in table 1 display good person reliability index at 0.77 and high item reliability index at 0.98. However, person reliability can still be improved by removing some misfit responses from the data. The mean fit and outfit for person and item mean squares are expected to be 1.00. From the findings, it shows that they are all close to 1.00. The mean standardized fit and outfit for persons are 0.2 and 0.1, respectively while for items are 0.0 and 0.5, respectively. The cut-off value for standard deviation
of the standardized infit is 2.00. The data shows an overall acceptable fit as the value for standardized infit standard deviation for person is 1.6, while for item is 1.2. The index of spread for the persons and items are measured by the separation index. In other words, the value of the item separation refers to the number of strata of item difficulties obtained in the questionnaire. Person separation index is about 2.00 and item separation index is at 6.68. Separation index of more than 2 is acceptable but not demeaning [15].

| Table 1. The summary statistics of the person ability and item difficulty (initial analysis). |
|---------------------------------------------------------------|
|                  | Infit MNSQ | ZSTD | Outfit MNSQ | ZSTD |
| PERSON            |            |      |            |      |
| Mean              | 1.07       | -0.2 | 1.08       | -0.1 |
| Standard Deviation | 0.61       | 1.9  | 0.68       | 1.7  |
| Separation        |            |      |            |      |
| Reliability       | 1.82       |      | 0.77       |      |
| ITEM              |            |      |            |      |
| Mean              | 1.01       | 0.0  | 1.09       | 0.5  |
| Standard Deviation | 0.24       | 2.3  | 0.36       | 2.8  |
| Separation        |            |      |            |      |
| Reliability       | 6.68       |      | 0.98       |      |

Item fit is analysed by considering the elements of the Point Measure Correlation (PTMEA Corr), the Outfit and Infit Mean Square and Z-standard. Figure 2 shows the item statistics for 20 survey items for acceptability towards HPV self-sampling. The Infit and Outfit Mean Square statistics are used to examine the content validity of the survey items [16]. According to [12], mean square (MNSQ) values which lies between 0.4 and 1.6 are productive for measurement. Based on Figure 2, all items except acc3 ‘To perform Pap smear, I have to be away from home or work’, have positive PMEA Corr with a small measurement standard error of +0.07 logit. The analysis also showed that the mean squares infit for most items are between 0.68 to 1.69 and mean square outfit lies between 0.67 and 2.28. Items acc3 and item aid1 were observed to have an outfit mean square value of 2.28 and 1.61, respectively. These are underfit items which are likely to be the agents of unusual or inappropriate response. Item acc3 was also found to have infit mean square value of 1.69.

Figure 2. Fit statistics for acceptability towards HPV self-sampling prior to removal of misfit responses.

Table 2 illustrates the summary statistics for patients’ acceptability towards HPV self-sampling before and after removal of misfit responses. Separation index shows an increasing value from 1.82 to 2.07. The indices indicate that person ability to response can be categorized into two levels of spread for the person ability. The initial person reliability index was estimated at 0.77, but after all misfit responses were removed, the reliability index improved to 0.81. As for summary statistics of items, the
fit statistics shows a slight improvement prior to removal of misfit responses. Overall item reliability index remained the same prior to removal of misfit responses. Items spread shows a slight increment from 6.68 to 6.99. Figure 3 shows the detail list of items with their respective logit measurement. It is observed that all items fulfil the requirement of [12] where mean square outfit and infit range (0.4 – 1.6) are accepted.

Table 2. Summary statistics for patients’ Acceptability towards HPV self-sampling before and after removal of misfit responses.

| PERSON         | Before removal of misfit response | After removal of all misfit response |
|----------------|-----------------------------------|-------------------------------------|
| MNSQ           | ZSTD                              | MNSQ                                |
| Mean           | 1.07                              | 1.07                                |
| Std Deviation  | 0.61                              | 0.58                                |
| Separation index | 1.82                         | 2.07                                |
| Reliability index | 0.77                          | 0.81                                |

| ITEM         | MNSQ | ZSTD | MNSQ | ZSTD |
|--------------|------|------|------|------|
| Mean         | 1.01 | 0.0  | 1.01 | 0.0  |
| Std Deviation | 0.24 | 2.3  | 0.21 | 2.0  |
| Separation index | 6.68 | 6.99 | 6.68 | 6.99 |
| Reliability index | 0.98 | 0.98 | 0.98 | 0.98 |

Figure 3. Fit statistics after removal of misfit responses.

4.2. Person and Item Distribution Map (PIDM)

Figure 4 shows the PIDM of acceptability towards HPV self-sampling after removal of misfit responses. The top right of the PIDM shows the item that is most difficult to endorse which relates to iss3 ‘I am concerned about not being able to take a good sample.’ at 1.19 logit on the upper scale, while the easiest item to endorse relates to item aid1 ‘Getting assistance with the procedure from the healthcare personnel’ with measurement at -0.95 logit on the lower scale.
There are about 6.4% respondents who indicated a high level of perceived acceptability towards HPV self-sampling. The profiles of respondents who have high level of acceptability are Malays living in urban locality, no family history of cervical cancer and most gave birth to 3 or less children. Meanwhile, there are less than 16.5% of respondents considered as having low level of acceptability towards HPV self-sampling and this include two persons who did not endorsed all items regarding perceived acceptability towards HPV self-sampling. The profiles of these persons are non-Malay, live...
in urban locality and no family history of cervical cancer. The three items which are most difficult to endorse relates to iss3, iss1 and iss2, located on the upper scale. There are about 11 items which are located below the item mean logit 0.00. Overall, about 31% respondents are able to endorse items related to perceive acceptability towards HPV self-sampling since they are located above the person mean logit at 0.32.

4.3. Probabilistic Outcome
Probability values represent the endorsement of items for acceptability towards HPV self-sampling which comprise of all items from the perception, best aid and issues domains. For person measure, low negative logit indicates that the respondents are less acceptable to HPV self-sampling while high positive logit indicates that the respondents are more acceptable to HPV self-sampling. As for item measure, negative logit represents items which are easy for respondents to endorse while high positive logit indicates that item are more difficult for respondents to endorse.

Respondent 82UMd1N (a Malay from the urban locality, gave birth to 3 or less children and has no family history of cervical cancer) was most acceptable to HPV self-sampling with a logit of 3.1. It can be seen that this respondent was consistently endorsing all items. Respondent 44UCd1N (Chinese from the urban locality, gave birth to 3 or less children and has no family history of cervical cancer) was considered as the least acceptable to HPV self-sampling with a logit of -2.52. It can be seen that the respondent was consistently not endorsing all items. Items iss3, iss1, and iss2 were observed to be the most difficult items to endorse by the respondents. Meanwhile, items aid1, iss6 and iss8 were found to be the least difficult to endorse. Since Issue domain had the most problematic responses, we extracted all issue items to determine the probabilistic outcome for issues that could affect the use of HPV self-sampling.

4.3.1 Probabilistic outcome for issues that could affect the use of HPV self-sampling
In summary, only 1.2% (two Malay respondents from urban locality, have no family history of cervical cancer) were more likely to endorse items iss1, iss2 and iss3 about 80% of the time. About 93% of respondents have less than 50% probability of endorsing iss3 ‘I am not concerned about not being able to take a good sample’. Item iss6 ‘I believe in modern medicine’ was found to be the easiest item to endorse since 41.8% (66) of the respondents are more likely to endorse the item more than 80% of the time. This is followed by item iss8 ‘I want to help improve health care for women’ where 24.7% (39) of the respondents are more likely to endorse the item more than 80% of the time.

5. Conclusion
Generally, the results show a good person reliability index and a high item reliability index. Person reliability have been improved by removing some misfit responses. However, differences were noted for subpopulation. For future improvement, items with negative PTMEA and out of range outfit and infit mean squares should be subjected to a more stringent validation. The possibility of adding new domain and items in order to uncover more responses on perceived acceptability towards HPV self-sampling is expected. In order to further examine and validate the profiles of those who rejected the HPV self-sampling, we could select other subsamples from other localities with similar characteristics in order to examine the consistency of the findings.

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References

[1] Ministry Of Health Malaysia 2003 Clinical Practice Guidelines on Management of Cervical Cancer April 2003. P/ PAK/60.03 (GU)

[2] Wong L P, Wong Y L, Low W Y, Khoo E M and Shuib R 2009 Knowledge and awareness of cervical cancer and screening among Malaysian women who have never had a Pap smear: A Qualitative Study Singapore Medical Journal 50(1) 49

[3] Waller J, McCaffery K, Forrest S, Szarewski A, Cadman L, Austin J and Wardle J 2006 Acceptability of unsupervised HPV self-sampling using written instructions Journal of Medical Screening 13(4) 208-213

[4] National Health and Morbidity Survey II (NHMS II) 1996 Pap smear examination. Vol 19 Kuala Lumpur: Institute of Public Health, Ministry of Health, Malaysia 1997

[5] Racey C S, Withrow D R and Gesink D 2013 Self-collected HPV testing improves participation in cervical cancer screening: a systematic review and meta-analysis Can J Public Health 104(2) 159-166

[6] Ma’som M, Bhoo-Pathy N, Nasir N H, Bellinson J, Subramaniam S, Ma Y and Woo Y L 2016 Attitudes and factors affecting acceptability of self-administered cervicovaginal sampling for human papillomavirus (HPV) genotyping as an alternative to Pap testing among multiethnic Malaysian women. BMJ open 6(8) e011022

[7] Gok M, Heideman D A M, van Kemenade F J, de Vries A L M, Berkhof J, Rozendaal L, et al. 2012 Offering self-sampling for human papillomavirus testing to non-attendees of the cervical screening programme: characteristics of the responders Eur J Cancer 48 1799–1808

[8] Latiff L A, Ibrahim Z, Pei C P, Rahman S A and Akhtari-Zavare M 2015 Comparative assessment of a self-sampling device and gynecologist sampling for cytology and HPV DNA detection in a rural and low resource setting: Malaysian experience Asian Pacific Journal of Cancer Prevention 16(18) 8495-501

[9] Szarewski A, Cadman L, Ashdown-Barr L and Waller J 2009 Exploring the acceptability of two self-sampling devices for human papillomavirus testing in the cervical screening context: a qualitative study of Muslim women in London. Journal of Medical Screening 16(4) 193-198

[10] Guan Y, Castle P E, Wang S, et al. 2012 A cross-sectional study on the acceptability of self-collection for HPV testing among women in rural China. Sex Transm Infect. 88 490-494

[11] Broquet C, Triboullier D, Untiet S, Schafer S, Petignat P and Vassilakos P 2015 Acceptability of self-collected vaginal samples for HPV testing in an urban and rural population of Madagascar Afri Health Sci. 15(3) 755-761 doi: http://dx.doi.org/10.4314/ahs.v15i3.8

[12] Bond T G and Fox C M 2007 Applying the Rasch Model Fundamental Measurement in the Human Sciences 2nd edition

[13] Azrilah A A, Mohd S M and Azami Z 2013 Asas Model Pengukuran Rasch Pembentukan Skala & Struktur Pengukuran Bangi: Penerbit UKM

[14] Tisci S, Shen Y H, Fife D, Huang J, Goycoolea J, Ma C P and Qiao Y L 2003 Patient acceptance of self-sampling for human papillomavirus in rural China Journal of Lower Genital Tract Disease 7(2) 107-116

[15] Linacre J M 2015 Test validity, and Rasch measurement: Construct, content, etc. Rasch Measurement Transactions Retrieved at http://www.rasch.org/rmt/rmt162fhtm.

[16] Royal K D and Elahi F 2011 Psychometric properties of the Death Anxiety Scale (DAS) among terminally ill cancer patients Journal of Psychosocial Oncology 29(4) 359-71