Assessing attitudes towards and beliefs about pain among Chinese patients with chronic pain: Validity and reliability of the Chinese version of the Pain Beliefs and Perceptions Inventory (ChPBPI)

Running title: Pain beliefs in Chinese with chronic pain

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Abstract

Context: Research consistently evidenced the reliability and validity of the Pain Beliefs and Perceptions Inventory (PBPI). The instrument however has not been tested for its applicability and validity in non-Western populations.

Objective: To translate the English language version of the PBPI into Chinese (ChPBPI) and to evaluate its reliability, validity, and factor structure.

Methods: A total of 208 Chinese patients with mixed origin chronic pain were recruited from an orthopedic specialist out-patient clinic associated with a public hospital in Hong Kong. In addition to the ChPBPI, patients were administered the Chronic Pain Grade (CPG) questionnaire, the Pain Catastrophizing Scale (PCS), the Centre for Epidemiological Studies -- Depression Scale (CES-D), and questions assessing socio-demographic characteristics.

Results: Using the original factor structure of the PBPI as a model, confirmatory factor analyses revealed that, all four ChPBPI scales demonstrated good data-model fit (CFI≥0.92) and adequate internal consistency (Cronbach's αs: 0.60– 0.76). The four ChPBPI scales showed significant positive correlations with CES-D, PCS, pain intensity, and disability. Results of hierarchical multiple regression analyses showed the ChPBPI scales predicted concurrent depression ($F(4,187)=6.01$, $p<0.001$), pain intensity ($F(4,186)=4.61$, $p<0.01$), and pain disability ($F(4,190)=3.54$, $p<0.05$) scores.

Conclusions: These findings support the factorial validity of the scales of the ChPBPI as well as its reliability and construct validity. Now clinically relevant beliefs about pain can be assessed among Chinese patients with chronic pain.

Key words: Pain beliefs; Chronic pain; Chinese; Confirmatory factor analysis.

(word count: 224/250**)**

Introduction

Pain belief is defined as "a subset of a patient's belief system which represents a personal understanding of the pain experience" (p.351).[1] Patients' own conceptualizations of the cause, time line, and consequences of pain provide them with a framework for coping with their pain problems and understanding their illness. The meaning of and beliefs about pain held by patients have direct relevance to the clinical setting.[2-6] Previous studies of pain beliefs showed that beliefs in the permanence and daily constancy of pain were positively correlated with disability.[5] Pain beliefs were also significantly associated with pain interference and affective distress.[7] Specifically, the belief of pain as being mysterious predicted the mental health dimension of quality of life.[8] Patients holding stronger beliefs in pain being an enduring part of life and as being mysterious were more likely to catastrophize and less likely to use cognitive coping strategies such as reinterpretation of pain sensation.[9]

Despite the well-documented relationships between pain beliefs and patient functioning, the existing data have been obtained exclusively from Western populations. Research in the cross-cultural similarities and differences in the associations between specific pain-related beliefs and measures of patient functioning has been limited. The importance of culture in pain experience has been acknowledged since the seminal work of Zborowski.[10, 11] In addition, previous clinical and laboratory pain research has demonstrated cultural differences in pain perception[12, 13] and responses[14, 15] Thus far, only a few studies have examined cross-cultural differences in pain beliefs. In one such study, patients who identified themselves as Hispanics reported lower external health locus control beliefs (over back pain) and employed fewer self-management strategies for such pain than those who identified themselves as "Old Americans" (at least third-generation US-born non-Hispanic Caucasians who define themselves as Americans), Italians, French Canadians, Irish or Polish.[16] In another study, Taiwanese and Singaporean female undergraduate healthcare students reported more negative back pain beliefs than their Australian counterparts.[17] These studies support the hypothesis that culture may affect pain beliefs.

The Pain Beliefs and Perceptions Inventory (PBPI) is a widely used instrument for assessing pain beliefs.[1] The PBPI was designed to assess the representations and the meanings patients hold regarding pain.[1] The initial version of the PBPI consisted of 16 items grouping into three subscales: (1) Time, (2) Mystery, and (3) Self-blame. The three PBPI scales were shown to have satisfactory internal consistency with Cronbach's αs ranging from 0.65 to 0.80. Higher

scores on the "Time" scale was associated with greater pain intensity and decreased compliance with pain interventions whereas the "Mystery" scale was positively associated with worse psychological distress and negatively correlated with any improvements in psychological distress over time.[18] The factor structure of the PBPI was further assessed in a sample of Australian patients with chronic low back pain.[19] The Mystery and Self-blame factors of the PBPI were replicated; however, the "Time" factor was split into two factors, which were labeled as "Acceptance" and "Constancy". The 4-factor structure obtained in the Australian sample was replicated in a German sample drawn from a pain clinic[20] Williams et al.[21] later relabeled the "Acceptance" scale as "Permanence" to more accurately reflect the negative connotation of the items reflecting a belief that pain will be an enduring part of life in the long term. The factor structure of the revised PBPI received further support was subsequently assessed again in two independent samples of American patients with chronic pain, in which the 4-factor structure was replicated. The four PBPI scales were also found to have significant positive relationships with pain quality, depression, anxiety, and physical functioning. The 4-factor structure of the PBPI received further support in a British sample drawn from a pain clinic.[22]

The existing literature strongly supports the reliability and validity of the 16-item PBPI as a 4-factor measure of beliefs about pain. These data however have been obtained exclusively from Western populations. The utility of the scale in non-Western pain populations remains unknown, and no empirical data to date has documented the pain belief systems among Chinese patients with chronic pain. The goal of this study was to address these gaps by examining the factor structure and other psychometric properties of a Chinese translation of the PBPI among Chinese individuals with chronic pain. Validation of a Chinese version of the PBPI would inform cross-cultural perspectives of pain beliefs and help clarify cultural similarities and differences among patients with chronic pain.

Method

Subjects

Following ethics approval, patients with chronic musculoskeletal pain were recruited from an orthopedics out-patient clinic of Hong Kong public hospital (Kwong Wah Hospital). Patients were invited to participate in the present study during regularly scheduled clinical consultation visits. Patients were eligible for study participation if they met the following criteria:

(1) 18 years of age or above; (2) native Cantonese speakers; (3) having no communication problems or physical conditions that would prevent the completion of the study measures; (4) no confusion or cogitive impairment diagnosis from the medical record; and (5) willingness to participate in the study. All eligible patients gave informed consent. While waiting for medical consultation, patients were interviewed by a research assistant regarding pain and socio-demographic characteristics; after which, the research assistant was administered the battery of questionnaires to patients.

Of the 218 patients approached, 208 patients were eligible to take part in the study and completed the interview and the questionnaires. The mean age of the sample was 50 (SD=11.3) years and 54.3% were female. About 47.0% of the patients reported monthly household incomes of <HK$15,000 [*] and 55.9% were married or cohabited. Over half (53.4%) of the sample completed secondary education and 12.1% completed tertiary education. While 53.4% reported no particular religious belief, 28.2% endorsed Buddhism, Daosim or ancestor worship as religion. Over half (53.0%) of the patients had full-time employment, whereas unemployed and housewives constituted 16.5% and 11.7% of the sample, respectively.

Measures

The Pain Beliefs and Perceptions Inventory (PBPI)

The PBPI consists of 16 items assessing four dimensions of pain beliefs: (1) the "Mystery" dimension (4 items) measures the belief that pain is mysterious and is a poorly understood experience; (2) the "Permanence" dimension (5 items) assesses the belief that pain is an enduring part of life; the "Constancy" dimension (4 items) measures the temporal dimension of daily pain; and (4) the "Self-blame" dimension (3 items) taps patient's beliefs that they themselves are responsible for their own experience of pain. The four scales possessed satisfactory internal consistency (Cronbach αs: 0.64-0.83).[20] Patients are asked to rate using a 4-point Likert scale (-2 = Strongly disagree, -1 = Disagree, +1 = Agree, +2 = Strongly agree) their level of agreement with each of 16 statements about beliefs and perceptions concerning pain.[1, 21] The Chinese version of the PBPI (ChPBPI) was translated from the original by the first author (WSW). Comprehensibility and appropriateness of the language in the Chinese cultural context were emphasized for the translation and used a cross-cultural adaptation procedure. The Chinese

[*] $1 U.S. = $7.8 HK.

version was back-translated into English by a bilingual psycholinguist. The English back-translation was reviewed by the author of the original English version (DAW) for content equivalence between the back-translation and the original version of the PBPI. Discrepancies were discussed and resolved by consensus, and modifications were made as needed, resulting in the penultimate version of the ChPBPI.

As a further test of equivalence, the penultimate items of the ChPBPI were evaluated by a panel consisting of 11 bilingual postgraduate students. Each panel member was asked to rate independently the fluency and semantic equivalence of the Chinese translation against the original English version of the PBPI items on 5-point Likert scales (1=poor, 2=fair, 3=good, 4=very good, 5=excellent). The results of the panel evaluation showed that 4 of the 16 items obtained a modal rating of 5, suggesting an excellent equivalence of the item translation. All of the remaining items had a modal rating of 4, indicating good equivalence of the English-Chinese translation. The penultimate version of the ChPBPI was subsequently piloted in 10 Chinese patients attending a public hospital orthopaedics specialist out-patient clinic in Hong Kong. The patients indicated that the instructions and the items were easy to understand. The final Chinese translation of the ChPBPI was prepared based on the results the above translation and evaluation processes.

Chronic Pain Grade (CPG)

The presence of chronic pain was first identified by affirmative answers to two questions: (1) "Are you currently troubled by physical pain or discomfort, either all the time, or on and off?" and (2) "Have you had this pain or discomfort persisted for more than 3 months?".[23] Subjects answering yes to both questions were then asked about the site and duration of their pain. Chronic pain severity was assessed using the Chronic Pain Grade (CPG) questionnaire,[24] a seven-item instrument that measures three domains of pain severity: intensity, disability/interference, and persistence. The three intensity items ask respondents to rate their current, average and worst pain intensity on a 0 – 10 Numerical Rating Scales (NRS). Three CPG items assess pain interference with (1) daily activities, (2) social activities, and (3) working ability using 0 – 10 NRS. Persistence is assessed in the original CPG by asking the respondent to indicate the number of days out of the past six months that he or she was disabled by pain (although we modified this to "the past three months" because chronic pain is now defined as pain that persists for at least

three months[23]). The responses of the seven items generate a Characteristic Pain Intensity Score, a Disability Score, and Disability Points were generated. Based on the Pain Intensity Score and Disability Points, the CPG classifies respondents into five hierarchical grades: Grade Zero (pain free), Grade I (low disability-low intensity), Grade II (low disability-high intensity), Grade III (high disability-moderately limiting) and Grade IV (high disability-severely limiting). The English version of the CPG possesses good psychometric properties[25] and is responsive to change in pain severity over time.[26] The underlying structure of the CPG (excluding the screening question) among Chinese was assessed using Exploratory Factor Analyses (EFA).[27] EFA with promax rotation showed that the six items were grouped into 3 main dimensions: Disability (which explained 43.33% of total variance), Intensity (which explained 15.25% of total variance) and Persistence (which explained 12.94% of total variance). All items loaded to the corresponding factors with moderate to high factor loadings (ranging from 0.67 to 0.91). Cronbach's αs for the CPG Disability and Characteristic Intensity scales were 0.87 and 0.68, respectively.

Pain Catastrophizing Scale (PCS)

Pain-related catastrophic cognitions were assessed using the 13-item Pain Catastrophizing Scale (PCS). Respondents were asked to reflect on past painful experiences and to indicate the frequency with which they experienced each of 13 thoughts or feelings when experiencing pain on 5-point Likert scales (0="Not at all"; 4="All the time"). The PCS can be scored to produce three scales (Rumination, Magnification, and Helplessness) as well as a total score that ranges from 0 to 52. The PCS has demonstrated good internal consistency (Cronbach's α for the total scale=0.87), test-retest reliability at 6 weeks (r=0.75), and construct validity.[28] The Chinese PCS also showed good psychometric properties (Cronbach's α for the total score=0.93, item-total correlation coefficients ranging from 0.58 to 0.78).[29]

Center for Epidemiological Studies -- Depression Scale (CES-D)

Depression was assessed using the 20-item Center for Epidemiological Studies -- Depression scale (CES-D).[30] The CES-D was designed to assess frequency of depressive symptoms in non-psychiatric populations. Respondents are asked to indicate the frequency with which they experience each of the 20 symptoms listed during the past week on 4-point Likert scales (0="Less than one day"; 3="5-7 days"). The total CES-D score is computed by summing

the responses of all items, with higher scores indicating greater depressive symptoms (score range: 0-60). The CES-D has demonstrated good concurrent validity with clinical diagnoses of depression in chronic pain populations.[31, 32] The Chinese version has been validated, yielding good internal consistency (Cronbach's α=0.77) and reliability (r=0.77).[33]

Data Analysis

SPSS (Statistical Package for the Social Sciences) version 15.0[34] was used to compute sample descriptive statistics, internal consistency coefficients (Cronbach's αs) for each of the ChPBPI scales, and associations between the ChPBPI scales and the validity criteria (CPG Characteristic Pain and Disability score, CES-D score, and PCS score). Since the PBPI is a theory-driven measure with known factor structure, confirmatory factor analyses (CFA) were first performed using EQS for Windows 6.1 structural equation modeling program[35] Prior to performing the CFAs, univariate skew and kurtosis as well as Mardia's coefficient for skewness and kurtosis were computed to examine univariate and multivariate normality assumptions in the data.[36] Each of the 16 ChPBPI items was specified to load on its respective factor based on the four hypothesized pain beliefs and perception scales of PBPI as reported in William et al.[21] Specifically, four items were specified to load on a single latent "Mystery" factor (Model 1), five items were specified to load on a "Permanence" factor (Model 2), four items were specified to load on a "Constancy" factor (Model 3), and three items were constrained to load on a "Self-blame" factor (Model 4). The PBPI was designed to assess four theoretically-derived pain beliefs and the four factors were not necessarily correlated to each other. As such, the four factors were tested individually, and no second-order factor was hypothesized. Model fit was assessed using χ^2 statistics, comparative fit index (CFI),[37] normed-fit index (NFI),[38] root mean square error of approximation (RMSEA),[39] and 90% confidence interval of RMSEA (CI). CFI and NFI value of ≥0.90, and RMSEA value of ≤0.08 were indicative of good fit.[37, 39] If results of CFAs failed to confirm the structure of the original PBPI in the present data, principal component analysis and exploratory factor analysis would be used to identify the underlying dimension of the present data.

Finally, three hierarchical multiple regression models were fitted to evaluate the extent to which the ChPBPI scales were associated with concurrent criterion variables (depression, pain intensity, and disability). In all models, socio-demographic variables that were significant in univariate analyses (p<0.05) were entered in the first block to control for potential confounding

effects. Two pain variables, including pain duration and number of pain sites, were entered in the second block, followed by PCS. The four ChPBPI scales were entered in a final step. The dependent variables of pain intensity and disability were indexed by the CPG Characteristic Pain Intensity Score and Disability Score, respectively. Depression was indexed by the CES-D total score.

Results

Pain Characteristics

The present sample had an average of 1.89 (SD=1.44; range: 1-11) pain sites with 51.4% reporting a single pain site and 48.7% multiple pain sites (Table 1). The most common pain site was leg (37.0%), followed by low back (28.8%) and hand (26.9%). Patients reportedly experienced an average of 4.15 years (SD=5.83, range, 3 months to 40 years) of pain problems. While over half (54.3%) had had pain for up to 2 year's duration, 22.6% had suffered from chronic pain for more than 5 years. The mean scores of present, average, and worst pain were 3.98 (SD=2.70), 5.40 (SD=2.16), and 7.54 (SD=2.38), respectively. On pain interference measures, the sample reported a mean score of 5.82 (SD=2.98), 5.00 (SD=3.40), and 5.79 (SD=3.36) for daily activity, social activity, and working ability interference, respectively. The sample reported an average of 25.38 days (SD=38.10; range: 0-90 days) of pain associated disability. The CPG classification placed 52.5% of the sample as Grade III or above (high disability and moderately to severely limiting). The mean total scores of PCS and CES-D were 29.00 (SD=14.30) and 17.99 (SD=14.06), respectively.

Factorial validity of the ChPPBI

The univariate skew estimates for the ChPBPI items ranged from -1.52 to 13.33. The univariate kurtosis estimates ranged from -1.63 to 184.04. Mardia's normalized estimate of multivariate kurtosis was 171.14. These estimates indicated that the data tended not to be normally distributed, we therefore reported the Satorra-Bentler chi-square statistic, as this incorporates a scaling correction for non-normal sampling distributions.[40]

Table 2 presents the results of CFAs applied on the present sample for the four ChPBPI scales. All four models fit the data well with CFI and NFI meeting the minimum acceptable fit criterion (≥0.90) (Mystery, Model 1: CFI=0.99, NFI=0.99; Permanence, Model 2: CFI=0.92,

NFI=0.92; Constancy, Model 3: CFI=0.94, NFI=0.92; Self-blame, Model 4: CFI=0.99, NFI=0.97). The standardized factor loadings of all items on their respective factors were statistically significant ($p<0.05$).

Reliability and validity the ChPBPI

Table 3 presents the internal consistency coefficients (Cronbach's αs) and descriptive statistics, and the correlation of the four ChPBPI scales with four validity criteria. The four ChPBPI scales demonstrated acceptable internal consistency, with Cronbach's α ranging from 0.60 to 0.76. The Constancy scale obtained the highest mean of 2.31 (SD=0.93), suggesting that it was the most highly endorsed pain belief in the present sample. Self-blame was among the lowest ChPBPI scales (Mean=1.03; SD=1.05), suggesting that this pain beliefs was not commonly endorsed as compared to the other three pain beliefs assessed.

The four ChPBPI scales were significantly correlated with each other ($p<0.05$), except the association between Self-blame and Permanence ($r=0.05$, ns). The strength of association was the highest between Constancy and Permanence ($r=0.45$, $p<0.01$). As it is commonly accepted that correlations below 0.60 indicate unidimensionality between scales,[41] the results lend support for the present data that, while the four subscales are intercorrelated with each other ($r \leq 0.45$), they measure significantly different dimensions of ChPBPI (i.e., the scores obtained on each subscale are distinct from those obtained on the other subscales). The four scales were also significantly associated with the four validity criteria ($p<0.05$), except for the association between Permanence and catastrophizing thinking ($r=0.13$, ns).

Multivariate prediction of concurrent chronic pain adjustment from the ChPBPI scales

Table 4 reports the results of hierarchical multiple regression analyses. After controlling for socio-demographic and pain variables, both PCS ($F(1,191)=69.43$, $p<0.001$) and ChPBPI scales ($F(4,187)=6.01$, $p<0.001$) contributed significantly to the prediction of concurrent depression. While ChPBPI accounted for 7% of the total variance in depression scores, only "Permanence" emerged as a significant independent correlate of concurrent depression (when controlling for other ChPBPI scales; std $\beta=0.22$, $p<0.01$). The amount of unique variance explained by PCS was the largest at 23% whereas pain variables and ChPBPI scales each explained 7% of the total variance.

Similarly, after adjusting for socio-demographic and pain variables, both PCS ($F(1,190)=32.93$, $p<0.001$) and ChPBPI scales ($F(4,186)=4.61$, $p<0.01$) contributed significantly to the prediction of concurrent pain intensity. While 13% of the total variance was explained by sociodemographic variables, 6% was explained by ChPBPI scales, with "Constancy" being a significant independent predictor of concurrent pain intensity (when controlling for other ChPBPI scales (std $\beta=0.21$, $p<0.01$)).

When socio-demographic and pain variables were controlled, both PCS ($F(1,194)=35.96$, $p<0.001$) and ChPBPI scales ($F(4,190)=3.54$, $p<0.05$) contributed significantly to the prediction of concurrent disability. The amount of unique variance explained by PCS and ChPBPI scales were 14% and 5% respectively. Of the four ChPBPI scales, "Constancy" (std $\beta=0.19$, $p<0.05$) significantly predicted concurrent disability.

Discussion

The aim of the present paper was to examine the factor structure, reliability, and construct validity of the Chinese version of the PBPI (ChPBPI) in a sample of Chinese patients with chronic pain. The findings support the reliability and validity of the four ChPBPI scales, as evidenced by its satisfactory internal consistency, replication of a 4-factor structure by CFA, univariate associations with depression, pain severity, and disability measures in expected directions, and multivariate associations with the validity criterion.

The results of CFAs replicate, in a sample of Chinese patients with chronic pain, a model hypothesizing that the 16 pain beliefs assessed by PBPI represent four factors, as has been found in English speaking samples.[21, 22] All four of the ChPBPI scales possessed good data-model fit. These findings offer preliminary support for the cross-cultural validity of the PBPI, in that the underlying latent constructs of the PBPI appear to be similar for both the present Chinese and patients with chronic pain in the United States[21] and the United Kingdom.[22] Although we cannot directly evaluate cross-cultural factorial invariance, from a cross-cultural perspective, the findings tentatively suggest that there would be few differences between Chinese and Western patients in terms of the underlying structure of beliefs about pain as assessed by PBPI. Differences in PBPI verses ChPBPI mean scores may therefore indicate true group differences, or true effects of an intervention on the underlying construct, as opposed to differences or a change in the factor structure of the scale. The similarity in factor structure between the ChPBPI (in our

sample) and the PBPI (in an American and a British sample) might be partly explained by the similarities of patient characteristics between the present sample and the sample employed in William et al[21] and Morley and Wilkinson.[22] However, this is the first study to examine the factor structure of the ChPBPI; future research is needed to determine if the cross-cultural factorial invariance of PBPI suggested in this study replicates in other samples.

The reliability of the ChPBPI scales was supported with adequate Cronbach's αs ranging from 0.60 to 0.76 for the four scales. With the exception of the poor correlation between Permanence and pain catastrophizing, validity was supported with correlations between the ChPBPI scales and measures of depression, catastrophizing, pain intensity, and disability -- all in the expected positive directions -- with the strengths of the associations found generally comparable with other studies.[1, 5, 19, 21, 42] Of the four ChPBPI scales, the degree of association between Constancy and the criterion measures was the strongest, indicating that a stronger belief in pain being constant was associated with higher levels of depressive symptoms, more catastrophizing, higher pain intensity and higher levels of disability.

The predictive validity of the ChPBPI scales was also supported. The ChPBPI scales contributed significantly to the prediction of depression (7% unique variance after all other factors in the model were considered), pain disability (6% unique incremental variance), and pain disability (5% unique incremental variance) in multivariate analyses. After controlling for the other ChPBPI scales, Permanence made an independent contribution to the prediction of depression (std β = 0.22, p<0.01), whereas Constancy emerged as independent predictor of both pain intensity (std β=0.21, p<0.01) and pain disability (std β=0.19, p<0.05). These findings are in line with previous multivariate findings that demonstrated significant independent association between Constancy and pain interference.[7] The amount of variance explained by pain beliefs in the three regression models is comparable with that of the socio-demographic and pain variables. These findings suggest that patients' representation of pain is as important as their background information (e.g., age, gender, pain duration, etc) in influencing their adjustment outcomes. Although ccatastrophizing thought was consistently shown to be the most important factor predicting chronic pain adjustment, accounting for the greatest proportion of variance in all 3 models tested (12% to 23%), the significant contribution of pain beliefs to the prediction of all three adjustment variables suggests that the relationship between pain beliefs and patient psychological and physical functioning is not entirely mediated by catastrophizing. This implies

that cognitive-behavioral interventions that usually target only catastrophic thought could expand its scope by identifying and addressing maladaptive pain beliefs such that the overall effectiveness could be increased.

Caution is warranted in interpreting and generalizing the findings. The evidence reported here that support the reliability and validity of the ChPBPI should be considered preliminary, since the ChPBPI translation was validated within a Cantonese-speaking Chinese patients in Hong Kong, and the measure was validated on Cantonese speaking Hong Kong-Chinese. The extent to which the ChPBPI can be generalized to Chinese populations speaking other Chinese dialects (e.g., Mandarin) remains unknown. To address this question, the ChPBPI should be studied in other Chinese populations. Despite the good psychometric properties of the ChPBPI, the instrument might not fully capture unique pain related needs and concerns among Chinese pain patients because the PBPI was developed in a Western context. Future studies are therefore encouraged to explore pain beliefs that are unique in the Chinese cultures using qualitative methods. In addition, and as alluded to above, since the validity of the ChPBPI in the present study was based on cross-sectional data, causal conclusions regarding the influence of pain beliefs on adjustment, or vice versa, cannot be made. Future research that employs longitudinal prospective designs could help delineate the causal associations between coping strategies and adjustment. In particular, analytic approaches such as latent growth curve modelling could be used to help disentangle the potential nonlinear relationships among ChPBPI scales, catastrophizing thinking, pain variables, and adjustment outcomes.

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