

## 1 Introduction

The Pain Sensitivity Questionnaire (PSQ) consists of 17 imagined situations, of which 14 are considered painful. Subjects are asked to rate each item's painfulness on a 0-10 numeric rating scale, originally in a pen-and-paper format<sup>1</sup>. Ruscheweyh et al. showed that the PSQ had strong internal consistency consisting of two sub-factors labeled as sensitivity to "minor" and "moderate" pain and also correlation with subjective pain experienced from pinprick, pressure, phasic and tonic heat and cold, and the cold pressor test, but not with response thresholds, including, in the cold pressor test, time to withdraw one's hand from cold water.

This study describes the internal and criterion validity of the PSQ in an online self-administered format. Online administration allows for the collection of substantially larger samples of people in the general population and with conditions including chronic pain. Such large samples are required for genome-wide and other "omic" association studies which involve thousands or millions of statistical tests.

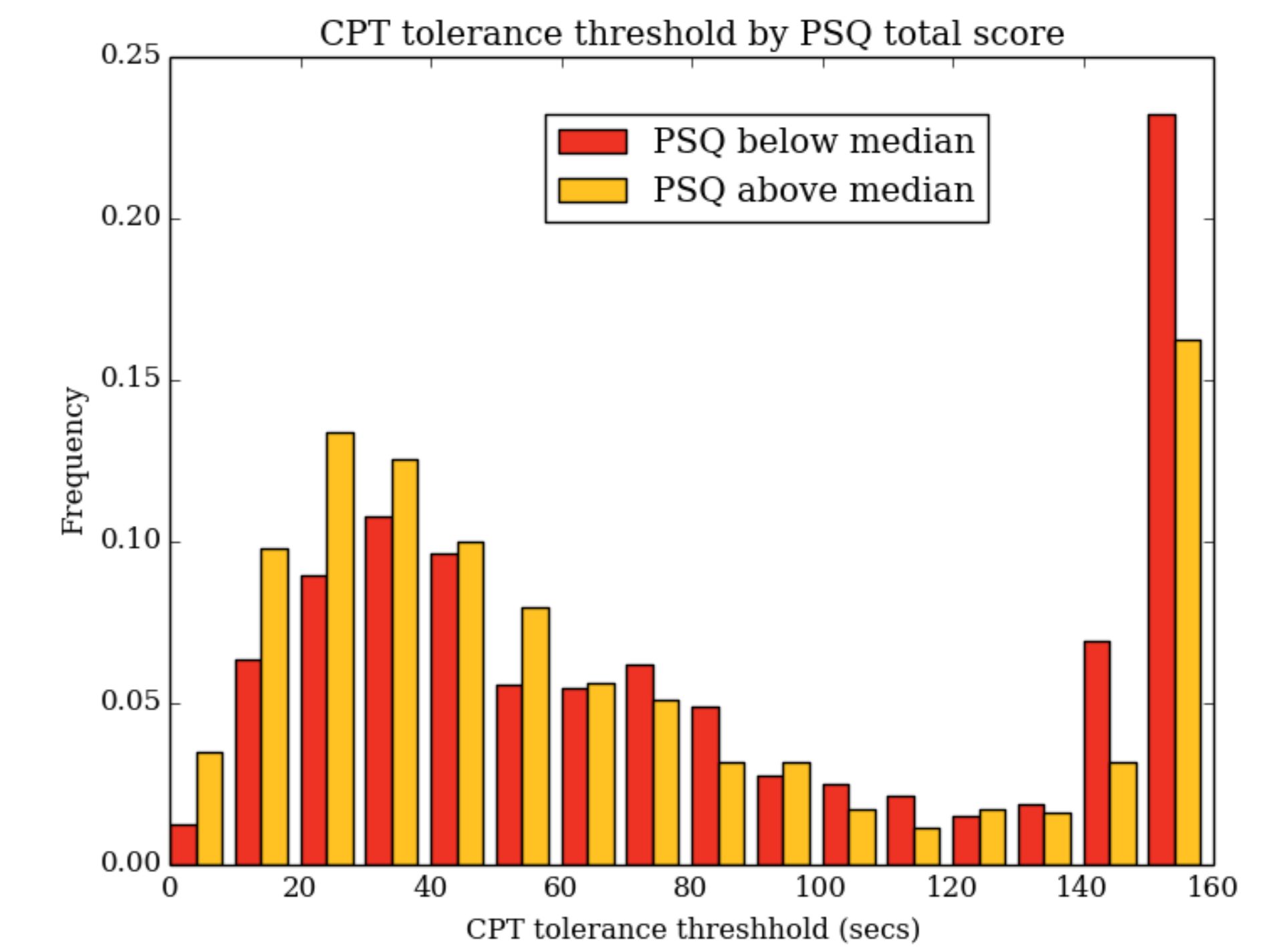
We assessed criterion validity using the cold pressor test (CPT), which was also self-administered in an innovative online format, described in more detail elsewhere<sup>2</sup>.

## 3 Results: Online PSQ factor structure

Item	Mean (SD)	Factor loading Online PSQ-E n=33,303		Factor loading Ruscheweyh et al. (2009) Table 2 n = 354	
		Moderate (2)	Minor (1)	Moderate (1)	Minor (2)
1 bump shin	4.5 (2.1)	0.83	0.16	0.77	0.12
2 burn tongue	3.6 (1.9)	0.81	0.22	0.78	0.21
3 sore muscles	2.6 (1.7)	0.59	0.33	0.12	0.78
4 trap finger	4.8 (2.1)	0.77	0.34	0.77	0.28
6 sunburn shoulders	1.9 (1.6)	0.35	0.56	0.08	0.77
7 graze knee	3.2 (1.8)	0.50	0.56	0.42	0.53
8 bite cheek	3.5 (2.0)	0.59	0.53	0.72	0.36
10 cut finger	2.6 (1.8)	0.32	0.73	0.41	0.65
11 prick finger	2.1 (1.6)	0.36	0.72	0.48	0.56
12 hands in snow	2.7 (2.1)	0.17	0.73	0.32	0.51
14 strong hand shake	1.3 (1.7)	0.10	0.65	0.25	0.53
15 hot handle	4.9 (2.2)	0.47	0.61	0.71	0.35
16 crush foot	4.5 (2.2)	0.52	0.59	0.77	0.30
17 funny bone	3.8 (2.1)	0.57	0.54	0.79	0.31

## 5 Results: PSQ and Cold Pressor Test (CPT)

In a subset of 2,198 participants, the PSQ total score was weakly, but significantly, associated with first reporting pain sooner ("pain threshold", Spearman rho = -0.16, p<0.00001), withdrawing one's hand from cold water sooner ("tolerance threshold", Spearman rho = -0.21, p<0.00001), and reporting more intense pain intensity during the CPT (Spearman rho = 0.31, p<0.00001).



**Key Message** The online PSQ does not fully replicate the same "minor" and "moderate" pain factors found in the original validation of the pen-and-paper questionnaire.

**Key Message** Pain sensitivity measure via an online, self-administered PSQ is associated with pain sensitivity measured via an online, self-administered cold pressor test.

## 2 Methods and Subjects

A total of 33,228 participants completed the PSQ on the 23andMe website over the course of several months, of whom 21,437 participants also completed an addition survey about their pain history.

Participants were enriched for those who previously reported chronic pain conditions, especially arthritis, chronic, and back pain to 23andMe. Of the 21,437 reporting about pain history at the time of the PSQ, 4,064 participants (19.0%) reported being currently treated with prescription medication for a chronic (n=1,258) or acute (n=2,806) pain condition. Because a history of chronic pain is much more commonly reported by women than men in the broader 23andMe cohort, most of those who completed the survey were women (23,600 or 70%).

Of those who completed the pain questionnaires, 2,198 also completed an online version of the CPT at a later time. Participants with certain chronic pain and other conditions, including migraine were not invited to participate in the CPT.

We analyzed the PSQ by calculating the PSQ total score and by factor analysis. In addition to comparing derived factors with published reports, we assessed the extent to which each participant's rating correlated with the factor loadings, reflecting the extent to which they rated experiences more indicative of pain sensitivity more highly than ones less indicative, regardless of the average level of painfulness report. Finally, we compared PSQ scores with CPT thresholds and pain intensity ratings.

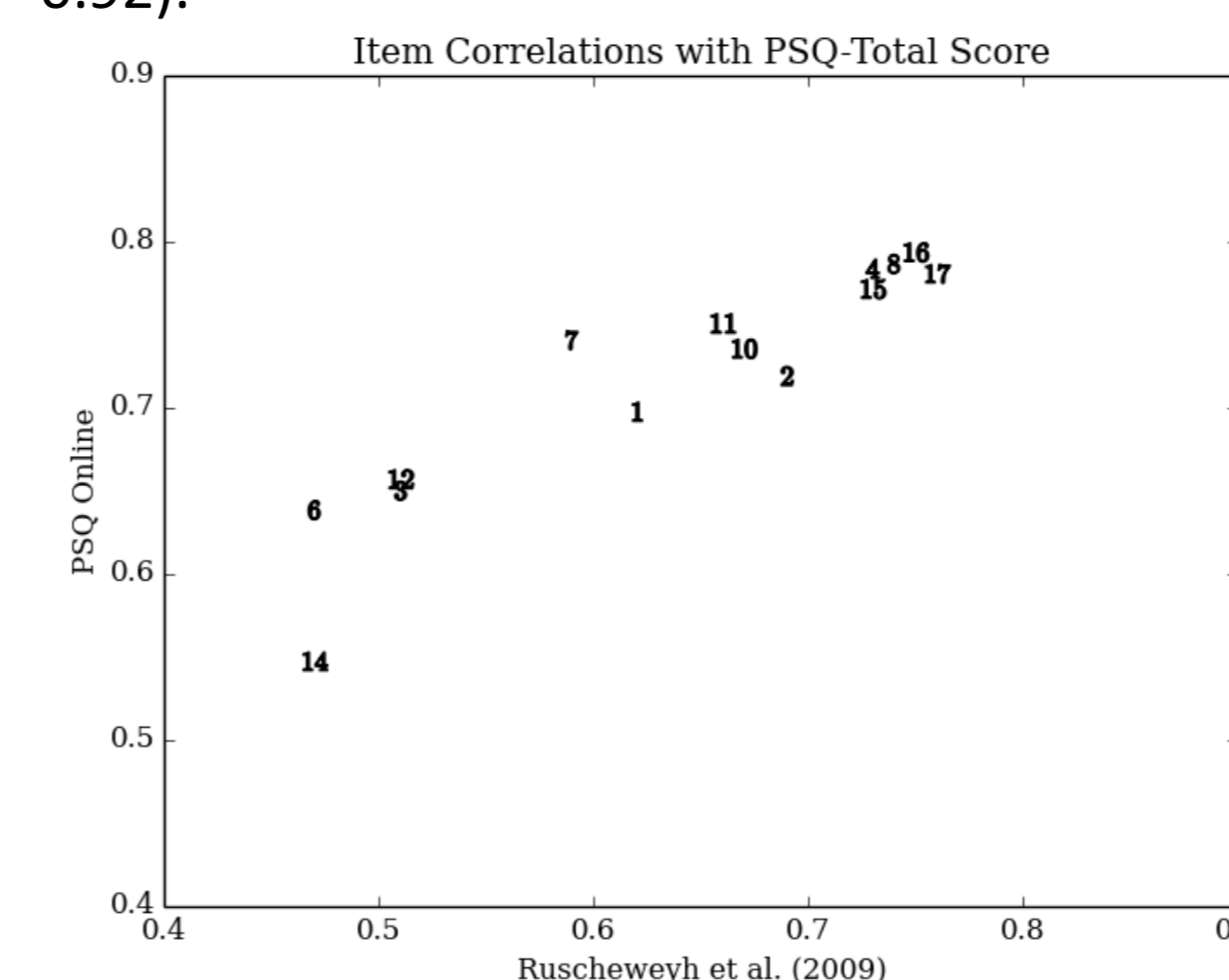
		PSQ total mean (SD)
Ruscheweyh et al. <sup>1</sup>		3.6 (1.2)
23andMe/Grünenthal online cohort Total		3.3 (1.4)
SEX: Male	9661	3.2 (1.3)
SEX: Female	23567	3.3 (1.4)
AGE: 20-29	3517	3.3 (1.3)
AGE: 30-39	5507	3.2 (1.3)
AGE: 40-49	5428	3.3 (1.4)
AGE: 50-59	6288	3.3 (1.4)
AGE: 60-69	7549	3.3 (1.4)
AGE: >70	4939	3.3 (1.4)
PAIN: Acute	2806	3.3 (1.4)
PAIN: Chronic	1256	3.3 (1.4)
PAIN: None	17373	3.2 (1.3)

## 4 Results: Internal consistency of painful items

Item	Correlation with PSQ total Online	Correlation with PSQ total Ruscheweyh et al. (2009)
	0.70	0.62
1 bump shin	0.72	0.69
2 burn tongue	0.65	0.51
3 sore muscles	0.78	0.73
4 trap finger	0.64	0.47
6 sunburn shoulders	0.74	0.59
7 graze knee	0.79	0.74
8 bite cheek	0.74	0.67
10 cut finger	0.75	0.66
11 prick finger	0.66	0.51
12 hands in snow	0.55	0.47
14 strong hand shake	0.77	0.73
15 hot handle	0.79	0.75
16 crush foot	0.78	0.76

The 14 painful items, from which the PSQ-total score is derived showed high internal consistency (Cronbach's alpha = 0.93). This reliability was similar to the pen-and-paper German-language version (Cronbach's alpha = 0.92).

Moreover, although there were differences between the two studies in their two-factor solution, items were similarly correlated with the PSQ-total score which is analogous to a one-factor solution (correlation of correlations = 0.92).



**Key Message** The online PSQ 14-item scale shows strong internal consistency, comparable to the original validation study.

## 6 Conclusions

The online version of the PSQ performed similarly to the original pen-and-paper version and the PSQ-total score. Convergent validity of the PSQ total was demonstrated by internal consistency and consistent discrimination between more and less painful items. Criterion validity was demonstrated by correlation with pain sensitivity as measured by the cold pressor test.

Upcoming investigations will include the identification of patients whose pain perception is different from the average, especially those able to discriminate better between more and less painful stimuli. Further we will derive pain sensitivity relevant genes / pathways / targets in this largest known genetic association study in pain. This may allow us to adjust pain scales to standardize individual responses and to identify groups of patients for precision medicine approaches.

### Acknowledgements/Dislosures

This research was conducted by 23andMe and Grünenthal GmbH. All authors are employees of these companies. We thank the research participants of 23andMe for making this study possible.

### References

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Press release



**Key Message** Deployed pain sensitivity questionnaire (PSQ) in an online setting, in a sample of over 30,000 participants enriched for chronic pain sufferers.