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Development of a short form of the Hong Kong Chinese orebro musculoskeletal pain screening questionnaire

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Background: The Orebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) is a valid screening tool to identify those musculoskeletal patients at risk of developing chronicity and disability. A Hong Kong Chinese version of the OMPSQ (COMPSQ-HK) was developed with satisfactory construct validity and predictive validity.

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Objective: The aim of this study was to develop a 10-item short form of the COMPSQ-HK (COMPSQ-HK10) and examine its measurement properties.
Methods: The 10 items were identified from the suggestion by the original author of OMPSQ. The data of the 10 items were extracted from the main study to develop the COMPSQ-HK conducted from 2010 to 2013. The internal consistency using Cronbach's alpha, test–retest reliability examining intraclass correlation coefficient ($ICC_{1,1}$), minimum detectable change and 95% limits of agreement, construct validity by correlating COMPSQ-HK10 with pain, disability score, kinesiophobia score and Medical Outcomes Study Short Form 12, and predictive validity investigating receiver operating characteristic (ROC) curve analyses with sick leave > 60 days and return-to-work status at one year were calculated.
Results: A total of 305 back patients and 160 neck patients were recruited with about 30% of patients lost to follow-up at one year. Both the internal consistency (Cronbach's alpha as 0.732 to 0.757) and test–retest reliabilities ($ICC_{1,1}$ as 0.868 for both back and neck patients) were satisfactory. The correlations between COMPSQ-HK10 and COMPSQ-HK for back and neck patients were excellent (Pearson r as 0.919 and 0.896, respectively, $p < 0.001$). The areas under the ROC curves for back and neck patients were similar for COMPSQ-HK10 and COMPSQ-HK, ranging from 0.603 to 0.712. A cut-off score of 54 of COMPSQ-HK10 was recommended in predicting "sick leave of more than 60 days at one year" and "return to work for at least four consecutive weeks at one year".
Conclusion: The COMPSQ-HK10 has comparable measurement properties with the COMPSQ-HK. It is recommended to use the COMPSQ-HK10 for routine screening to identify patients of back and neck pain at risk of developing chronic pain and disability.

Keywords: Musculoskeletal disorders; screening; yellow flags.

Introduction

Musculoskeletal disorders are the second most common cause of disability.[1] Among the 291 conditions studied in the Global Burden of Disease 2010 study, low back pain (LBP) was ranked first in causing global disability and the sixth in terms of overall burden in disability-adjusted life years (DALYs)[2]; whereas neck pain was ranked the 4th in terms of overall disability and the 21st in terms of overall burden in DALYs.[3] In the more recent Global Burden of Disease Study 2015, low back and neck pain was the leading cause of disability globally in terms of years lived with disability in 2015.[4] The management of persistent LBP and neck pain implies substantial burden to the society due to direct and indirect costs, especially for LBP.[5] People with persistent LBP or neck pain are more disabled when they possess certain psychosocial factors, known as "yellow flags". Yellow flags are psychosocial factors that will increase the risk of developing prolonged pain and disability in patients with LBP or neck pain.[6] Early identification of yellow flags is highly recommended in managing patients with LBP[7] and neck pain.[8]

The Orebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) is a widely used screening tool for psychological risk factors for LBP and neck pain.[9] Although the OMPSQ has shown moderate predictive validity in identifying patients with LBP or neck pain at risk of persisting pain and disability,[10] it becomes increasingly difficult for patients to complete the 25-item questionnaire in busy physiotherapy out-patient clinics. If a shorter questionnaire with comparable measurement properties is available, it will be more practical for administration with reduced burden to physiotherapists and patients. A short form of 10-item OMPSQ had been developed from the original OMPSQ based on the factors from a theoretical framework.[11] It includes five concept areas, namely pain experience, self-perceived function, distress, return-to-work expectancy and fear avoidance beliefs. A summary score from 1 to 100 is obtained with higher scores indicating higher estimated risk for cumulated sick leave for 14 days. High correlation and comparable predictive validity of the short and original forms of OMPSQ were reported. The short form had been translated into Brazilian–Portuguese with measurement properties tested.[12]

The aim of this study was to develop a Chinese version of the 10-item short form OMPSQ based on Linton *et al.*'s work[11] and to examine its measurement properties in patients with back and neck pain.

Methods

Setting and design

This study was a part of a prospective observational study conducted in 14 public physiotherapy outpatient centers in Hong Kong. Patients were followed up for one year and the main study aimed to develop a Hong Kong Chinese version of OMPSQ (COMPSQ-HK). The original Hong Kong COMPSQ was cross-culturally adapted and administered. Its development has been reported elsewhere.[13] The Chinese short form was constructed according to the 10 items of OMPSQ identified from Linton *et al.*'s study[10] with five concept areas in pain experience, self-perceived function, distress, return-to-work expectancy and fear avoidance beliefs (see Appendix). The data of the 10-item short form (COMPSQ-HK10) were extracted from the original form of COMPSQ-HK. It was then pilot tested on 30 subjects for field testing.

Participants

Patients were recruited if they were Chinese workers aged 18–65 years old; with acute or subacute non-specific back or neck pain without recognizable or known specific pathology and having onset less than 12 weeks; resulted from injury on duty or having sick leave for more than seven days due to musculoskeletal injury. Those with spinal surgery in the past 12 months; serious spinal pathologies such as fracture, tumor, infection; or other specific conditions such as spondylolisthesis, spinal stenosis, inflammatory disorder, neurological deficits, pregnancy; illiteracy or inability to read Chinese were excluded. Written consent was obtained from each subject and the study was approved by the respective Research Ethics Committees of the seven clusters of the Hospital Authority, Hong Kong.

Procedures

At baseline, data were collected from patients with acute or subacute non-specific back or neck pain on COMPSQ-HK, Chinese Numeric Pain Rating Scale (NPRS),[14] Chinese Roland-Morris Disability Questionnaire (RMDQ-HK),[14] Chinese Northwick Park Neck Pain Questionnaire (NPQ-HK),[15] Chinese Tampa Scale for Kinesiophobia (TSK-HK),[16] Chinese Medical Outcomes Study Short Form 12 (SF-12),[17] together with demographic data such as age, gender, educational level and occupation. The Chinese NPRS is a 0 to 10-point numeric scale to measure pain intensity of patients. The Chinese RMDQ-HK and Chinese NPQ-HK were 24-item and 10-item questionnaires to assess the functional status of patients with back pain and neck pain, respectively. The Chinese TSK-HK was a 11-item scale designed to assess fear of movement/(re)injury. The Chinese SF-12 is a 12-item health-related quality of life summary measure of physical health and mental health. At discharge from physiotherapy treatments, data on NPRS, RMDQ-HK and NPQ-HK were collected again. The Numeric Global Rating of Change Scale (NGRCS)[14] was also used to assess the overall change in condition of patients at discharge. The patients were contacted by phone to assess their cumulative duration of sick leave and return to work status at one year from baseline. Data analyses for patients with back pain and patients with neck pain were separately conducted.

Internal consistency and test–retest reliability

The internal consistency was assessed to compute the Cronbach's alpha. Stable patients with no change in overall condition one week after the first attendance were invited to complete the COMPSQ-HK again to estimate the test–retest reliability of the COMPSQ-HK and COMPSQ-HK10 using the intraclass correlation coefficient with one-way random-effects model ($ICC_{1,1}$). The standard error of measurement (SEM), minimum detectable change in 95% confidence interval ($MDC_{95\%CI}$), and 95% limits of agreement (95% LoA) were computed.

Construct validity

The construct validity of the COMPSQ-HK and COMPSQ-HK10 was tested using correlational analyses of COMPSQ-HK and COMPSQ-HK10 score with scores of NPRS, RMDQ-HK, NPQ-HK, TSK-HK and SF-12 at baseline. With normality assumption of data fulfilled, the Pearson r was calculated.

Predictive validity

The predictive validity of the COMPSQ-HK and COMPSQ-HK10 was also examined with the baseline score as the predictor variable and sick leave duration (more than 60 days of cumulative sick leave) and return-to-work status (return to

part-time or full-time work for at least four consecutive weeks) at one-year follow-up as the outcome variables using receiver operating characteristic (ROC) curve analyses. The ROC curve is a plot of sensitivity (true positive) against "1 minus specificity" (false positive) for various cut-points of the test variable in relation to the outcome.[18] The areas under the curve (AUC) of the ROC curve analyses of COMPSQ-HK and COMPSQ-HK10 were computed and compared. The optimal cut-off scores of the COMPSQ-HK and COMPSQ-HK10 were chosen with the consideration of balanced values of associated sensitivity (Sn), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV) calculated.[18] The predictive values were computed on a presumed prevalence of 50%.

Data analysis

The ROC curve analyses were conducted using the MedCalc Statistical Software 14 (MedCalc, Ostend, Belgium). All other statistical analyses were conducted using the IBM SPSS Statistics 23.0 (IBM Corp, NY). The level of significance of all statistical tests was set at 0.05.

Results

Baseline data

Twelve males and 18 females participated in the field testing of the COMPSQ-HK10 questionnaire. Their mean age was 47.0 years old (SD 13.6). Twenty-two patients had back pain and eight patients had neck pain. The average time to complete the short form version was 3.2 min (SD = 0.3). Floor and ceiling effects were not observed with COMPSQ-HK10. A total of 465 neck and back pain patients with informed consent were recruited in the original COMPSQ-HK study from November 2010 to July 2013 and the patients were followed up for one year. All the data for the COMPSQ-HK10 were extracted from the COMPSQ-HK. There were 305 patients with back pain and 160 patients with neck pain. The back pain group had a mean age of 42.2 years (SD = 10.0) and half of them were male. The neck pain group had a mean age of 41.6 years (SD = 10.4) and 63% of patients were male. Details of their demographics and baseline data have been reported previously.[13]

For patients with back pain ($n = 305$), the mean COMPSQ-HK and COMPSQ-HK10 was 110.7 (SD = 26.4) and 54.6 (SD = 14.4), respectively. The mean NPRS was 6.1 (SD = 1.9). Pearson correlation coefficient between COMPSQ-HK and COMPSQ-HK10 for back pain patients was 0.919 ($p < 0.001$). For patients with neck pain ($n = 160$), the mean COMPSQ-HK and COMPSQ-HK10 was 109.1 (SD = 25.0) and 55.4 (SD = 13.5), respectively. The mean NPRS was 6.3 (SD = 1.9). Pearson correlation coefficient between COMPSQ-HK and COMPSQ-HK10 for neck pain patients was 0.896 ($p < 0.001$). At one-year follow up, there were 90 patients with back pain (29.5%) and 54 patients with neck pain (33.7%) lost to follow-up despite repeated contacts through various means. *Post-hoc* analysis showed that there was no significant difference in demographics and COMPSQ-HK score between the respondents and non-respondents, except the non-respondents of back pain were about 3.5 years younger.

Internal consistency

The internal consistency of COMPSQ-HK and COMPSQ-HK10 were summarized in Table 1. The Cronbach's alphas of the COMPSQ-HK were 0.843 (95% CI 0.816–0.867) and 0.826 (95% CI 0.784–0.863) for patients with back pain and neck pain, respectively. The Cronbach's alphas of COMPSQ-HK10 were 0.757 (95% CI 0.715–0.796) and 0.732 (95% CI 0.665–0.790) for patients with back pain and neck pain, respectively.

Test–retest reliability

The test–retest reliabilities of the COMPSQ-HK and COMPSQ-HK10 for patients with back pain and neck pain are shown in Table 2. For COMPSQ-HK, the $ICC_{1,1}$ are 0.814 (95% CI 0.627 to 0.913) and 0.922 (95% CI 0.762 to 0.977) in the

Table 1. Internal consistency of COMPSQ-HK and COMPSQ-HK10.

	Cronbach's alpha (95% CI)	
	COMPSQ-HK	COMPSQ-HK10
Back cases ($n = 305$)	0.843 (0.816–0.867)	0.757 (0.715–0.796)
Neck cases ($n = 160$)	0.826 (0.784–0.863)	0.732 (0.665–0.790)

Note: CI — Confidence interval.

Table 2. Comparison of COMPSQ-HK and COMPSQ-HK10 in ICC, SEM, MDC & LoA.

	$ICC_{1,1}$ (95% CI)		SEM		$MDC_{95\%CI}$		95% LoA	
	COMPSQ-HK	COMPSQ-HK10	COMPSQ-HK	COMPSQ-HK10	COMPSQ-HK	COMPSQ-HK10	COMPSQ-HK	COMPSQ-HK10
Back cases ($n = 25$)	0.814 (0.627 to 0.913)	0.868 (0.726 to 0.939)	11.6	5.9	32.1	16.5	−32.4 to 31.8	−16.5 to 16.4
Neck cases ($n = 12$)	0.922 (0.762 to 0.977)	0.868 (0.620 to 0.960)	7.6	5.2	21.1	14.3	−15.4 to 26.7	−10.5 to 16.7

Table 3. Correlations of COMPSQ-HK10 with other variables.

	Pearson r COMPSQ-HK10	
	Back patients	Neck patients
NPRS	0.467	0.525
RMDQ-HK/NPQ-HK	0.523	0.724
TSK-HK	0.472	0.554
SF-12 PCS	−0.437	−0.448
SF-12 MCS	−0.466	−0.339

Notes: All Pearson r with $p < 0.001$; MCS — Mental Component Summary; PCS — Physical Component Summary.

back pain and neck pain patient groups, respectively ($p < 0.001$ in both groups). For COMPSQ-HK10, the $ICC_{1,1}$ are 0.868 (95% CI 0.726 to 0.939) and 0.868 (95% CI 0.620 to 0.960) in the back pain and neck pain patient groups, respectively ($p < 0.001$ in both groups). The 95% LoA of the COMPSQ-HK for patients with back pain and neck pain were −32.4 to 31.8 and −15.4 to 26.7, respectively. The 95% LoA of the COMPSQ-HK10 for patients with back pain and neck pain were −16.5 to 16.4 and −10.5 to 16.7, respectively.

Construct reliability

The correlations of COMPSQ-HK10 scores and other baseline variables are shown in Table 3. Positive correlations were found between COMPSQ-HK10 and NPRS, RMDQ and TSK-HK. Negative correlations were found between COMPSQ-HK10 and SF-12. Correlation coefficients were the highest between COMPSQ-HK10 and RMDQ-HK ($r = 0.523$) for patients with back pain and NPQ-HK ($r = 0.724$) for patients with neck pain.

ROC curve analysis

The results of the ROC curve analyses of patients with back pain or neck pain are shown in Table 4.

Table 4. Results of ROC curve analyses with long sick leave and return to work status at one-year follow-up.

ROC curve analyses							
Patients	AUC (95% CI)	COMPSQ-HK10 optimal cut-off	Sn	Sp	PPV	NPV	Number of patients with affirmed outcome
Outcome: Sick leave more than 60 days at one-year follow-up							
Back ($n = 214$)	0.711 (0.645–0.771)	> 54	68.5%	64.8%	66.0%	67.3%	91 (43.0%)
Neck ($n = 105$)	0.660 (0.561–0.749)	> 54	64.7%	57.4%	60.3%	61.9%	58 (55.2%)
Outcome: Return to part-time or full-time work for at least four consecutive weeks at one-year follow-up							
Back ($n = 215$)	0.712 (0.646–0.771)	≤ 54	57.5%	75.0%	69.7%	63.8%	167 (77.7%)
Neck ($n = 106$)	0.603 (0.503–0.697)	≤ 54	51.3%	64.3%	58.9%	56.9%	78 (73.6%)

In order to predict "sick leave of more than 60 days at one-year", the optimal cut-off score of the COMPSQ-HK10 is > 54 for patients with back pain and neck pain (Table 4). The AUC at this cut-off was 0.711 (95% CI: 0.645 to 0.771), with a sensitivity of 68.5% and a specificity of 64.8% and a positive predictive value of 66.0% and a negative predictive value of 67.3% for back pain, and 0.660 (95% CI: 0.561 to 0.749), with a sensitivity of 64.7% and a specificity of 57.4% for neck pain, and a positive predictive value of 60.3% and a negative predictive value of 61.9%. To predict "return to work (full-time or part-time) for at least four consecutive weeks at one-year", the optimal cut-off score is ≤ 54 for back pain and neck pain (Table 4). The AUC at this cut-off was 0.712 (95% CI: 0.646 to 0.771), with a sensitivity of 57.5% and a specificity of 75.0% and a positive predictive value of 69.7% and a negative predictive value of 63.8% for back pain, and 0.603 (95% CI: 0.503 to 0.697), with a sensitivity of 51.3% and a specificity of 64.3% and a positive predictive value of 58.9% and a negative predictive value of 56.9% for neck pain.

Discussion

A local clinical trial, despite using an informal Chinese version of OMPSQ without adequate cultural adaptation for screening, showed superior effects for targeted interventions for patients with back pain.[19] This study further suggested that a short version of a validated Chinese OMPSQ would be beneficial for routine screening in busy physiotherapy out-patient clinics. The present COMPSQ-HK10 should be practical for routine use as it requires an average of about 3 min for completion. This will certainly help physiotherapists in assessing patient's fear, anxiety and depression in managing musculoskeletal pain disorders.[20,21]

The measurement properties of the COMPSQ-HK10 were comparable to findings of other study.[12] The internal consistencies of the COMPSQ-HK10 for back and neck patients were similar with that of the Brazilian–Portuguese short version (Cronbach's alpha = 0.72). The test–retest reliability of the Brazilian–Portuguese version in terms of ICC was 0.78 whereas that of the COMPSQ-HK10 for back and neck pain was substantial at 0.868. Both the SEM and the 95% LoA of the COMPSQ-HK10 for patients with back pain and neck pain were better than that of the Brazilian–Portuguese version. Different timing in administering the screening tool is likely to affect the test–retest reliability and in particular the predictive validity of the tool. Further studies are required to substantiate the appropriate timing in administering the tool to patients after their onset of musculoskeletal pain disorders.

As shown in Table 3, the construct validity of the COMPSQ-HK10 demonstrated moderate correlations with pain, RMDQ/NPQ, kinesiophobia and SF-12 scores. Despite there was a lower correlation of the COMPSQ-HK10 with RMDQ in the local population ($r = 0.523$) as compared to the correlation of the OMPSQ short form and RMDQ in the Brazilian–Portuguese population ($r = 0.690$), all other figures were comparable.

This study shows fair to moderate predictive validity of the COMPSQ-HK10 in predicting sick leave > 60 days and return to work status at one year. Cut-off days for sick leave was observed to vary from 7 days,[22] 14 days,[12,23] 30 days[24,25] to 6 months[26] in the literature. The choice of > 60 sick leave days as an outcome indicator in this study was much dependent on the local practice that both the waiting time for seeking orthopedic specialist care and the sick leave granted by the attending physician are usually more than 30 days. In the study of Linton *et al.*,[11] the AUC for the OMPSQ short form were 0.70 and 0.81 for the occupational sample and primary care sample, respectively. In the present study, the AUC for the COMPSQ-HK10 in predicting patients with back pain for > 60 days sick leave and RTW status at one year were > 0.7. However, the AUC for the COMPSQ-HK10 in predicting patients with neck pain for > 60 days sick leave and RTW status at one year were slightly less favorable (> 0.6). Similar phenomenon was observed for COMPSQ-HK in predicting long sick leave and RTW status at one year for neck patients. The AUCs for COMPSQ-HK and COMPSQ-HK10 were nearly identical in their predictive validity (Table 5). Linton *et al.*[11] recommended a cut-off of 50 for their OMPSQ short form. In the present study, a cut-off of 54 in the COMPSQ-HK10 for both the back and neck patients was suggested with consideration to optimize the sensitivity and specificity. The selection of optimal cut-off score is largely dependent on the patient characteristics, practice setting and the choice of outcome indicators.[27]

Strong correlations were observed between the COMPSQ-HK and COMPSQ-HK10 for back

Table 5. Comparison of areas under the ROC curve of COMPSQ-HK and COMPSQ-HK10.

	AUC			
Patients	COMPSQ-HK	COMPSQ-HK10	Difference	*P*-value
Outcome: Sick leave more than 60 days at one-year follow-up				
Back	0.708	0.711	0.003	0.828
Neck	0.605	0.660	0.009	0.745
Outcome: Return to part-time or full-time work for at least four consecutive weeks at one-year follow-up				
Back	0.710	0.712	0.002	0.910
Neck	0.586	0.603	0.017	0.591

patients ($r = 0.92$) and neck patients ($r = 0.90$). The test–retest reliability and predictive validity of the COMPSQ-HK10 were highly comparable to those of the COMPSQ-HK.

Limitations

The internal consistency of COMPSQ-HK10 dropped slightly in terms of Cronbach's alpha. Clinicians have to be aware that the short version of OMPSQ has less clinical information and the concept area on coping has been omitted. For a better understanding of the patient's psychosocial condition and discussion of the situation with the patient, the original OMPSQ will be more superior.[11]

About 30% of participants were lost to follow-up at one year and this posed a major limitation to the study. *Post-hoc* analysis was conducted and no significant difference in the demographics and COMPSQ-HK10 scores between the respondents and non-respondents were found, except the non-respondents of back pain were 3.5 years younger. It is believed that the results are still applicable to those patients lost to follow-up. In addition, the use of extracted items from the COMPSQ-HK to develop the COMPSQ-HK10 was likely to have the shared measurement error and contribute to type I error.[28] It is unknown if the results would have differed if only the COMPSQ-HK10 were administered. A study comparing the performance of three SF-36 scales (physical functioning, bodily pain and general health perceptions) administered independently to when they were administered wholly as the full version questionnaire showed no significant difference.[29] Extracting findings of items from those of the full questionnaire is, however, common in the validation of short version of OMPSQ of another language.[12] Finally, the self-reporting of outcomes of their RTW status and sick leave period was another limitation of the study. However, the actual figures could not be verified objectively as these data were not captured systematically in the local scene.

Conclusion

The results of the present study support the predictive validity of the COMPSQ-HK10 with comparable measurement properties to the COMPSQ-HK. Given its limitations, it is recommended to use the COMPSQ-HK10 for routine screening to identify patients of back and neck pain at risk of developing chronic pain and disability. Further study of the COMPSQ-HK10 in other musculoskeletal conditions is warranted.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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Author Contributions

All the authors contributed to the conception and design of study, data analysis and interpretation, manuscript drafting, revision and approval for the submission to publication. RKY Lee, JSY Lau, SSF Kwong, EML So, TFY Wong and EWC Lee assisted in the data collection of the study.

Appendix: Short Form of the COMPSQ-HK

Table A.1.

	Item	Concept area	Scoring
1	How long have you had your current pain problem? 你目前疼痛的問題已有了多久?	Pain experience	1–10
2	How would you rate the pain that you have had during the past week? 你如何評估**過去一星期**你痛楚的程度?	Pain experience	0–10
3	Please circle one number that best describes your current ability to participate in each of these activities 請圈出最能形容你現時參與每項活動的能力。 I can do light work for an hour. 我可以做一小時輕巧的工作。	Self-perceived function	0–10, reversed scoring
4	Please circle one number that best describes your current ability to participate in each of these activities 請圈出最能形容你現時參與每項活動的能力。 I can sleep at night. 我晚上睡得著。	Self-perceived function	0–10, reversed scoring
5	How tense or anxious have you felt in the past week? **過去一星期**你覺得緊張或焦慮的程度如何?	Distress	0–10
6	How much have you been bothered by feeling depressed in the past week? **過去一星期**你因感到沮喪而使你有多煩擾?	Distress	0–10
7	In your view, how large is the risk that your current pain may become persistent? 你認為你目前的痛楚持續下去的風險有多大?	Return to work expectancy	0–10
8	In your estimation, what are the chances you will be working your normal duties in six months? 你估計你未來**六個月**內能如常工作的機會有多大?	Return to work expectancy	0–10, reversed scoring
9	An increase in pain is an indication that I should stop what I'm doing until the pain decreases. 痛楚增加就表示我應該停止我正進行的事情，直至痛楚減退。	Fear avoidance beliefs	0–10
10	I should not do my normal work with my present pain. 以我目前的痛楚情況，我不應作我慣常的活動，包括工作。	Fear avoidance beliefs	0–10

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