



The perceived sensitivity to medicines (PSM) scale: An evaluation of validity and reliability

Rob Horne^{1*}, Kate Faasse², Vanessa Cooper³,
Michael A. Diefenbach⁴, Howard Leventhal⁵, Elaine Leventhal⁶
and Keith J. Petrie²

¹The UCL School of Pharmacy, University of London, UK

²Department of Psychological Medicine, University of Auckland, New Zealand

³Brighton and Sussex University Hospitals NHS Trust, Lawson Unit, Royal Sussex County Hospital, Brighton, UK

⁴Department of Urology and Ontological Sciences, Mount Sinai School of Medicine, New York, USA

⁵Institute for Health, Healthcare Policy and Aging Research, Rutgers University, New Jersey, USA

⁶UMDNJ Robert Wood Johnson Medical School, Piscataway, New Jersey, USA

Objectives. We report on the development and psychometric properties of a scale to measure perceived sensitivity to medicines (PSM).

Design. The internal consistency, test–retest reliability, criterion-related, and predictive validity of the PSM Scale were evaluated using data collected as part of four previously published studies and one unpublished data set.

Methods. Participants ($n = 1,166$) included patients receiving treatment for HIV infection and hypertension, individuals receiving a travel vaccination, and undergraduate students. Criterion-related validity was assessed by examining associations between the PSM and beliefs about medicines (Beliefs about Medicines Questionnaire), anxiety and depression (Hospital Anxiety and Depression Scale). Predictive validity was assessed by examining associations between the PSM and medication adherence and with symptom reports following vaccination. Test–retest reliability was assessed in an undergraduate sample who completed the PSM on two occasions, 2 weeks apart.

Results. Test–retest reliability was high ($r = .89, p < .001$). Cronbach's alpha ranged from 0.79–0.94. Consistent with expectations, high PSM scores were associated with negative beliefs about medicines in general, strong concerns about potential adverse effects of prescribed medicines, and doubts about the necessity for treatment. High PSM scores predicted non-adherence to anti-retroviral therapy and a higher incidence of symptoms following vaccination.

*Correspondence should be addressed to Rob Horne, The UCL School of Pharmacy, University of London, Mezzanine Floor, BMA House, Tavistock Square, London WC1H 9JP, UK (e-mail: rob.horne@pharmacy.ac.uk)

Conclusion. The findings present preliminary evidence that the PSM is a valid and reliable measure of perceived sensitivity to medication. While further work is needed to develop and evaluate the scale, the findings support its use as a research tool in studies of the use and effects of medicines.

Translating the potential benefits of effective medicines into health gain in long-term conditions is limited by low uptake and adherence (Nunes *et al.*, 2009). It is now well understood that beliefs about medicines have an important influence on whether patients start and continue with treatment. Research spanning a range of long-term conditions and across different countries has shown that treatment uptake and adherence are consistently related to specific beliefs about prescribed medicines, such as how patients judge their personal need relative to concerns about potential adverse effects (Horne, Cooper, Gellaitry, Leake Date, & Fisher, 2007). Moreover, negative attitudes to specific medicines are influenced by general beliefs or social representations of medicines as a class of treatment (Horne, Parham, Driscoll, & Robinson, 2009).

In deciding whether to use medicines, people are likely to be influenced, not just by their views of medicines, but also by how sensitive they perceive themselves to be to the effects of medicines. For example, a belief that one is particularly sensitive to the effects of medication might influence perceptions of the amount of medication necessary to produce beneficial effects or cause harm. So, while an individual may see a particular medicine as being effective, they may choose not to take it or may modify the dose because they see themselves as being particularly 'sensitive' to the effects of medicines. However, how a class of treatments affects the self has not been explored due perhaps, to the absence of a scale to measure this construct. In this paper, we describe the development of the Perceived Sensitivity to Medicines (PSM) Scale.

We anticipate the PSM scores may be important in explaining three aspects of medicine-related behaviour: treatment decisions, adherence, and the reporting of side effects. Patients are becoming more actively involved in decisions about their care and this is likely to increase (Nunes *et al.*, 2009). Perceptions of sensitivity to medicines are likely to influence initial decision about the type of treatment (e.g., medication vs. other treatments) as well as comparisons between individual medicines. Additionally, perceived sensitivity may cause some patients to delay accepting treatments because these perceptions increase concerns about potential adverse effects (Horne *et al.*, 2007).

Perceptions of PSM are likely to be related to adherence to treatment. Patients' personal judgements of how much medicine is needed to deliver benefit or to avoid harm may influence decisions about how much medication to take as well how long to persist on treatment. A person with high PSM scores may take less of the medicine to avoid potential adverse effects or because they believe that they need less compared to a person with a low PSM score.

The perception and reporting of medication side effects may also be affected by beliefs about PSM. There is evidence that side effect reporting is influenced by negative expectations. In a clinical trial involving patients with rheumatological diseases, the factor measured at baseline that was the strongest predictor of reported side effects at 6 months was concern about the potential adverse effects of medication (Nestoriuc, Orav, Liang, Horne, & Barsky, 2010). Two other studies support the role of patient expectations in the reporting of side effects. In the first study, participants taking Finasteride to treat benign prostatic hyperplasia reported higher rates of erectile dysfunction, low libido,

and ejaculation disorder if they were randomly assigned to the group that had been described Finasteride's possible side effects, compared to those who were not informed. (Mondaini *et al.*, 2007). Similarly, in a study looking at complaints of erectile dysfunction after therapy with the beta-blocker metoprolol, those who were fully informed of the possible side effects reported double the rates of erectile dysfunction compared with those who were not told about this potential side effect (Cocco, 2008). Thus, pre-treatment expectations of sensitivity to medicines may play an important role in side effect experiences. Pre-treatment expectations are likely to be influenced, not just by perceptions of the specific medicine, but by the belief that their bodies are highly sensitive to medicines.

The effect of information about side effects on later symptom reports may not exist across all patients. Psychological theories suggest that individuals differ in the degree to which they attend to their bodies and how readily they respond to even relatively mild somatic sensations (Barsky, Goodson, Lane, & Cleary, 1988). For a somatic sensation to be reported as a symptom, it must deviate from 'normal' experience of the self and activate sufficient concern to register in awareness for later recall (Petrie & Pennebaker, 2004). One factor suggested by psychological theory is that patients who report themselves as prone to negative affect, that is, who score high on traits of negative affectivity, would be more likely to respond emotionally and report symptoms when facing threats to the self in medical treatments. Another factor suggested by the common-sense model (CSM) of self-management (Leventhal, Brissette, & Leventhal, 2003) is that patients who believe their bodies to be overly sensitive to medication would be more attentive to, and more likely to recall and report somatic sensations after taking a medication than patients who do not believe themselves sensitive to medication (Leventhal, Leventhal, & Contrada, 1998).

Thus, high scores on the PSM are likely to be associated with a higher incidence of adverse effects and early discontinuation of treatment due to side effects. This may also be useful when looking at adverse event reports to formulation changes to medication (Faasse, Cundy, & Petrie, 2009) or following switches to generics from established brands (Figueiras, Alves, Marcelino, Cortes, & Horne, 2009).

This paper describes the development and preliminary evaluation of the PSM Scale. We report on the generation of items in the scale and on the reliability of the PSM, in terms of test-retest and internal consistency. We also provide details of the scale's criterion-related, discriminant and predictive validity in a range of samples drawn from five studies conducted in the United Kingdom and New Zealand.

Method

Item generation and scoring

The PSM comprises five items assessing perceptions of perceived sensitivity to potential adverse effects of medicines. The items are slight modifications of the comments made by patients when prescribed medication during regularly scheduled and patient-requested physician visits. The five items included in the scale represent essentially all of the comments elicited during these non-research encounters with a physician in internal medicine. The five items are *My body is very sensitive to medicines; My body overreacts to medicines; I usually have stronger reactions to medicines than most people; I have had a bad reaction to medicines in the past; Even very small amounts of medicines can upset my body.*

Responses are scored on a 5-point Likert-type scale. Individual item scores are summed to provide a total PSM score ranging from 5 to 25. High scores indicate high perceived sensitivity to potential adverse effects of medicines.

Testing the criterion-related and predictive validity of the PSM

Criterion-related validity

The assessment of criterion related validity of the PSM was based on the following predictions:

Beliefs about medicines in general. Patients who perceive themselves to be particularly sensitive to the effects of medicines would be sceptical about medicines in general. Thus, it was hypothesized that the PSM scores would be positively correlated with scores on the Beliefs about Medicines Questionnaire (BMQ) Harm and Overuse scales and negatively correlated with scores on the Benefits scale.

Beliefs about specific prescribed medicines. Patients who perceive themselves to be particularly sensitive to the effects of medicines would have strong concerns about their prescribed medicine and may have doubts about their need for medicine. Thus, it was hypothesized that PSM scores would be positively correlated with BMQ Concerns scores and negatively correlated with scores on the BMQ Necessity scale.

Anxiety and depression. Patients who report themselves as prone to anxiety and depression would be more likely to attend to, recall, and report somatic sensations after taking a medication. Thus, it was hypothesized that PSM scores would be positively correlated with scores on the Hospital Anxiety and Depression Scale (HADS) anxiety and depression scales.

Predictive validity

The assessment of predictive validity of the PSM was based on the following predictions:

Adherence to medicines. A person who perceives themselves to be sensitive to adverse effects from a medicine would take less of the medicine or miss doses to avoid potential adverse effects or because they believe that they need less compared to a person with who does not perceive themselves to be sensitive to adverse effects. Thus, it was predicted that patients with high PSM would have lower adherence than people with low PSM scores.

Side effects following vaccination. The perception and reporting of medication side effects would be affected by a person's beliefs about their sensitivity to medicines. Thus, it was predicted that a high score on the PSM would predict a greater number of symptoms following vaccination.

Sample

The evaluation of the PSM was based on data collected from five discrete studies ($n = 1,166$) conducted in the United Kingdom and New Zealand. The groups sampled were chosen to include both clinical samples where participants were prescribed medication for chronic illness (HIV, hypertension) or travel vaccinations and non-clinical samples (undergraduate students and test-retest samples). Ethical approval was granted in each

of the clinics, hospitals, and universities. The individual studies are described in more detail below.

HIV sample (n = 193)

Description of the broader study and contribution to this study. This was a prospective, follow-up study investigating patients' perceptions of HIV and beliefs about Highly Active Anti-Retroviral Therapy (HAART) in relation to subsequent treatment decisions and medication adherence (Horne *et al.*, 2007). Patients attending HIV clinics in Brighton, United Kingdom completed the PSM as part of a larger battery of questionnaires, allowing us to explore associations between PSM scores and beliefs about medicines, anxiety, and depression (criterion-related validity) and subsequent adherence (predictive validity). The PSM data collected as part of this study have not previously been published.

Sample characteristics. Most participants (88%) were men who have sex with men. The mean number of months since HIV diagnosis was 51.9 (range 0–207). Thirty percent had previously been prescribed anti-retroviral treatment, with the number of previous medication combinations ranging from one to 12.

Study procedures. Participants completed the PSM, BMQ, and HADS prior to initiating HAART. Fifty-three participants who subsequently started HAART were followed up after 3 months of treatment to assess relations between baseline PSM scores and adherence.

Hypertension sample (n = 230)

Description of the broader study and contribution to this study. This was a study of illness and treatment perceptions in hypertension, which was conducted as a sub-study of the Anglo Scandinavian Cardiovascular Outcomes Trial (ASCOT; Horne, Clatworthy, & Hankins, 2010). The sample comprised patients with hypertension recruited through general practitioners and ASCOT researchers in Brighton, United Kingdom. The PSM was completed alongside the BMQ, allowing us to explore associations between perceptions of sensitivity to medicines and beliefs about medicines prescribed for hypertension (criterion-related validity). The PSM data collected have not previously been published.

Sample characteristics. Participants were aged between 40 and 80 years (mean age 67.4 years [SD 8.6]) and had at least three other risk factors for a cardiovascular event (e.g., type-two diabetes, over 55 years old, regular smoker, family history of coronary artery disease). All were receiving either a beta blocker or calcium channel blocker based treatment regimen.

Study procedures. Participants completed the PSM and BMQ via a postal survey at four time-points (baseline, 6 months, 12 months, and 18 months). Participants were telephoned shortly after each questionnaire was sent to check it had arrived and address any questions the participant might have. The baseline data were used for this analysis.

Vaccination sample (n = 121)

Description of the broader study and contribution to this study. The vaccination sample was drawn from a study investigating the relationship between negative affect and PSM to symptom reporting following vaccination (Petrie, Moss-Morris, Grey, & Shaw, 2004). Data showing associations between PSM scores and symptom reporting post-vaccination were included in the current study to assess predictive validity.

Sample characteristics. Consecutive attendees at a travel medicine clinic who were receiving vaccinations needed for overseas travel. The sample was mostly European (87%). The majority of participants (74%) reported visiting a GP between zero and two times in the past years, while 26% reported between three and 10 visits. Seven-day follow-up data were obtained from 100% of the study participants.

Study procedures. Participants were asked to complete a pre-vaccination questionnaire including the PSM and the Positive and Negative Affect Scale. A symptom checklist was completed 20 min after vaccination.

Undergraduate student sample (n = 570)

Description of the broader study and contribution to this study. Participants completed the PSM as part of a broader, cross-sectional study investigating perceptions of medicines among university students (Horne, Frost, Hankins, & Wright, 2001). Data were used in the current study to examine associations between PSM scores and beliefs about medicines in general (criterion-related validity).

Sample characteristics. The sample consisted of UK undergraduate students in pharmacy, engineering, accounting and finance, social policy and administration, and humanities at the University of Brighton, of whom 77% described themselves as having a European cultural background, 15% as having an Asian cultural background, 3.7% described themselves as either Afro-Caribbean or African, and 4.7% as 'other'. A total of 23.7% of participants were taking prescribed medication at the time of the study and 47.4% reported receiving prescription medication during the previous year.

Study procedures. The PSM and BMQ were completed by students at the beginning of lectures at the University of Brighton.

Test-retest sample (n = 52)

Description of the broader study and contribution to this study. Test-retest reliability was explored in a sample of undergraduate students (Rob Horne, unpublished data).

Sample characteristics. All participants were students at the University of Sussex. More than two-thirds ($n = 36$, 69.2%) were psychology students, 45 (42.1%) were female,

41 (78.8%) described their ethnicity as white British, and 18 (34.6%) reported that they were currently taking a prescribed medicine. Ages ranged from 18–60 (median 20 years).

Study procedures. Students attending two specific undergraduate lectures (in neuropsychology and history) at the University of Sussex were asked to complete the PSM during a break in the lecture. Questionnaires were completed at two time points 2 weeks apart.

Measures

Beliefs about Medicines Questionnaire (BMQ; Horne, Weinman, & Hankins, 1999)

The BMQ comprises two sections: the BMQ-Specific assesses representations of medication prescribed for personal use and the BMQ-General assesses beliefs about pharmaceutical medicines as a whole. The BMQ-Specific consists of two sub-scales: the Necessity sub-scale assesses participants' beliefs about their personal need for taking their medication (e.g., 'Without these medications I would be very ill') and the Concerns sub-scale assesses their concerns about the potential adverse effects of taking medication (e.g., 'These medicines give me unpleasant side effects'). The BMQ-General comprises three sub-scales each containing four items. The Harm scale assesses individuals' beliefs about the intrinsic properties of medicines and the degree to which they are perceived to be harmful, addictive poisons. The Overuse scale assesses beliefs about the way in which medicines are used and the extent to which they are perceived to be over-prescribed. The Benefit scale assesses individuals' beliefs about the potential benefits of medicines. All items were rated on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. For each sub-scale, responses were summed and mean scores computed, with higher scores indicating stronger beliefs in the construct represented by the scale.

Symptom Checklist (Petrie et al., 2004)

A 17-item symptom checklist was completed 20 min after vaccination. This scale included both specific vaccination-related items, for example, 'pain or tenderness at injection site' and general somatic symptoms including 'headache'. Participants were asked whether each symptom was present or not and whether the participant attributed it to the vaccination. The number of symptoms experienced was calculated, with possible scores ranging from 0–17.

Medication Adherence Self-Report Inventory (MASRI; Walsh, Mandalia, & Gazzard, 2002)

Adherence to HAART was measured using a single item, the visual analogue scale (VAS) from the MASRI, where participants were asked to estimate the percentage of HAART medicines they had taken as prescribed over the previous month on a scale from 0–100%, marked with 10% indicators. The MASRI is worded in a non-judgmental manner in an effort to minimize socially desirable responses. The VAS has demonstrated good validity against objective measures (electronic monitoring: $r = .63, p < .001$; pill count: $r = .75, p < .001$; and viral load: $p < .01$; Walsh et al., 2002).

Participants were dichotomized into 'low-adherence' and 'high-adherence' groups on the basis of whether their average adherence score on the VAS was 95% or greater (high adherence) or less than 95% (low adherence). This adherence categorization was in accordance with the findings of clinical research, which suggested that at least 95% adherence to HAART was required for clinical efficacy (Paterson et al., 2000).

Table 1 Demographic characteristics of the PSM validation samples.

	HIV	Hypertension	Vaccination	Undergraduates	Test–retest
<i>n</i>	193	230	121	570	52
Gender, (% male)	96.8	88	53	51	13.5
Age, mean (SD)	37.2 (8.5)	67.4 (8.6)	32.9 (12.4)	23.9 (6.3)	23.4 (8.0)

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). This was used to assess trait negative affectivity in the vaccination sample. Participants rated each of 10 adjectives (nervous, *excited*) on a 5-point scale from ‘not at all’ to ‘extremely’ for they felt in general. This was used to assess trait negative affectivity in the vaccination study. Participants rated each of 10 adjectives (nervous, excited) on a 5-point scale from ‘not at all’ to ‘extremely’ for they felt in general. The scale has shown high levels of reliability and association with other measures of distress and psychopathology (Watson *et al.*, 1988).

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). This 14-item scale was designed to detect anxiety and depression among patients attending outpatient clinics without possible contamination of scores by reporting of physical symptoms. Items are scored from 0 to 3, with possible scale scores ranging from 0 to 21. Higher scores indicate greater anxiety or depression.

Statistical methods

Data were analysed using SPSS version 15.0 (IBM) for Windows

Cronbach’s alpha was used to assess internal consistency. Pearson’s correlations were used to examine test–retest reliability and criterion-related validity (associations between PSM scores and BMQ scores, symptom reports, depression, and anxiety). Partial correlations were used to examine associations between PSM scores and BMQ scores after controlling for anxiety and depression. Associations between PSM and BMQ scores and adherence (a dichotomous variable) were examined using point bi-serial correlations.

Results

Demographics characteristics

The demographic characteristics (age and gender) of each of the validation samples are shown in Table 1.

Acceptability

The percentage of respondents who completed the scale without omitting any items ranged from 98% in the HIV sample to 100% in the vaccination sample, indicating that participants found the scale acceptable.

Reliability

The PSM demonstrated good internal consistency in all samples. Cronbach’s alphas for the validation samples are as follows: HIV = 0.88; Hypertension = 0.89; Vaccination = 0.94; Undergraduate students = 0.79. Test–retest reliability was also high ($r = .89, p < .001$).

Table 2: Correlations between perceptions of sensitivity to medicines (PSM) scale scores and measures of validity (beliefs about medicines, anxiety, depression, adherence, symptoms) and reliability (PSM re-test scores).

	HIV	Hypertension	Vaccination	Student	Test–retest
BMQ necessity	−0.30*	−0.13**	–	–	–
BMQ concerns	0.39*	0.39*	–	–	–
BMQ harm	0.32*	–	–	0.25*	–
BMQ overuse	0.38*	–	–	0.24*	–
BMQ benefits	−0.34*	–	–	0.24*	–
HADS depression	0.29*	–	–	–	–
HADS anxiety	0.26*	–	–	–	–
Non-adherence	0.24** ^a	–	–	–	–
Number of symptoms	–	–	0.26***	–	–
Symptoms attributed to vaccination	–	–	0.27***	–	–
PSM at 2-week follow-up	–	–	–	–	0.89*

* $p < .001$, ** $p < .05$, *** $p < .01$.^aPoint bi-serial correlation.

Criterion-related validity

Beliefs about medicines in general

We investigated whether the PSM correlated with other measures relating to attitudes towards medication. The results are shown in Table 2. The association between the PSM scores and the BMQ (Horne *et al.*, 1999) was examined in three samples. In the HIV and hypertension validation samples, both General and Specific beliefs about medicines were assessed using the BMQ. In the undergraduate sample, only the General beliefs about medicines subscale of the BMQ was used.

This analysis demonstrated that the PSM scores were significantly correlated with the beliefs about medicines in general. In the HIV sample, PSM scores were positively correlated with the belief that medicines are over prescribed by doctors (Overuse: $r = .38$, $p < .001$) and the belief that medicines are harmful (Harm: $r = .32$, $p < .001$), and negatively correlated with the belief that medicines are beneficial (Benefit: $r = -.34$, $p < .001$). In the undergraduate student sample, PSM scores were significantly positively correlated with Overuse ($r = .24$, $p < .001$) and Harm ($r = .25$, $p < .001$), and negatively correlated with Benefit ($r = -.24$, $p < .001$).

The relationship of the PSM to beliefs about medication prescribed for a specific illness was investigated in the HIV and hypertension samples. In the HIV sample, belief in the perceived need for using medication (Necessity subscale) was negatively correlated with PSM score ($r = -.30$, $p < .001$) and positively correlated with concerns about potential adverse effects (Concerns subscale; $r = .39$, $p < .001$). A similar pattern was found in the hypertension sample (Necessity: $r = -.13$, $p < .05$; Concerns: $r = .39$, $p < .001$).

Depression and anxiety

Within the HIV sample, PSM scores were significantly associated with HADS anxiety ($r = .26$, $p < .001$) and depression ($r = .29$, $p < .001$) scores (Table 2). After controlling for the possible influence of anxiety and depression, associations between PSM scores and BMQ scores remained significant (Necessity: $r_p = -.38$, $p < .001$; Concerns: $r_p = .33$,

$p < .001$; Overuse: $r_p = .36, p < .001$; Harm: $r_p = .30, p < .001$; Benefits: $r_p = -.34, p < .001$). These partial correlations between the PSM scores and BMQ scores indicate that the relationship between PSM and beliefs about medicines was independent of depression and anxiety.

Predictive validity

Adherence to HAART

Rates of adherence were assessed in a subset of HIV patients ($n = 53$), 3 months after they began treatment with HAART. Participants in the low adherence group ($n = 11$) had significantly higher PSM scores (mean [M] = 15.64, standard deviation [SD] = 4.80) than those in the high adherence group ($n = 42$; M = 12.71, SD = 4.86, $p < .05$), as predicted.

We further explored whether the association between PSM scores and low adherence was mediated by patients' concerns about treatment. BMQ-Specific Concerns scores were significantly associated with PSM scores ($r = .55, p < .001$) and non-adherence ($r_{pb} = .41, p < .005$). When concerns were controlled for in the analysis, the relationship between PSM scores and adherence ($r_{pb} = .24, p < .05$) became non-significant ($r_{pb} = -.11, p = .442$), indicating that treatment concerns mediated the association between PSM scores and adherence.

Predicting symptoms following vaccination

A higher score on the PSM pre-vaccination predicted a greater number of symptoms 20 min post-vaccination ($r = .26, p < .005$) and a greater number of symptoms attributed to vaccination ($r = .27; p < .005$) (Table 2). The size of these relationships was unaffected after controlling for negative affect.

Discussion

The results show that the PSM is a reliable and valid measure of PSM. Internal consistency was high in all samples and test-retest reliability was adequate. Preliminary evidence of predictive validity was provided by correlations between PSM scores and subsequent reported adherence to anti-retroviral treatment (HIV sample) and reactions to vaccination, with higher PSM scores immediately before vaccination correlating with more frequent reports of symptoms 20 min after vaccination and greater attribution of symptoms to vaccination. The relationship between PSM scores, reported adherence (HIV sample), and side effect attributions (vaccination sample) was not explained by negative affect. This supports the premise that the PSM is assessing beliefs about PSM rather than more general negative affect. The effect of PSM scores on adherence was mediated by medication concerns (HIV sample). This finding is consistent with theoretical predications that perceptions of sensitivity to medicines might influence medication-related behaviour by elevating specific concerns about potential adverse effects (Horne, 2003).

Further evidence of construct validity is provided by the observed correlation between PSM scores and the BMQ-General scales. The latter scales measure beliefs about medicines: their intrinsic properties and potential for harm (General Harm scale) or benefit (General Benefit) and whether they are prescribed too readily by clinicians

(General Overuse scale), whereas the PSM measures perceptions of self, in relation to medicines. As anticipated, those who had negative perceptions of pharmaceuticals (perceiving them to be less beneficial, more harmful, and over prescribed) were more likely to report themselves as being sensitive to medicines. However, the size of the correlations ($<.4$) suggests that the constructs, although related, are distinct. 'Internal' perceptions (of self in relation to medicines) are related to 'external' perceptions (medicines and how they are used) but the shared variance between the constructs is relatively small.

The correlations between PSM and beliefs about medicines prescribed for HIV ranged from $r = .30$ to $r = .39$ and were therefore moderate in size (Cohen, 1988). While correlations between PSM and beliefs about medicines in general within the undergraduate sample may seem weak (ranging from $r = .24$ to $r = .25$), this would be expected in a large, heterogeneous sample. In relation to predictive validity, the small to moderate correlations between PSM and adherence ($r = .24$) and symptom reports (.26–.27) would be expected, because PSM is one of several factors that could influence outcomes. Furthermore, theoretical models of medication-related behaviour (Horne, 2006) would predict that PSM is a 'background belief' influencing perceptions of specific prescribed medicine and as such would be expected to be more weakly correlated with medicine taking behaviour than more proximal beliefs about specific prescribed medicines (e.g., Horne *et al.*, 2007).

Our findings should be interpreted in the context of the study's limitations. The questionnaire items were all worded negatively, which could potentially lead to biased responding. Although the evaluation was conducted across several samples and in different study and cultural contexts, the range of clinical samples is limited and we do not know if our findings are generalizable. For example, the chronic illness samples (HIV and hypertension) were predominantly male. Similar findings were found across the differing clinical situations and contexts reported in this paper. However, different measures were used across studies and the more detailed studies are now needed (and justified) to examine the properties of the scale across a range of illnesses. The PSM performed well in the undergraduate student sample suggesting that it may be useful for research involving non-clinical samples. We note that the undergraduate sample may not be demographically representative and further studies are needed to confirm the utility of the scale in this respect. While the preliminary test-retest data suggests the PSM has consistency over time, the test-retest sample was small and replication in a larger sample and with clinical groups would be beneficial.

Despite these limitations, our findings present preliminary evidence that the PSM is a valid and reliable measure of perceived sensitivity to medication. Further work is needed to develop the scale but this paper supports its use as a research tool in a range of studies of the use and effects of medicines, where previously no quantitative measure existed.

The PSM may have applications in studies testing theories of self-regulation in relation to illness and treatment. The scale assesses one of several potential features of an individual's underlying schema of the physical and functional (physical, cognitive, affective) self (Brown, 2004). In the CSM of self-regulation (Leventhal *et al.*, 1998), ongoing somatic sensations and functional changes are compared against the various features of the schema of the 'usual' or 'healthy self'. Observed deviations from this benchmark are appraised for fit to hypotheses respecting specific risks of illnesses, giving rise to illness representations, and to representations of the adverse effects of treatment and lifestyle behaviours (Leventhal, Breland, Mora, & Leventhal, 2010). The PSM assesses, therefore, one feature of the schema that is at the core of the dynamic processes involved in the common sense of self-regulation.

Potential applications include studies of medication-related behaviour (uptake, adherence, and persistence), where perceptions of sensitivity to medication might influence evaluations of the personal need for medication and enhance concerns about potential adverse effects or influence treatment preferences. For example, those with high PSM scores might gravitate towards non-pharmacological treatments (Astin, 1998). The PSM could also be applied in studies of placebo/nocebo effects, where perceptions of sensitivity to medicines might contribute to the amplification of somatic sensations (Barsky *et al.*, 1988), that are attributed to medication. Finally, the small item number of the scale makes the PSM particularly useful for clinical applications. Physicians might consider using the PSM as a starting point to discuss different treatment options and directing discussions around treatment decision making.

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