







BMJ Open Revalidation and adaptation of the Menstrual Practice Needs Scale (MPNS) in a cross-sectional survey to measure the menstrual experiences of adult women working in Mukono District, Uganda

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ABSTRACT

Objectives The Menstrual Practice Needs Scale (MPNS) is a comprehensive measure of menstrual self-care experience including access to sufficient, comfortable materials to catch or absorb bleeding, supportive spaces for managing menstruation and for disposal and laundering of used materials. It addresses a critical measurement gap to improve quantitative menstrual health research and programme evaluation. The scale was validated in a population of adolescent schoolgirls. This study appraises its performance among adult women.

Design Cross-sectional survey.

Setting and participants Seven cognitive interviews provided insights into the interpretability of scale items. A survey of 525 working women who had menstruated in the past 6 months (435 working in markets, 45 in schools and 45 working in healthcare facilities) in Mukono District, Uganda was used to test the dimensionality, reliability and validity of the measure.

Results The 36 scale items were well understood by the study population. Dimensionality was tested for the 28 items relevant to women disposing of menstrual materials and 32 items relevant to those washing and reusing materials. The original subscale structure fit with the data, however, fell short of recommended thresholds for those disposing of materials (root mean squared error of approximation, RMSEA=0.069; Comparative Fit Index, CFI=0.840; Trucker-Lewis Index, TLI=0.824). An alternative subscale structure was an acceptable fit for those disposing (RMSEA=0.051; CFI=0.911; TLI=0.897) and reusing materials (RMSEA=0.053; CFI=0.915; TLI=0.904). MPNS total and subscale scores demonstrated acceptable internal consistency. Higher scores reflected more positive menstrual experiences and were associated with well-being (total score $r=0.24$, $p<0.001$), not missing work due to the last menstrual period (total score OR=2.47 95% CI 1.42 to 4.30) and confidence to manage menstruation.

Conclusions The MPNS offers a valid and reliable way to assess menstrual health needs. The revised factor structure can be used for samples of adult workers.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Reliability and validity of the Menstrual Practice Needs Scale (MPNS) were assessed in a large sample of adult working women.
- ⇒ Cognitive interviews were used to appraise the interpretability and acceptability of scale items and ensure a high-quality study survey.
- ⇒ Systematic sampling proportional to the population of women working in all eligible markets in Mukono district balanced rigour and feasibility in sampling.
- ⇒ The variety of menstrual practices undertaken meant not every MPNS item was relevant to all respondents.
- ⇒ There remain few validated measures of menstrual experience against which to test convergent or divergent validity.

Findings also highlight challenges in assessing the variety of experiences relevant to managing menstrual bleeding.

INTRODUCTION

Efforts to improve menstrual health have rapidly grown around the globe.¹⁻³ Governments, UN agencies and civil society organisations have recognised the importance of menstruation in the lives of women, girls and all people who menstruate, and the need to address menstrual health to achieve the Sustainable Development Goals.⁴⁻⁶ To support these objectives, a growing body of evidence is emerging to understand menstrual health needs and investigate programme effectiveness.⁷⁻¹⁰ However, more research is needed and funding has been scarce.^{8 11 12} Quantitative studies have been limited by a lack of high-quality measurement

tools.^{6 13 14} Systematic review and audit of the field found inconsistent and ad hoc measures were often used, and concepts for measurement poorly defined.¹³ In response, recent efforts have sought to develop measures for core constructs,^{15–19} and identify indicators and measures for consistent use in research and monitoring.^{14 20}

The Menstrual Practice Needs Scale (MPNS) was developed to capture respondents' experiences of managing their menstrual bleeding.¹⁵ The measure was informed by a systematic review and synthesis of qualitative research across low-income and middle-income countries (LMICs), which found women's and girls' perceptions of their menstrual management practices and environments to be a crucial component of their menstrual experience.⁷ Items in the MPNS were drawn from participant narratives reported across studies in the review. This included participants' perceptions about their access to and quality of menstrual materials, the availability and security of disposal and storage options, comfort transporting and storing materials, and perceived accessibility, cleanliness, privacy, and safety of menstrual management environments. The MPNS is aligned with the requirements for achieving menstrual health outlined in the recently published menstrual health definition, including that: all people who experience a menstrual cycle are able to 'care for their bodies during menstruation such that their preferences, hygiene, comfort, privacy and safety are supported.'³ The MPNS provides a self-reported, quantitative measure of this requirement.

The MPNS was validated in a population of adolescent schoolgirls in Soroti, Uganda and administered in Ateso, a regional Ugandan language.¹⁵ A final 36-item measure with six subscales was developed. Subscales had adequate reliability, and validity was established through hypothesised associations with girls' reported confidence to measure menstruation, self-reported school absenteeism and well-being, and known groups comparing disposable pad users and non-users.¹⁵ To the best of our knowledge, the performance of the measure has not been tested in other languages or population groups such as adult women.

Menstrual health research and practice in LMICs has focused on adolescent girls as a priority population for supporting menstrual health and education at this critical developmental stage.^{21 22} However, menstrual needs continue into adulthood and there is increasing recognition of their importance.^{3 23–25} Studies highlighting unmet menstrual needs among adult women are emerging, finding that women report consequences for their health, well-being, participation at work and uptake and continued use of contraceptive methods.^{26–29} While the items included in the MPNS were designed to be applicable to adult women, the performance of the measure in this population is untested.

The present study

In this study, we used cognitive interviews and a cross-sectional survey among women working in Mukono

District, Uganda to test the acceptability, dimensionality, validity and reliability of the MPNS among an adult sample. Findings will inform the use of the measure in this population.

METHODS

This study uses data collected as part of a larger exploratory sequential mixed-methods study aiming to understand the sanitation and menstrual experiences of adult women working in Mukono District, Uganda.²⁶ The Strengthening the Reporting of Observational Studies in Epidemiology checklist³⁰ is included as online supplemental materials 1. The quantitative survey data related to this publication is available on the study Open Science Framework page to support replicability.³¹

Study sample

The population were adult women aged 18–45 working in markets, government primary schools and public healthcare facilities (HCFs) in the Mukono district. In collaboration with the local government, we identified all markets in the district operating for at least 8 hours per day and 3 days per week (n=10). In markets, women were systematically sampled proportional to the estimated population of female workers based on site observations and advice from market leaders. Enumerators mapped and sampled 50% of the population in each market, and 20% in the largest market in the municipality to ensure sufficient experiences from smaller markets were captured. Women were eligible for participation if they worked at least 3 days per week over the last month, ineligible women were replaced by the next eligible worker. We sampled teachers and HCF workers at the sites in closest geographic proximity to the markets, surveying 5 for each market to reach a total of 50 teachers and 50 HCF workers. Where there were less than five eligible participants at the closest school or HCF we continued to the next until the sample size was reached. Teachers and HCF workers were sampled based on their availability.

The sample size was designed for power and precision to estimate the prevalence and impacts of unmet sanitation and menstrual needs on health and work participation. For the purposes of revalidating the MPNS, our sample exceeded the recommended 10 participants per survey item, requiring 360 participants for the 36-item scale.³²

Cognitive interviews

Seven, hour-long cognitive interviews were undertaken to test the interpretability of the survey, including the MPNS items. Participants were purposively sampled and included six women from markets spread from ages 20–43 and one teacher. Interviews were undertaken in February 2020. Participants were asked to 'think aloud' or explain their answer, to anticipate the type of responses other women may provide, or to reframe the question in their own words.

Interviews were conducted by JB and PN, with JH supporting two interviews. Interviewers made written notes on printed copies of the survey, including notable quotations.

Data collection

Surveys were conducted in March 2020 by a team of 10 female enumerators. Enumerators were university graduates and had prior experience administering surveys on sexual and reproductive health and water, sanitation and hygiene topics and received 5 days of training. Questions were delivered verbally in Luganda or English, and answers entered into the survey using Open Data Kit (ODK) loaded on smartphones. Survey data was uploaded to the secure cloud server, removing it from the smartphone, at the end of each day of data collection to protect participant confidentiality. Participants provided written consent for survey or cognitive interview. Interviews and surveys were undertaken with auditory, and if possible, visual privacy. Surveys lasted 45–60 min, and participants received a bar of soap in appreciation for their participation.

Measures

Survey measures were developed in English and translated to Luganda by bilingual researchers (JB, SPSK, PN) along with back-translation. The full survey is available on the project page: www.osf.io/nzjtq.

MPNS.¹⁵ All MPNS items ask respondents about experiences during their last menstrual period. The interview version of the scale was used, and questions are displayed in results tables. Participants responded on a 4-point scale: Never, Less than half the time, More than half the time, Always. This alternative to the original 'Never, Sometimes, Often, Always' response options was drawn from the WHO-5 scale^{33 34} with the aim of achieving more balanced distribution across middle responses. Positively scored items included questions about participant satisfaction or comfort, for example, 'During your last menstrual period, could you get more of your menstrual materials when you needed to?' and were scored from 0 (never) to 3 (always), and negatively scored items asked about participant insecurities, for example, 'When at home during your last period, were you worried that someone would see you while you were changing your menstrual materials?' scored from 3 (never) to 0 (always). This question construction avoids double negatives which may result in translation or response errors. All items were positively scored in ODK, with reverse scoring applied during analysis to avoid errors. Total and subscale scores were calculated as a mean score for all relevant items with higher scores representing more positive experiences. Where respondents indicated questions were not applicable (eg, those who did not dispose of any materials or did not attend work during menstruation) the total score reflects the mean of relevant questions, subscales are not calculated where more than one item was not applicable to the respondent.

Demographics and menstrual practices

Demographic questions captured participant age, role at their workplace, level of education and marital status. Poverty was assessed using five items from the Afrobarometer lived poverty index³⁵ scored on a 5-point response scale asking how often over the past 12 months participants' household went without food, water, medicines, fuel for cooking or a cash income. A total score across the five index items was calculated with a lowest possible score of 0 and maximum 20, with higher scores representing greater poverty.

Menstrual practices were captured using items from the Menstrual Practices Questionnaire.³⁶ We describe the practice profile of the sample using the core items suggested for report in menstrual health research including the type of material used, frequency of change and change and disposal locations.³⁶

Mental health

Psychological well-being was assessed using the WHO Well-being Index (WHO-5).³³ The measure has been used across contexts with high validity. Responses were indicated across the 6-point response scale with raw scores from 0 to 25 multiplied by 4 to give a total score from 0 to 100, with higher scores indicating greater well-being.

Confidence to manage menstruation

Participants were asked 'How confident do you feel that you can manage your menstruation [pad yourself, change your materials, dispose of them or wash and dry them] when you are at home/during your work day?' with four response options form 'very unconfident' to 'very confident'. Dichotomous variables were used for analysis with 'very confident' and 'not very confident' used for home confidence, and 'confident' and 'not confident' for work.

Work absenteeism

Participants were asked 'Did you miss work due to your last menstrual period?', with Yes/No responses used dichotomously to capture absenteeism due to menstruation.

Analysis

Analyses were undertaken using Stata V.15 and R V.4.1.0. Descriptive statistics highlight item responses. Confirmatory factor analysis (CFA) using the *lavaan* package³⁷ in R was undertaken using a robust diagonally weighted least squares estimator (DWLS). DWLS requires complete data. Participants who had not disposed of any menstrual materials did not have responses for items 11–14. Factor structure was thus investigated separately for those who reused materials, and for those who disposed of materials. Forty-four women did not attend any days of work during their last menstrual period or did not change their menstrual materials during the workday. As these participants had missing responses to MPNS items 24–28 they were excluded from CFAs. Consistent with current guidance, we considered a root mean squared error of approximation (RMSEA) ≤ 0.05 as indicative of a close fit and RMSEA ≤ 0.08 as indicative of a fair fit.^{38 39} We

considered Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) ≥ 0.95 as indicative of a close fit and ≥ 0.90 as an acceptable fit.³⁸ Robust estimates are presented. Finding near acceptable but not close fit for the previously validated factor structure, we investigated an alternative structure. This included inspection of the polychoric correlation matrix and exploratory factor analysis (EFA) with oblique rotation (*promax*), along with investigating model fit through examination of factor loadings, residual correlations and modification indices.

We present internal consistency for the original and revised scales calculated using polychoric correlations to provide an ordinal alpha (α_{ordinal}) as appropriate for the four-item response scale,⁴⁰ using 0.70 as indicative of satisfactory reliability. We also provide Cronbach's alpha for comparison.

Validity was tested through hypothesised relationships with lived poverty, well-being, confidence to manage menstruation at home and work, and self-reported work absenteeism tested using Pearson's correlation coefficients

and binary logistic regressions. We also compared scores between worker groups and women using commercially produced disposable or reusable pads compared with those using other improvised materials.

RESULTS

Cognitive interviews

Seven women participated in cognitive interviews, two had some primary school education, three had secondary education, and two had tertiary education. All participants reported that questions capturing menstrual experiences were acceptable when asked by a female interviewer. MPNS items were well comprehended, including the four-point response scale administered verbally. During cognitive interviews participants explained why they gave their answer. These explanations made clear that participants had interpreted the scale items in the way the authors intended. Selected verbatim explanations of item responses are displayed in [table 1](#). These explanations

Table 1 Selected quotations from cognitive interview participants explaining their response selection.

MPN1 During your last menstrual period, were your menstrual materials comfortable?	More than half of the time. "I didn't have enough so had to stay longer [before changing] and it became uncomfortable."
MPN2 During your last menstrual period, did you have enough of your menstrual materials to change them as often as you wanted to?	More than half of the time. "When I have to, I hold back a bit, because I think it's expensive"
MPN4 During your last menstrual period, could you get more of your menstrual materials when you needed to?	Participant noted that less than 'always' response would be if she "can't get home or to the store to buy"
MPN5 Were you worried that your menstrual materials would allow blood to pass through to your outer garments?	Always. "I have a heavy flow, so I am always worried that my pad might overflow"
MPN9 Did you feel comfortable carrying menstrual materials to the place where you changed them?	Less than half the time "Fear that other women or people in the market will know that I am in periods"
MPN20 When at home during your last period, were you worried that someone would see you while you were changing your menstrual materials?	Never. "I always change before my husband comes home, I am never worried because I know his schedule"
MPN20 When at home during your last period, were you worried that someone would see you while you were changing your menstrual materials?	Never. "I'm not bothered. I have my own room and I'm not worried about my husband seeing me" However, this participant noted that when washing her materials, she is worried about privacy. The bathroom is near the bedroom and then she worries that her husband will see her.
MPN35 During your last menstrual period, were you worried that your menstrual materials would not be dry when you needed them?	"You may wash them and hang them whenever you want, but they will not necessarily be dry when you want" "So yes, I was always worried they would not be dry when I needed them"(despite reporting she could 'always' dry her materials when she wanted to).
MPN36 During your last menstrual period, were you worried that others would see your menstrual materials while they were drying?	"Yes, always. Even sometimes you dry and then you cover"(due to being worried that other people would see drying materials).

also provide examples of the variety of circumstances that impact on women's experiences of managing menstrual bleeding, and thus their responses to the MPNS items.

One item (MPN 10) was amended based on cognitive interview feedback from 'Did you feel comfortable storing your menstrual materials until your next period?' to 'Did you feel comfortable storing [keeping] your leftover or cleaned menstrual materials until your next period?' for clarity.

Two further insights were fed back through enumerators administering the survey. First, that some women expressed the sentiment that no one had ever asked them about their satisfaction or insecurities around their menstrual management practices before and thus needed time to consider their answers. This was consistent with the findings from the qualitative research undertaken as part of the broader research programme²⁶ which found that women prioritised cleanliness and secrecy in menstrual management, regardless of discomforts endured. Second, some women felt there were too many scale items, with duplicated items asking about experiences at home and at work taking too long to complete.

Survey participants

A total 600 adult women participated in the Women and Workplaces survey, this included 500 women working in markets, 50 teachers and 50 healthcare facility staff members. Of these participants, 87.5% had menstruated in the past 6 months and were eligible to answer questions about their menstrual experience. For this study, a total 525 participants, including 435 working in markets, 45 in HCFs and 45 working in schools were included.

Sample ages ranged from 18 to 45 years with a mean of 30.6. A total 35.8% of the sample had attended primary or no school, 46.5% had attended secondary school, and 17.7% had postsecondary training. Most of the sample (80.7%) identified as Christian, with the remaining 19.2% identifying as Muslim. A total 60.8% were currently married or cohabitating.

The median number of working days was 6, with 28.6% of women working 6 days and 41.5% working 7 days a week. On days worked, participants reported spending a median 12 hours at the workplace.

As menstrual material, women reported most often using disposable pads (70.6% at work, 68.6% at home), followed by cloth (16.5% at work, 18.3% at home) and reusable pads (8.2% at work, 7.6% at home) with the final 4.7% at work and 5.52% at home using other materials such as toilet paper, cotton or underwear alone during their last period. At home, most women disposed of used materials into latrines (80.5%) and approximately one-third (27.6%) washed and reused materials during their last period. Most women reported changing menstrual materials three times in 24 hours on the heaviest day of their period (49.8%), with others changing twice (28.8%) or four times (13.9%). When at home during their last period, most women changed their menstrual materials in their bedroom (42.2%), followed by the latrine (20.5%).

While at work, most participants (61.4%) changed in the sanitation facility, while others reported most often going home to change (26.4%) or using a bathroom or other location at work (12.2%).

Item responses

Table 2 displays participant responses to each MPNS item. Item means, SD, skew and kurtosis are included in online supplemental materials 2. Many women reported positive menstrual management experiences, particularly at home. Environments at work were rated more poorly, and many women reported insecurities around their menstrual practices at least some of the time. Approximately 20% of respondents did not dispose of any menstrual materials during their last period, consistent with the proportion using reusables. An error in ODK coding meant that 42 women were not asked item 28 and have missing data. Approximately 8% of respondents reported that they did not ever change their menstrual materials during the workday or did not attend any work during their last period, resulting in a reduced sample of women responding to items 23–28.

Dimensionality

Table 3 displays the factor loadings and robust model fit statistics for the original MPNS structure. The original four-factor structure for those disposing of menstrual materials during the last period showed a fair fit for the data based on absolute fit test (RMSEA=0.069, 90% CI 0.064 to 0.075) but unacceptable fit based on tests comparing to a null model (CFI=0.840, TLI=0.824). Sensitivity analyses excluding item 28 where cases had missing data due to a skip error allowed us to test the structure in the larger sample of 371 but did not change the findings (RMSEA=0.073, 90% CI 0.068 to 0.078; CFI=0.844; TLI=0.828). The full six-factor structure was a fair fit for the data based on absolute and comparative fit statistics for those who reused materials (RMSEA=0.052, 90% CI 0.040 to 0.063; CFI=0.922; TLI=0.913) and the two-factor solution for the reuse items alone showed good fit (RMSEA=0.050 90% CI 0.00 to 0.094; CFI=0.984; TLI=0.977).

Based on the fit statistics and visual inspection of the polychoric correlation matrix, we explored an alternative factor structure. We observed correlations between all disposal-related items (items 12, 13, 14 and 15) and noted the challenges in assessing fit for those who did not dispose of any materials. Scree plot, eigenvalue and factor loadings on an EFA undertaken on these items alone suggested a one-factor solution to be a good fit. In testing the internal consistency of this scale, we found that reliability was improved with the removal of item 12.

In testing the adequacy of the remaining items for EFA, very high correlations between items capturing satisfaction with, and cleanliness of, the sanitation facilities at home (items 17 and 18 correlated 0.80) and at work (items 24 and 25 correlated 0.89) were identified. We also found that high endorsement of item 21, with

Table 2 Participant responses to MPNS-36 items (n=525)

No. item	Never %	Less than half %	More than half %	Always %	NA % (n)	Missing % (n)
1. Were your menstrual materials comfortable?	3.24	11.81	14.86	70.10		
2. Did you have enough of your menstrual materials to change them as often as you wanted to?	1.71	8.76	13.52	76.00		
3. Were you satisfied with the cleanliness of your menstrual materials?	1.53	4.58	11.83	82.06		0.19 (1)
4. Could you get more of your menstrual materials when you needed to?	2.29	11.62	13.52	72.57		
5. Were you worried that your menstrual materials would allow blood to pass through to your outer garments?	36.19	26.86	18.10	18.86		
6. Were you worried that your menstrual materials would move from place while you were wearing them?	50.67	22.18	9.75	17.40		0.38 (2)
7. Were you worried about how you would get more of your menstrual material if you ran out?	60.76	18.86	12.76	7.62		
8. Did you feel comfortable carrying spare menstrual materials with you outside your home?	18.15	12.36	14.48	55.02		1.33 (7)
9. Did you feel comfortable carrying menstrual materials to the place where you changed them?	12.57	14.12	14.51	58.8		1.52 (8)
10. Did you feel comfortable storing [keeping] your leftover or cleaned menstrual materials until your next period?	6.29	4.38	5.90	83.43		
11. Were you able to wash your hands when you wanted to?	2.48	6.10	8.38	83.05		
12. Were you able to immediately dispose of your used menstrual materials?	4.08	6.24	10.55	79.14	20.19 (106)	0.38 (2)
13. Were you able to dispose of your used materials in the way that you wanted to?	5.29	6.73	10.82	77.16	20.76 (109)	
14. Were you worried about where to dispose of your used menstrual materials?	70.38	10.9	6.40	12.32	19.62 (103)	
15. Were you concerned that others would see your used menstrual materials in the place you disposed of them?	65.18	12.72	7.81	14.29	14.48 (76)	0.19 (1)
16. When at home, were you able to change your menstrual materials when you wanted to?	0.57	1.90	5.71	91.81		
17. When at home, were you satisfied with the place you used to change your menstrual materials?	0.57	2.86	9.52	87.05		
18. When at home, did you have a clean place to change your menstrual materials?	0.57	2.10	7.82	89.5		0.19 (1)
19. When at home, were you worried that you would not be able to change your menstrual materials when you needed to?	85.71	7.05	2.86	4.38		
20. When at home, were you worried that someone would see you while you were changing your menstrual materials?	78.86	10.48	4.95	5.71		
21. When at home, were you worried that someone would harm you while you were changing your menstrual materials?	92.38	4.38	1.52	1.71		
22. When at home, were you worried that something else would harm you while you were changing your menstrual materials (eg, animals, unsafe structure)?	90.48	7.05	1.14	1.33		
23. When at work, were you able to change your menstrual materials when you wanted to?	3.52	16.15	13.66	66.67	8.00 (42)	
24. When at work, were you satisfied with the place you used to change your menstrual materials?	14.85	18.85	12.34	53.97	8.76 (46)	0.19 (1)
25. When at work, did you have a clean place to change your menstrual materials?	13.93	20.79	13.31	51.98	8.38 (44)	

Continued

Table 2 Continued

No. item	Never %	Less than half %	More than half %	Always %	NA % (n)	Missing % (n)
26. When at work, were you worried that you would not be able to change your menstrual materials when you needed to?	53.00	19.25	16.15	11.59	7.43 (39)	0.57 (3)
27. When at work, were you worried that someone would see you while you were changing your menstrual materials?	59.38	11.96	11.96	16.70	7.62 (40)	
28. When at work, were you worried that someone would harm you while you were changing your menstrual materials?	80.94	8.74	4.71	5.61	7.05 (37)	8.00 (42)*
Among those reusing menstrual materials (n=145)						
29. Did you have enough water to soak or wash your menstrual materials?	0.69	3.45	18.62	77.24		
30. Did you have access to a basin or bucket to soak or wash your menstrual materials whenever you needed it?	0.00	2.07	12.41	85.52		
31. Were you able to wash your menstrual materials whenever you wanted to?	4.14	11.72	17.24	66.90		
32. Did you have enough soap to wash your menstrual materials?	0.69	8.97	17.93	72.41		
33. Were you able to dry your materials when you wanted to?	6.90	11.72	24.14	57.24		
34. Were you worried that someone would see you while you were washing your menstrual materials?	53.10	17.24	13.10	16.55		
35. Were you worried that your menstrual materials would not be dry when you needed them?	52.41	22.07	20.69	4.83		
36. Were you worried that others would see your menstrual materials while they were drying?	48.97	17.24	14.48	19.31		
Values in italics report the proportion of the sample missing or not applicable, these are not included in the percentages presented for item responses.						
*These participants were missing due to a skip pattern error during data collection.						
MPNS, Menstrual Practice Needs Scale; NA, not applicable.						

most women ‘never’ worried they would be harmed when changing their menstrual materials at home resulted in a not positive definite matrix. We removed items 18 and 25, retaining only 17 and 24, and removed item 21. The Kaiser-Meyer-Olkin (KMO) sampling adequacy was then adequate (KMO=0.66). EFA suggested a three-factor solution, grouping items related to experiences in the workplace, material and home needs, and material and home environment insecurities. Item 11 (handwashing) loaded across multiple new subscales (home, home insecurity and workplace needs) and was removed. Item 8 was weakly loaded on the workplace factor (0.35) and was removed.

While the proportion of women who feared someone would harm them while changing their menstrual materials at home was low (item 21), for those who did report fear this is a priority concern and content validity would be reduced by removing this item. One negative polychoric correlation was observed, between item 21 (fearing for safety at home) and item 16 (being able to change whenever the respondent wanted to) (polychoric correlation=-0.30). Item 16 was removed in favour of item 21 to resolve the issue. To preserve balance across the number of items relating to different parts of menstrual experience, we removed item 7,

which also cross-loaded on insecurity and home needs scales, along with item 30 as the reuse item with the weakest loading.

The revised factor structure, loadings and model fit statistics are displayed in table 4. We found the revised subscales were a good fit for the data among those disposing of materials and those reusing materials. We also noted that our CFIs were constrained by a high performing null model (with a RMSEA=0.160), with a null RMSEA of 0.158 rendering comparative fit statistics unable to exceed 0.90.⁴¹ Visual inspection of the polychoric correlation matrix suggests the well performing null model this was driven by low correlations between items regarding home changing facilities and those capturing concerns at work, as well as worries about the performance of menstrual materials and items capturing satisfaction with the environment at home. This was consistent with the subscale structure and our understanding of menstrual experiences.

The revised scale includes a total 28 items: 21 items for those who did not reuse any materials, and 25 items for those who reused but did not dispose of any items.

Subscales were all positively correlated (correlations displayed in online supplemental materials 2).

Table 3 Confirmatory factor analysis (CFA) standardised factor loadings and model fit statistics for the original four and two factor structure

No. item	CFA for those disposing of materials	CFA for those reusing materials	CFA for only reuse items
N	N=335	N=125	N=145
Material and home environment needs			
1. Were your menstrual materials comfortable?	0.415	0.580	
2. Did you have enough of your menstrual materials to change them as often as you wanted to?	0.704	0.693	
3. Were you satisfied with the cleanliness of your menstrual materials?	0.551	0.675	
4. Could you get more of your menstrual materials when you needed to?	0.707	0.851	
10. Did you feel comfortable storing [keeping] your leftover or cleaned menstrual materials until your next period?	0.501	0.759	
11. Were you able to wash your hands when you wanted to?	0.603	0.614	
12. Were you able to immediately dispose of your used menstrual materials?	0.522	–	
13. Were you able to dispose of your used materials in the way that you wanted to?	0.590	–	
16. When at home, were you able to change your menstrual materials when you wanted to?	0.494	0.652	
17. When at home, were you satisfied with the place you used to change your menstrual materials?	0.596	0.666	
18. When at home, did you have a clean place to change your menstrual materials?	0.644	0.704	
Material reliability			
5. Were you worried that your menstrual materials would allow blood to pass through to your outer garments?	0.619	0.867	
6. Were you worried that your menstrual materials would move from place while you were wearing them?	0.636	0.689	
7. Were you worried about how you would get more of your menstrual material if you ran out?	0.776	0.638	
Transport and work			
8. Did you feel comfortable carrying spare menstrual materials with you outside your home?	0.418	0.544	
9. Did you feel comfortable carrying menstrual materials to the place where you changed them?	0.676	0.598	
23. When at work, were you able to change your menstrual materials when you wanted to?	0.718	0.596	
24. When at work, were you satisfied with the place you used to change your menstrual materials?	0.876	0.894	
25. When at work, did you have a clean place to change your menstrual materials?	0.931	1.00	
Insecurity			
14. Were you worried about where to dispose of your used menstrual materials?	0.612	–	
15. Were you concerned that others would see your used menstrual materials in the place you disposed of them?	0.642	–	
19. When at home, were you worried that you would not be able to change your menstrual materials when you needed to?	0.289	0.332	
20. When at home, were you worried that someone would see you while you were changing your menstrual materials?	0.513	0.703	

Continued

Table 3 Continued

No. item	CFA for those disposing of materials	CFA for those reusing materials	CFA for only reuse items
21. When at home, were you worried that someone would harm you while you were changing your menstrual materials?	0.485	0.615	
22. When at home, were you worried that something else would harm you while you were changing your menstrual materials (eg, animals, unsafe structure)?	0.608	0.759	
26. When at work, were you worried that you would not be able to change your menstrual materials when you needed to?	0.776	0.629	
27. When at work, were you worried that someone would see you while you were changing your menstrual materials?	0.778	0.797	
28. When at work, were you worried that someone would harm you while you were changing your menstrual materials?	0.712	0.736	
Among those reusing menstrual materials (n=145)			
Reuse needs			
29. Did you have enough water to soak or wash your menstrual materials?		0.783	0.729
30. Did you have access to a basin or bucket to soak or wash your menstrual materials whenever you needed it?		0.700	0.746
31. Were you able to wash your menstrual materials whenever you wanted to?		0.739	0.796
32. Did you have enough soap to wash your menstrual materials?		0.689	0.587
33. Were you able to dry your materials when you wanted to?		0.614	0.619
Reuse insecurity			
34. Were you worried that someone would see you while you were washing your menstrual materials?		0.862	0.888
35. Were you worried that your menstrual materials would not be dry when you needed them?		0.592	0.588
36. Were you worried that others would see your menstrual materials while they were drying?		0.730	0.734
RMSEA (90% CI)	0.069 (0.064 to 0.075)	0.052 (0.040 to 0.063)	0.050 (0.00 to 0.094)
CFI	0.840	0.922	0.984
TLI	0.824	0.913	0.977

CFI, Comparative Fit Index; RMSEA, root mean squared error of approximation; TLI, Tucker-Lewis Index.

Scores on the revised total scale ranged from 1.1 to 3.0, with the distribution of revised total scores presented in [figure 1](#). A total 2.1% of total scores were between 0.50 and 1.49, 41.3% of scores between 1.50 and 2.49, and 56.6% of participants scored between 2.5 and 3.0.

Reliability

[Table 5](#) displays the mean, SD and internal consistency of the total and subscale scores for both the original and revised scales. Both versions exhibited acceptable reliability assessed with an ordinal alpha. Home and environment needs scales, which were similar across the original and revised subscale structures, suffered slightly poorer reliability in the revised version due to a smaller number of items.

Validity

Mean scores were high across the sub-scales and total score. Women reported greater unmet needs in relation to their work environment and laundering experiences. This was consistent with reports during the cognitive interviews. [Table 5](#) displays the bivariate relationships between sub and total scale scores and hypothesised correlates. Greater poverty was associated with decreased MPNS score. Significant relationships between MPNS scores and mental health assessed through the WHO-5 were observed across original and revised scale structures. Total scores showed a moderate (0.25) association with mental health, while among the subscales material and home needs showed the strongest association. Having

Table 4 Confirmatory factor analysis (CFA) standardised factor loadings and model fit statistics for the revised factor structure

No. item	CFA for those disposing of materials	CFA for those reusing materials	CFA for only reuse items
N	N=335	N=125	N=145
Material and home environment needs			
1. Were your menstrual materials comfortable?	0.515	0.613	
2. Did you have enough of your menstrual materials to change them as often as you wanted to?	0.747	0.702	
3. Were you satisfied with the cleanliness of your menstrual materials?	0.606	0.671	
4. Could you get more of your menstrual materials when you needed to?	0.736	0.875	
10. Did you feel comfortable storing [keeping] your leftover or cleaned menstrual materials until your next period?	0.463	0.740	
17. When at home, were you satisfied with the place you used to change your menstrual materials?	0.339	0.382	
Material and home environment insecurity			
5. Were you worried that your menstrual materials would allow blood to pass through to your outer garments?	0.634	0.803	
6. Were you worried that your menstrual materials would move from place while you were wearing them?	0.669	0.654	
19. When at home, were you worried that you would not be able to change your menstrual materials when you needed to?	0.370	0.365	
20. When at home, were you worried that someone would see you while you were changing your menstrual materials?	0.625	0.733	
21. When at home, were you worried that someone would harm you while you were changing your menstrual materials?	0.578	0.685	
22. When at home, were you worried that something else would harm you while you were changing your menstrual materials (eg, animals, unsafe structure)?	0.708	0.788	
Disposal needs			
13. Were you able to dispose of your used materials in the way that you wanted to?	0.618		
14. Were you worried about where to dispose of your used menstrual materials?	0.758		
15. Were you concerned that others would see your used menstrual materials in the place you disposed of them?	0.783		
Work practice needs			
9. Did you feel comfortable carrying menstrual materials to the place where you changed them?	0.584	0.642	
23. When at work, were you able to change your menstrual materials when you wanted to?	0.692	0.555	
24. When at work, were you satisfied with the place you used to change your menstrual materials?	0.718	0.653	
26. When at work, were you worried that you would not be able to change your menstrual materials when you needed to?	0.757	0.65	
27. When at work, were you worried that someone would see you while you were changing your menstrual materials?	0.777	0.841	
28. When at work, were you worried that someone would harm you while you were changing your menstrual materials?	0.712	0.783	
Among those reusing menstrual materials (n=145)			
Reuse needs			

Continued

Table 4 Continued

No. item	CFA for those disposing of materials	CFA for those reusing materials	CFA for only reuse items
29. Did you have enough water to soak or wash your menstrual materials?		0.715	0.649
31. Were you able to wash your menstrual materials whenever you wanted to?		0.761	0.856
32. Did you have enough soap to wash your menstrual materials?		0.691	0.615
33. Were you able to dry your materials when you wanted to?		0.599	0.603
Reuse insecurity			
34. Were you worried that someone would see you while you were washing your menstrual materials?		0.859	0.902
35. Were you worried that your menstrual materials would not be dry when you needed them?		0.605	0.584
36. Were you worried that others would see your menstrual materials while they were drying?		0.723	0.724
RMSEA (90% CI)	0.051 (0.043 to 0.060)	0.053 (0.038 to 0.067)	0.036 (0.00 to 0.094)
CFI	0.911	0.915	0.993
TLI	0.897	0.904	0.989

CFI, Comparative Fit Index; RMSEA, root mean squared error of approximation; TLI, Tucker-Lewis Index.

higher levels of menstrual needs met was associated with increased odds that women did not miss work due to their last period. In both the original and revised structure, work-related needs were not significantly associated with absenteeism, which may indicate a stronger role of material needs. These relationships also suffer from missing cases where those absent from the workplace were unable to report on their experiences at work. Having more met needs at work did translate into significantly higher odds of feeling confident to manage menstruation in the workplace and was not associated with confidence managing menstruation at home, supporting the validity of these

subscales. Tests of scale validity were broadly comparable between the original and revised approaches.

As hypothesised, and consistent with the original validation, participants using commercially produced disposable or reusable pads ($M=2.49$) had higher MPNS scores (revised measure) than those using improvised materials ($M=2.38$), ($t(512)=2.45$, $p=0.007$).

DISCUSSION

This study tested and adapted the MPNS for use in a population of adult working women in Mukono District, Uganda. Through cognitive interviews and enumerator training we found the measure was acceptable and comprehensible to the study population. The four-point response scale was well understood, and previously suggested modifications of midpoints to 'less than half the time' and 'more than half the time' resulted in more balanced use of these options. Cognitive interviews and survey responses were consistent with the in-depth qualitative findings capturing women's experiences of menstruating at work.²⁶ Women reported more positive perceptions of menstrual management locations at home than in the workplace. Approximately 70%–80% of women were satisfied with the comfort, quantity and cleanliness of their materials, consistent with interview reports that women highly valued and prioritised purchase of preferred menstrual materials. At the same time, many reported worrying about soiling or accessing materials, also consistent with qualitative interviews where many participants reported these anxieties.²⁶

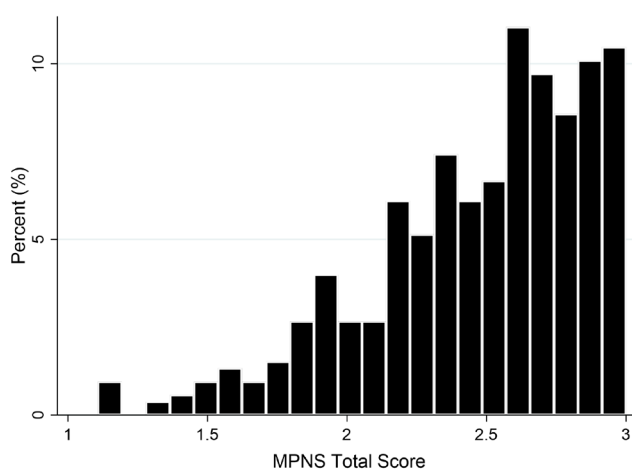


Figure 1 Distribution of revised MPNS total scores in the study sample. MPNS, Menstrual Practice Needs Scale.

Table 5 Original and revised scale reliability and validity

	Mean	SD	α_{ordinal}	α	Lived poverty index r (p value)	WHO-5 r (p value)	Did not miss work due to last period OR (95% CI)	Very confident managing menses at home OR (95% CI)	Confident managing menses at work OR (95% CI)
Original Subscales									
Material and home environment needs (n=525)	2.70	0.33	0.81	0.65	-0.25 (<0.001)	0.24 (<0.001)	1.86 (0.95 to 3.64)	4.11 (2.19 to 7.73)	3.88 (2.21 to 6.83)
Insecurity (n=525)	2.06	0.82	0.83	0.71	-0.34 (<0.001)	0.15 (<0.001)	1.80 (1.14 to 2.83)	1.13 (0.79 to 1.62)	4.49 (2.99 to 6.76)
Material reliability concerns (n=523)	2.54	0.49	0.71	0.64	-0.32 (<0.001)	0.19 (<0.001)	1.57 (1.18 to 2.08)	1.13 (0.92 to 1.41)	2.27 (1.80 to 2.87)
Transport and work needs (n=483)	2.16	0.78	0.83	0.76	-0.26 (<0.001)	0.15 (<0.001)	1.15 (0.84 to 1.59)	0.97 (0.76 to 1.22)	2.60 (1.99 to 3.39)
Reuse needs (n=145)	2.59	0.47	0.83	0.66	-0.30 (<0.001)	0.18 (.032)	1.62 (0.73 to 3.60)	1.74 (0.79 to 3.81)	2.19 (1.04 to 4.61)
Reuse insecurity (n=145)	2.08	0.86	0.77	0.69	-0.25 (<0.001)	0.25 (.003)	1.75 (1.11 to 2.76)	2.39 (1.49 to 3.84)	1.29 (0.88 to 1.89)
Total score (original) (n=525)	2.48	0.38	0.93	0.87	-0.39 (<0.001)	0.25 (<0.001)	2.58 (1.43 to 4.63)	1.76 (1.09 to 2.84)	12.10 (6.78 to 21.56)
Revised adult subscales									
Material and home environment needs (n=525)	2.66	0.40	0.72	0.57	-0.34 (<0.001)	0.26 (<0.001)	1.83 (1.08 to 3.13)	3.73 (2.18 to 6.36)	2.32 (1.48 to 3.63)
Material and home insecurity (n=525)	2.50	0.47	0.74	0.56	-0.25 (<0.001)	0.17 (<0.001)	2.31 (1.45 to 3.67)	1.31 (0.90 to 1.92)	3.32 (2.20 to 5.01)
Disposal (n=421)	2.42	0.77	0.77	0.64	-0.09 (.078)	0.06 (0.216)	1.16 (0.82 to 1.64)	1.01 (0.78 to 1.30)	2.13 (1.62 to 2.81)
Work practice needs (n=481)	2.26	0.73	0.86	0.79	-0.36 (<0.001)	0.14 (.002)	1.30 (0.93 to 1.81)	0.89 (0.70 to 1.15)	3.51 (2.59 to 4.75)
Reuse needs (n=145)	2.53	0.53	0.79	0.64	-0.31 (<0.001)	0.18 (.029)	1.55 (0.77 to 3.10)	1.48 (0.76 to 2.91)	1.91 (1.00 to 3.65)
Reuse insecurity (n=145)	2.08	0.86	0.77	0.69	-0.24 (<0.001)	0.25 (0.003)	1.75 (1.11 to 2.76)	2.39 (1.49 to 3.84)	1.29 (0.88 to 1.89)
Total score (revised) (n=525)	2.47	0.40	0.91	0.85	-0.39 (<0.001)	0.24 (<0.001)	2.47 (1.42 to 4.30)	1.64 (1.05 to 2.57)	10.19 (5.94 to 17.51)

Women in this study reported more positive experiences of managing menstruation (mean score 2.47) than adolescent girls in the original validation in Soroti (mean score 1.82).¹⁵ While it remains unclear if scores are directly comparable across study populations, this finding is consistent with the hypothesis that urban working women are likely to have greater access to resources and more experience managing menstruation than adolescents. Further, in the original validation, schools for the study were selected by the local government as those in greatest need of support in Soroti, an area with greater poverty than Mukono.^{15 42 43}

In testing the dimensionality of the scale among adults, the original factor structure identified for adolescents was not the best fit for the data. Although near acceptable fit was noted on some metrics, an alternative structure represented a better fit. This was driven by a greater consistency between women's insecurities and their comfort and satisfaction with their practices. The original validation study found null or negative associations between satisfaction and insecurities, with negative correlations identified between these factors.¹⁵ In the present study, these items remained on separate factors for material and home environment needs but grouped together in capturing women's practice needs in relation to disposal and experiences at work. The finding suggests that adult women, who have more years' experience of menstruation than adolescents, have more realistically calibrated their insecurities with their satisfaction. It may also suggest that women's experiences at work are less informed by their experiences at home, in contrast to adolescents where worries about access, privacy and safety at home and school covaried more closely.¹⁵

Our findings suggest that a shorter, revised subscale structure can be used for adult women. In our study sample, we found that questions capturing satisfaction with the location used to change menstrual materials were near synonymous with items asking if the location was clean, suggesting that women's satisfaction was most influenced by cleanliness. This is consistent with the qualitative findings from the research programme, where women expressed concern and disgust in response to unclean facilities and worries about contracting infections.²⁶ However, it is unclear if this relationship would be observed for other samples and further testing would support dropping or retaining these items in other populations. Further, future research is needed following use of the MPNS in a broader range of contexts to develop a short form of the scale, informed by data across populations.

In developing a revised subscale structure, we found that some items with applicability across home and work locations (eg, availability of handwashing) were cross loaded. This indicates that respondents are correctly taking both home and work experiences into account in their response. While this accurately represents menstrual experiences, it presents challenges for developing parsimonious subscales. Future research using the MPNS in

service of different research questions can provide guidance on the use of generalised items in contrast to location specific items.

Construct validity was demonstrated through relationships between the MPNS and hypothesised correlates, and differences between known groups. Significant correlations between the MPNS and poverty index were consistent with the role of resource deficits in menstrual experience.^{7 10} MPNS scores were also associated with absence from work in bivariate analyses. Having a higher level of met menstrual practice needs was associated with feeling confident to manage menstruation at home and at work, with subscale relationships further supporting validity.

Strengths and limitations

Cognitive interviews and enumerator training helped to refine items and confirmed the interpretability of questions. However, the applicability of items for those reusing or disposing of materials split the sample for which we could test dimensionality. Removing items that do not apply to all respondents would simplify analysis but would greatly diminish the content validity of the measure. Similarly, those who do not change their menstrual materials during the workday are unable to report on their experiences of changing or managing menstrual needs at work. The reasons for not changing at work are varied and may include not needing to change due to a lighter flow or use of products such as menstrual cups with longer changing intervals, avoiding changing at work due to poorly supportive facilities, or avoiding work entirely during menstruation. This also presents a challenge for the assessment of the subscale structure and relationships with work absenteeism when those missing work also do not have responses on these items. However, again, removal of these items would reduce content validity and fail to capture important experiences for those who do manage their bleeding in the workplace.^{25 26} In balancing factor structure performance and internal consistency metrics with validity we have prioritised validity and breadth in capturing women's experiences. Future research is needed to test the sensitivity of the MPNS to changes in response to menstrual health interventions and will also need to explore the influence of respondents who start attending work during menstruation or switch from using disposable or reusable items on changes in scale scores. Other contextual factors will also need to be considered, such as the impact of rainy and dry seasons on material drying.

Further research is needed to investigate the cross-cultural validity of the measure, particularly dimensionality, in other populations. While this study tested the performance in a large sample, the sample was not large enough to explore differences across worker groups, with a small proportion of teachers and healthcare workers included, or in different adult age groups or life stages which may show further variation.^{44 45}



Implications for research and practice

The MPNS offers a reliable and valid way to measure menstrual management experiences. This study revalidated the measure in an adult working population and offers a revised subscale structure for this group. The adult version of the measure can be used to consistently assess the menstrual experiences of women in research and for practice monitoring and evaluation. This work equips quantitative studies to build the evidence to understand the contributors to and consequences of unmet menstrual health needs and to evaluate the performance of interventions; a critical evidence gap for improving menstrual health.

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