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Original Article

# Reliability Generalization of the Medical Student Stressor Questionnaire

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## Abstract

**Background:** Medical education is known to be stressful. Thus, medical schools have begun amending curricula to incorporate holistic wellness and stress reduction. Assessing medical student stressors is key to curricula development as well as the selection of appropriate reliable measures. This study investigated reliability reporting for studies using the Medical Student Stressor Questionnaire (MSSQ), as no study of this kind currently exists using Reliability Generalization (RG). **Methods:** A meta-analytic method, RG, was used to analyze the reliability reporting practices and reliability coefficients, in the form of Cronbach's alpha coefficient, for the MSSQ. While a total of 18 studies were initially isolated related to the MSSQ, only those studies reporting reliability based on their sample ($n$ = 8) were included in the final analysis. Blind coding was utilized and percent agreement among raters was excellent (95.18%). **Results:** Reliability estimates reported for the total scale fell within the excellent range (Range alpha coefficient (α) = 0.800 – 0.970; Mean alpha coefficient ($M\alpha$) = 0.933, Standard Deviation alpha coefficient ($SD\alpha$) = 0.050). A larger percent of males was negatively correlated to academic stressors while the number of females in studies was negatively correlated with social, drive, group activities and inter/intrapersonal aspects of medical student stressors**. Conclusions:** Outcomes provide useful suggestions, implications, and future recommendations regarding the use and application of the MSSQ. It is essential to assess medical student stress via measures which demonstrate robust reliability. Insights into sources of stress can offer important feedback to making specific changes to medical school curricula.

**Key Words:** Medical education; Medical students; Physician burnout; Reliability Generalization; Stress (Source: MeSH-NLM).

## Introduction

Wellness initiatives instituted by medical schools in the United States (US) are aimed to help address the recent research outcomes by the Association of American Medical Colleges (AAMC), which suggests medical education can taint humanism, decrease empathy, and increase rates of depression and suicidal ideation.[1] With approximately 82% of medical students having some degree of distress, prudent assessment of stress and follow-up is necessary to avoid the challenges of the omnipresent hierarchical system of medical training.[2] Unfortunately, there is a 5.7% attrition rate in medicine, with mental stressors being a significant factor.[3] The potential etiologies of stress placed on medical students is innumerable and multifactorial. Stress associated with medical education can have negative effects on patient care and lead to physician burnout.[4] Therefore, reliably assessing medical student stress can reduce this negative impact and improve later clinical experiences. Research shows that demonstrating attempts to reduce stress and subsequent implementation of curriculum changes can improve the well-being of medical students.[5]

Given that first and second year medical school is physically and psychologically demanding, some programs in the United States, such as Case Western Reserve University, developed a wellness elective for their medical students who were subsequently qualitatively evaluated on their stress.[1] This wellness elective, presented by physician mentors in a one-hour lecture format over six weeks, focused on topics related to health and wellness outlining the stressors in medical practice and the importance of self-care. Results demonstrated that medical students struggled to prioritize their own well-being with the stress of medical school. The authors proposed that future studies should explore medical students' perceptions of stress in an effort to promote future wellness. Based on these findings, it is clearly important to assess medical student stress in a reliable and quantitative way to localize and implement stress reduction interventions that can be maintained longitudinally.[1]

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Medical education is complex and involves both broad and specific knowledge, and to date, there are only four measures designed to specifically assess medical student stress. Current tools to evaluate student stress in medical school include the Medical Student Stress Profile (MSSP[6]), Medical School Stressor Questionnaire (MSSQ[7]), the Korean version of the Higher Education Stress Inventory (K-HESI[8]), and the Medical Education Hassles Scale-R (MEHS-R[9]). Selection and use of reliable measures can provide meaningful feedback to programs about medical student stress. Although these tools are available, there is a paucity of evidence showing that these four measures can be used reliably. Moreover, to date, no meta-analysis has yet been conducted examining the MSSQ.

### Medical Student Stressor Questionnaire

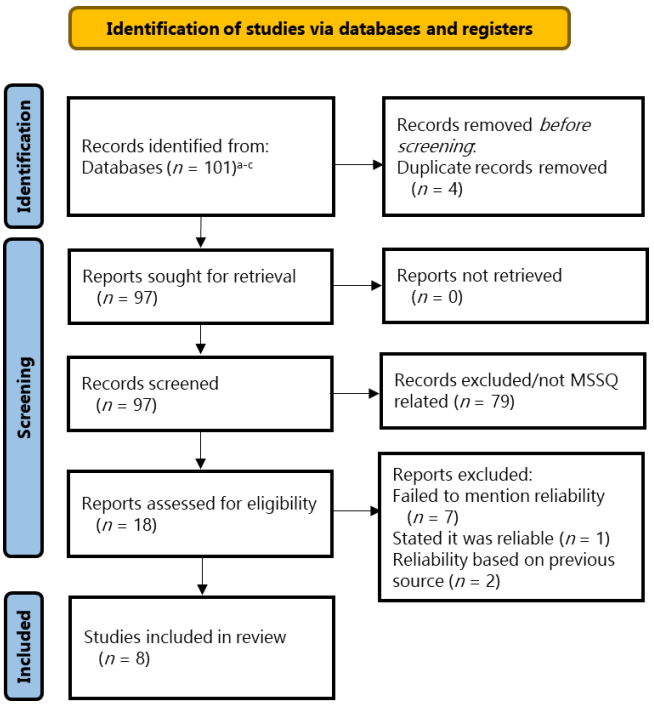
The Medical Student Stressor Questionnaire (MSSQ) was selected for analysis as it is a measure aimed directly to evaluate stressors associated with medical school. The MSSQ was initially normed in 2008-2009 on a sample of 761 medical students ranging from first to fifth year students at the School of Medical Sciences, Universiti Sains Malaysia.[7] The MSSQ is a self-report measure that contains 40 items that are rated on a 5-point Likert-type scale ranging from 0 "causing no stress" to 4 "causing extreme stress.[8] The MSSQ has a total of six *stressor groups* which include Academic Related Stressors (ARS), Interpersonal and Intrapersonal Related Stressors (IRS), Teaching and Learning Related Stressors (TLRS), Social Related Stressors (SRS), Drive and Desire Related Stressors (DRS), and Group Activities Related Stressors (GARS). The MSSQ does not appear to yield an overall score of stress, but rather evaluates stress in the context of each stressor group. Stressor scores are ranged from 0 to 4, where 0 - 1.00 = "cause mild stress," 1.01 - 2.00 = "cause moderate stress," 2.01 - 3.00 = "cause high stress," and 3.01 - 4.00 = "cause severe stress".[7]

The psychometrics of the MSSQ have been assessed among diverse medical students over the past 10 years. The initial alpha coefficients established by Yusoff et al.[7] was 0.952 for the total MSSQ; 0.921 for ARS; 0.895 for IRS; 0.858 for TLRS; 0.710 for SRS; 0.646 for DRS; and 0.728 for GARS. The MSSQ has also been validated in the Netherlands, India, Nepal, Romania, and Sri Lanka.[10] In the above cited studies (excluding the studies from Nepal and Netherlands which did not report reliability), reliability estimates for the total MSSQ ranged from 0.80 to 0.95; while subscale reliability estimates have ranged from less than 0.50 to 0.90.[10-12] Furthermore, the MSSQ has been utilized in other countries such as Italy, Bangladesh, and Ethiopia.[13-15]

### The Current Study

The MSSQ was developed to help assess medical student stress. Medical students are diverse in age, sex, socioeconomic status, race/ethnicity, among many other demographic characteristics. These demographic characteristics, also known as sample characteristics, impact reliability and therefore utility of a measure like the MSSQ. Reliability is heavily influenced by the characteristics of the individuals completing a measure; thus, it is essential for researchers to accurately report reliability coefficients for their study samples.[16-18] Currently, there exists a gap in the research for the MSSQ in that there is no study outlining the overall reliability of the measure and the sources of variance. Unfortunately, this critical step is often overlooked as many researchers erroneously induct reliability. Reliability induction is the process of inferring reliability of scores from previous studies.[19] We commonly see researchers stating that a measure is "reliable" or they may cite the initial reliability coefficients found for the measure. This creates an inadequate gauge of a measure's actual reliability, knowing that reliability is unique for each and every sample evaluated. This is problematic as reliability is not a product of a measure, but rather dependent on the individuals examined in a given sample. It is also concerning as it develops poor reliability reporting and limits the widespread utilization of a measure, like the MSSQ. Reliability Generalization (RG) is a form of meta-analysis used to explore reliability coefficients and analyze potential sources of variance among samples for assessment measures. The primary aim of this meta-analysis is to provide a current summary of reliability estimates, highlight patterns within the sample characteristics that may influence reliability, and speak to reliability reporting patterns of the MSSQ gathered from primary research.

***Figure 1.*** PRISMA diagram of RG for MSSQ.




***Legend:*** a. Search terms used were "Medical Student Stressor Questionnaire" or "MSSQ"; b. Timeframe delimiter was 2009 – 2018; c. Only articles available in English were included in the analysis

## Methods

A meta-analytic method, known as Reliability Generalization (RG), was conducted with studies using the MSSQ in order to (a) investigate the reliability reporting practices in published studies for this measure, (b) determine the average internal consistency of the measure, and (c) determine its variability when administered to various populations. The RG method was initially developed by Tammy Vacha-Haase[16] and is a form of meta-analysis "used to explore reliability estimates and characterize the sources of this variance."[16(p562)] RG studies provide integral information about the calculated reliability coefficients as they may be affected by study sample and measurement characteristics. Typically, reliability coefficients estimate the percentage of variance in a set of observed scores. Cronbach's[18] alpha coefficient is the most common statistic of reliability and internal consistency. Researchers may use other types of reliability estimates, however, for the current study we focused on Cronbach's[18] alpha coefficient as it is the most broadly utilized reliability estimate.

***Table 1.*** Comprehensive List of All Databases Used in the Meta-Analysis.

| Academic Search Premier | ERIC (Education Resources Information Center) |
|---|---|
| AHFS Consumer Medication Information | GreenFILE |
| Alt Health Watch | Health Source: Consumer Edition |
| APA PsycArticles | Health Source: Nursing/Academic Edition |
| APA PsycBooks | Library, Information Science & Technology Abstracts |
| APA PsycExtra | MAS Reference eBook Collection |
| APA PsycInfo | MEDLINE with Full Text |
| APA PsycTests | Military & Government Collection |
| Business Source Complete | Newspaper Source |
| eBook Collection (EBSCOhost) | Regional Business News |
| Education Research Complete | SocINDEX with Full Text |

An extensive literature search using the terms "Medical Student Stressor Questionnaire" or "MSSQ" of the EBSCOhost database was conducted, encompassing a total of 22 electronic databases (e.g., PsycINFO, MEDLINE with Full Text; for details, see ***Table 1***). In addition, the research timeframe was for articles published in 2009 through to 2018. Only articles available in English were included in the study. An initial total of 101 articles were reviewed, and of these, 18 were directly related to the MSSQ and were included in this RG (see ***Figure 1***). These 18 articles were assessed by an initial coder and then sorted into one of four categories: (a) articles that used the MSSQ but failed to mention reliability in any form, (b) studies that indicated the instrument was reliable and/or no mention of reliability from the authors' data or from a previous source that used the MSSQ, (c) articles that only presented reliability coefficients from previous studies, and (d) studies that reported reliability based upon their current study data. Only articles within the final category were included in the analysis for the purposes of this RG.

A coding sheet was developed to gather uniform data across the articles to be analyzed. These articles were initially coded by one researcher and then blind-coded by another researcher to confirm accuracy. Discrepancies were investigated and resolved among coders, as the overall percent agreement among coders was 95.18%, demonstrating excellent interrater reliability. Continuous variables coded included publication year, total reliability score, subscale reliability scores, sample size, and year of study (in medical or graduate program). Additional sample characteristics, including gender and race/ethnicity were categorically coded. After differences from interrater reliability discrepancies were resolved, data was entered into Microsoft Excel and then exported to Statistical Package for Social Sciences (SPSS) for statistical analyses.

Reliability reporting patterns for each study included in the analysis were numerically calculated through sums and percentages as is one of the main aims in RG analysis. Additionally, mean alpha coefficients ($M\alpha$) for each subscale were calculated. While there are a number of ways to interpret Cronbach's[18] alpha coefficients, it is more commonly interpreted via the guidelines established by George and Mallery[20] where "> 0.9 – Excellent, > 0.8 – Good, > 0.7 – Acceptable, > 0.6 – Questionable, > 0.5 – Poor, and < 0.5 – Unacceptable".[21] Moreover, in order to determine if sample and measurement characteristics had any statistically significant impact on reported alpha coefficients in published studies, Pearson's $r$ correlations were computed for continuous variables. It should be noted that variables included within the analysis depended upon the reporting practices within original studies, thus, the current analyses will include number of males or females and/or percents, and therefore utilize both in the analyses.

## Results

The results outlined within this section begin by examining the overall sample size and reliability reporting practices. Second, results discuss study characteristics of those included within the analysis, and present the mean alpha coefficients. Third, results based on correlations conducted for subscales, and demographic variables with alpha coefficients are presented. Finally, variables that could not be assessed are outlined.

Data collected for this study represented a total sample of 2,542 participants. In order to determine which of the four categories publications fell within, analysis of reliability reporting practices was conducted. Of the articles reviewed, 44% ($n$ = 10 alpha coefficients; 8 studies[7,22-28]) of the studies did report a Cronbach's[18] alpha reliability coefficient for their sample. One study reported a total of three alpha coefficients, whereas the remainder of studies reported one alpha coefficient. Another 11%, ($n$ = 2) of the studies reported reliability based on previous

sources. Additionally, 6%, ($n$ = 1) of studies stated, "it is reliable." Overall, 39%, ($n$ = 7) of studies completely failed to mention reliability at all (see Figure 1). Fifty-six percent (56%) of studies failed to report reliability coefficients for their samples. The MSSQ was used predominantly in studies within Malaysia ($n$ = 9 alpha coefficients, 90%) and one study reporting reliability was conducted with a sample from Aruba ($n$ = 1; 10%). None of the studies used the MSSQ in the US.

***Table 2.*** MSSQ Summary Statistics for Reported Cronbach's Alpha Coefficients.

| Scale | *n* | *Mα* | *SDα* | Minimum α | Maximum α |
|---|---|---|---|---|---|
| ARS | 9 | 0.886 | 0.047 | 0.810 | 0.940 |
| IRS | 9 | 0.907 | 0.050 | 0.780 | 0.950 |
| TLRS | 9 | 0.827 | 0.088 | 0.610 | 0.900 |
| SRS | 9 | 0.688 | 0.185 | 0.200 | 0.800 |
| DRS | 9 | 0.690 | 0.108 | 0.420 | 0.777 |
| GARS | 9 | 0.790 | 0.105 | 0.550 | 0.911 |
| MSSQ total | 10 | 0.933 | 0.050 | 0.800 | 0.970 |

***Legend:*** ARS = Academic Related Stressors, IRS = Interpersonal and Intrapersonal Related Stressors, TLRS = Teaching and Learning Related Stressors, DRS = Drive and Desire Related Stressors, GARS = Group Activities Related Stressors, MSSQ = Medical Student Stressor Questionnaire, *n* = number, *Mα* = Mean alpha coefficients, *SD* = Standard Deviation.

A total of eight studies, providing 10 alpha coefficients, were included for analysis. All the publications reporting alpha coefficients for their study sample were peer-reviewed journal articles published between 2009 and 2018. Total reliability scores for the MSSQ ranged from 0.800 to 0.970 with a mean of 0.933 ($SD$ = 0.050), falling within the excellent range (> 0.90). There was variability in reliability coefficients for subscales of the MSSQ where subscales yielded low alpha coefficients (< 0.70) based on study samples suggesting caution for use and interpretation of scale outcomes (see ***Table 2***). One subscale, Interpersonal and Intrapersonal Related Stressors (IRS), reported alpha coefficients that fell within the excellent range of values ($Mα$ = 0.907). Two subscales fell within the good range, including Academic Related Stressors (ARS, $Mα$ = 0.886) and the Teaching and Learning Related Stressors (TLRS, $Mα$ = 0.827). One subscale fell within the acceptable range, Group Activities Related Stressors (GARS, $Mα$ = 0.790). There were two subscales whose reported mean reliability estimates fell just below acceptable values, Social Related Stressors (SRS, $Mα$ = 0.688) and Drive and Desire Related Stressors (DRS, $Mα$ = 0.690).

Most studies reported administering the MSSQ one time ($n$ = 7, 87.5%) while one noted multiple administrations of the measure ($n$ = 1, 12.5%). Analyses found a positive correlation between reported reliability coefficients and the number of males in the sample ($r$ = 0.982, $p$ = 0.018) suggesting that the items within the MSSQ may be more readily endorsed by males completing the measure. Percent of males within a study sample was negatively correlated with reported ARS subscale reliability coefficients ($r$ = - 0.943; $p$ = 0.016). Conversely, the number of females within studies was negatively correlated with the reliability estimates reported for the MSSQ subscales including IRS ($r$ = - 0.822, $p$ = 0.023), SRS ($r$ = - 0.759, $p$ = 0.048), DRS ($r$ = - 0.957, $p$ = 0.001), and GARS ($r$ = - 0.781, $p$ = 0.038).

***Table 3.*** Supplementary Variables and Reported Cronbach's Alpha Coefficients.

| Variables | *n* | *Mα* |
|---|---|---|
| Publication Year | | |
| 2009 | 1 | 0.950 |
| 2010 | 1 | 0.952 |
| 2011 | 2 | 0.933 |
| 2013 | 2 | 0.960 |
| 2014 | 1 | 0.915 |
| 2015 | 1 | 0.800 |
| Race/Ethnicity | | |
| > 60% Asian | 4 | 0.951 |
| Other | 1 | 0.915 |
| Unknown | 3 | 0.901 |
| Year of Study (Medical School) | | |
| First Year | 1 | 0.963 |
| Varied Years | 4 | 0.904 |
| Unknown | 3 | 0.940 |

***Legend:*** *n* = Number of studies, *Mα* = Mean alpha coefficient, > = greater than.

Publication year, race/ethnicity, and year of study did not demonstrate any impact on reported reliability estimates in the published studies reviewed due to lack of variability in data collected (see ***Table 3***). Some sample and measurement variables were not able to be assessed due to lack of reporting which included age of study participants, gender diversity (other than male or female), marital status, religion, income, sampling procedure, total scale mean, and total scale standard deviation.

## Discussion

The MSSQ was initially validated and subsequently utilized in Southeast Asian communities as a way to assess sources of stress for medical students. Medical students worldwide experience stress in their coursework and clinical training. Consequently, utilizing an instrument that demonstrates high internal consistency estimates with diverse samples is paramount. The goals of the present RG analysis were to assess the reliability reporting practices and internal consistency estimates for the studies employing the MSSQ. The current RG found that total reliability estimates for the MSSQ were consistent with the initial alpha coefficients established by Yusoff et al.[7]

Reliability estimates for the subscales of the MSSQ demonstrated variability and ranged from just below acceptable (< 0.70) to excellent (> 0.90). In general, among the totality of published literature that was initially examined for inclusion within this RG meta-analysis, overall reliability reporting patterns using the MSSQ showed underreporting of reliability coefficients. Many of

the studies did not report reliability coefficients based on their own samples and some neglected to include anything about reliability of the instrument. More specifically, only 44% of the articles that were reviewed reported an alpha coefficient directly calculated from their sample, which limits generalizability of the current results and consequently should be interpreted cautiously. These results are similar to past reliability generalization studies, which indicate very small percentages of studies reviewed had reported reliability data for their samples.[16]

MSSQ total reliability score analysis found a significant positive correlation between percent of males and total MSSQ reliability. While small in sample size, overall, these outcomes indicate that items on the MSSQ may resonate more consistently with men's experience of medical stressors. Additional subscale analyses found significant negative correlations between percent of males in the study and reported ARS reliability coefficients. Therefore, items on the ARS subscale were less consistent with men. Items on the ARS relate to tests, heavy workload, falling behind, receiving poor marks, needing to do well, and difficulty answering questions from teachers and ultimately, were not consistently reflective of men's stress factors related to medical education. Related to these outcomes, recent research in medical education pertaining to gender specific perception and attitudes toward the burdens of everyday student life indicated that more male students were convinced they were superior to the other sex in handling academic performance pressure.[29] Therefore, this tendency among males may help contextualize inconsistent responding to items on this subscale because males may be less likely to reliably endorse issues with academic performance. In addition, four subscale analyses revealed a significant negative relationship between reported reliability estimates and the number of females within the studies.

Outcomes of this study suggest that there are gender differences for some MSSQ subscales. Women's experiences in medical school were not consistently reflected by items on the IRS subscale which relate to conflict with others or poor motivation to learn, nor items on the SRS subscale which are associated with stress in conveying medical information to patients or answering patient questions. Further, the DRS subscale (family responsibility, unwillingness to study medicine, and a parental desire to study medicine) were not consistently reflective of women's drive to pursue medical education. Finally, the GARS subscale assesses perceived pressure to do well by others or feelings of incompetence and was not reliably reflective of stressors experienced by women in medical education. It is possible that like men, women are driven to pursue medical education by a desire to be a helping professional and reduce inequities in health systems which are not currently reflected as items on the MSSQ. Consequently, items on these subscales need further revision to better assess and reflect stressors consistently experienced by women in medical school. Given that these results are preliminary and from a small sample size, they should be interpreted with caution and assessed in further research to determine if such correlational relationships exist in larger samples among other nations and cultures worldwide.

**Limitations**

One of the largest limitations of this reliability generalization meta-analysis was the lack of reliability estimates reported within published studies utilizing the MSSQ. Over half of the studies reviewed did not report reliability; they either inferred or inducted reliability or made no mention of reliability at all. The RG method relies on available literature to report reliability estimates for their sample and provide details related to study and measurement characteristics. Therefore, studies that lack such information for their sample cannot be utilized. Consequently, this is a limitation to the current data presented within this study, implicating that these results have limited generalizability, and thus, the results should be interpreted with caution. Reliability reporting standards are not currently being upheld. Second, as a consequence of limited reliability reporting, detailed analyses for sample and measurement characteristics (i.e., age, marital status, income, projected specialization, and language spoken) could not be conducted and need to be further analyzed in larger studies. Third, while the MSSQ has been translated into English, no studies have yet been conducted in North American samples. Expanding utilization of the MSSQ geographically could improve the instrument's overall generalizability internationally. In addition, a significant limitation to this RG study is the restricted sample size as this limits interpretability of the analyses and outcomes presented. The additional subscale analyses conducted with percent of males and number of females infers a possible presence of sex bias, though yielded in even smaller sample sizes and should be cautiously interpreted.

**Future Directions**

Future research for the MSSQ should focus on utilizing the instrument with diverse international samples, including the US. As medical schools continue to put more attention to assessing and reducing medical students' experiences of stress, the formal use of the MSSQ in medical schools may help to identify specific sources of stress and targeted interventions. It is incumbent upon medical school programs to raise their awareness and knowledge of adequate measures to reliably assess medical student stress as a means to make medical education experiences more manageable. While overall the MSSQ as applied to Asian cultures produces good to excellent reliability estimates predominantly for men, there is some caution for use of interpreting the subscales with female medical students. Additional research is warranted due to the small sample size within this study.

In addition, researchers are encouraged to include detailed descriptors of diversity in their sample, such as age, gender, sexual orientation, income, socioeconomic status, year of medical school, marital status, and previous education to better quantify participants' data. Inherent in medical school is the experience of stress, although sources of stress may vary by individual. Further research is needed to assess and quantify stressors present

among medical students. Outcomes from measures, such as the MSSQ, can greatly inform medical schools to further develop practices or supplementary resources to reduce the potential negative effects of medical student stress. Researchers who intend to use the MSSQ are strongly encouraged to calculate and report reliability estimates for their samples to contribute to the growing body of knowledge of the utilization of this measure.

**Conclusions**

Overall, reliability estimates reported for studies included in this RG analysis were similar to those initially established by Yusoff et al.[7] for the MSSQ. Total score reliability for the MSSQ falls within the excellent range while subscales showed some variability. Unfortunately, many studies did not report reliability, limiting the number of studies that could be included in this analysis. This is similar to previous RG study findings and indicates reliability reporting practices remain low in published literature. Reliability needs to be assessed as it is an integral first step towards inferring measurement validity. As such, researchers are encouraged to report the reliability estimates for their study samples to uphold reliability reporting standards. Assessing medical student stress reliably and accurately is essential to designing interventions and reducing the potential resultant negative impacts that are currently present within the medical education system. It is imperative that more researchers use the MSSQ and report their sample's reliability estimates before the MSSQ can be more widely adopted.

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