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Meta-analysis of scale cutoffs in the Structured Inventory of Malingered Symptomatology

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Abstract
Objective: Using various published data, we estimated the rates of false positives in samples of normal controls when the usual diagnostic cutoffs of the Structured Inventory of Malingered Symptomatology (SIMS) are applied as stipulated in the SIMS manual for all of its 5 scales and for the total score.
Method: The original normative data (means and SDs) by Glenn Smith published in SIMS manual for all of its 5 scales and for the total score were used to calculate z scores of each recommended cutoff stipulated in the SIMS manual and thus to estimate, via the assumption of normal distribution, proportions of normal persons that would exceed these cutoffs. The same procedure was then used on meta-analytically combined data from 9 published samples of normal controls.
Results: The proportions of 34 normal controls (non-malingerers) in Smith's original normative sample of presumably healthy undergraduates exceeding the cutoffs for the 5 SIMS scales were 42.1% for the Psychosis (P) scale, 30.9% for Low Intelligence (LI), 29.8% for Amnestic Disorders (AM), 19.8% for the Affective Disorders (AF) scale, and 15.9% for Neurologic Impairment (NI): these persons are misclassified by the cutoffs as "malingerers."
In the meta-analytic sample of controls, the highest proportions of normal controls misdiagnosed as malingerers were 41.7% for Low Intelligence (LI) scale, 28.8% for Psychosis (P), 24.8% for Affective Disorders (AF), 17.9% for Amnestic Disorders (AM), and 15.9% for Neurologic Impairment (NI). The lowest proportions of misdiagnosed normal persons were on the SIMS total score: 4.5% in Smith's normative sample and 4.6% of persons in the meta-analytically combined sample of 500 normal controls.
Conclusion: SIMS cutoffs for its scales misclassify too many normal persons as malingerers. These normal controls were presumably young healthy persons. Since the SIMS items list mainly legitimate medical symptoms (i.e., not items with a reasonable capacity to differentiate legitimate patients from malingerers), the proportions of legitimately injured or otherwise ill persons misclassified as malingerers are likely to be much higher than those reported here for normal controls.

Keywords: SIMS, malingering, score cutoffs, false positives, validity

1. Introduction

The Structured Inventory of Malingered Symptomatology (SIMS) [1, 2] is a widely used test of malingering, in particular by psychologists contracted by car insurance companies. The SIMS consists of 5 scales with 15 items each: Psychosis (P), Affective Disorders (AF), Neurological Impairment (NI), Amnestic Disorders (AM), and Low Intelligence (LI) [2].

Recent content analyses of SIMS P, AF, NI, and AM scales by teams of doctoral level clinicians with more than 35 years of experience each in psychiatry/clinical psychology showed that these scales are only lists of legitimate medical symptoms without a reasonable capacity to differentiate malingerers from real patients with legitimate medical difficulties [3, 4, 5].

The SIMS LI scale consists mainly of arithmetic and logical reasoning tasks or tasks assessing general knowledge on which patients tired by chronic illness, or those with the post-concussion syndrome, or persons whose attentional focus is disrupted by chronic pain may perform worse than uninjured persons [6, 7].

When all SIMS scales are scored, patients with vehicular injuries such as memory and concentration problems, other post-concussive symptoms, and depression are likely to obtain higher scores than healthy uninjured persons[8] and they are thus more likely (falsely) classified as malingerers by the cutoffs stipulated for SIMS scales in the SIMS manual [2].

In scoring of SIMS scales, each item counts 1 point if endorsed in the direction specified in the SIMS manual. For example, in the SIMS Affective Disorders scale, the Item 47 "I am depressed all the time, Item 37 "As the day progresses my mood gets worse," and Item 6 "I seldom laugh," if all endorsed as "True," count jointly already 3 points towards the diagnosis of malingering of "affective disorder" [3].

The SIMS cutoffs are 5 points for AF, 2 points for NI, AM, and for LI, and 1 point for the P scale, see SIMS manual [2]. Thus, a person who endorses more than 5 legitimate depressive symptoms on the AF scale would be classified as "malingering affective disorder."

The SIMS items were not selected and validated by procedures consistent with test development standards of the American Psychological Association (APA) [9]. Since the very purpose of the SIMS is to differentiate malingerers from legitimate patients, the criterion groups in the test validation must include groups of patients, to be compared statistically to groups of malingerers (or at least to persons instructed to feign medical symptoms). Instead, the validation described in SIMS manual [2] was a comparison of normal students instructed to respond honestly to those instructed to feign medical symptoms. From a logical perspective, such validation only verifies that high SIMS scores would be found in persons reporting medical symptoms (no matter whether real or malingered) and low scores in persons who report no or very few symptoms.

Even a cursory inspection, by a statistician, of the means and SDs listed in SIMS manual for the normative data suggests that too many healthy normal controls may be misclassified as malingerers by some of SIMS cutoffs. For example, the average score of 34 normal undergraduates (see SIMS manual, pages 24 and 25) on the P scale was 0.8, SD=1.0, i.e., already too near the malingering range (cutoff > 1 point) which suggests that perhaps more than a third of these undergraduates (normal controls) could be misdiagnosed as "malingering psychosis."

The present study estimates the proportions of normal controls misclassified by SIMS cutoff scores as malingerers by the 5 SIMS scales. When knowing the average score and the SD of the scores in a particular sample of persons, we can estimate the proportions of persons scoring above the cutoff of a particular scale by assuming the normal distribution curve, see Figure 1. At the horizontal line, the Greek letter sigma (σ) denotes SD. For example, if the average score in the sample is 2 points, the SD = 1, and the cutoff = 3 points, then the cutoff is at the distance of one SD to the right from the average (the peak) of the curve: this means that only an estimated 13.59%+2.14%+0.13% = 15.86% of persons might score above the cutoff. If the scale measures malingering, then these 15.86% are classified as malingerers.

Another example: the SIMS study led by Richard Rogers [10] in 2005 included a sample of 16 healthy doctoral students responding honestly (i.e., not malingering). Their average score on SIMS AF scale was 5.1 points, with an SD of 3 points. Thus, the peak of the curve (i.e., the average score) is at 5.1 points. Since the cutoff point for AF scale is 5 points, this number 5 is smaller than 5.1, and is therefore situated 0.1 points to the left of the average (i.e., of the peak) of the curve: when converted to z score, this distance of 0.1 is equal to z=-.03.

If this z score is converted to a corresponding percentile via tables provided in most textbooks of elementary statistics[11], it indicates mathematically that an estimated 51.2% of these normal students are (presumably very falsely) classified by the SIMS AF scale as malingerers of affective disorder.

We used the same z score calculation procedure to estimate proportions of persons who would score above cutoffs of the 5 SIMS scales in Glenn Smith's normative data [1, 2] on college undergraduates responding honestly to the SIMS, i.e., non-malingering predominantly young persons fit for college studies, see data for "honest responders (HR)" reported on pages 24 and 25 in the SIMS manual [2].

As the next step, we then also extended this procedure to meta-analytically combined data on other published samples of normal, and presumably healthy, non-malingerers.

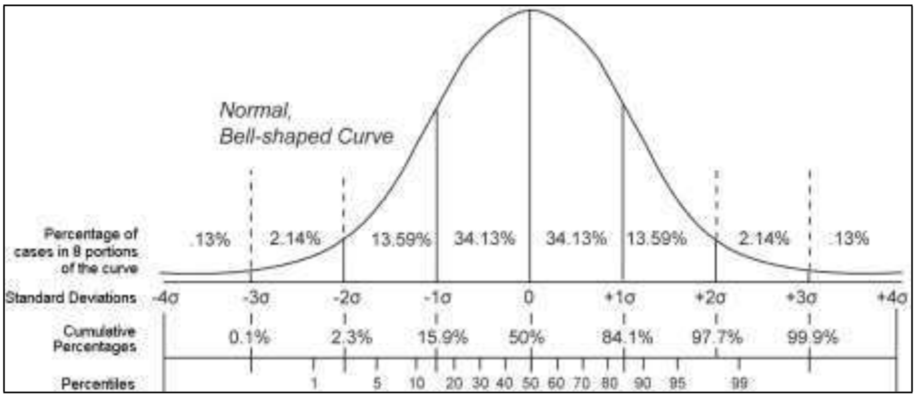

Fig 1: The normal distribution curve

2. Method

Normative data (means and SDs) listed in SIMS manual [2] (page 24 and 25) for the 5 SIMS scales and for the total SIMS score (see the first row of data in Table 1) were used to calculate the z scores for each cutoff stipulated in the SIMS manual and thus to estimate, via the assumption of normal distribution, proportions of normal persons that exceed these cutoffs.

The same procedure was used on meta-analytically combined data from 9 published samples of normal controls (see listing in Table 1): the total number of normal controls in the meta-analytically combined sample appears sufficient for generalizations (N=500).

The meta-analysis included Glen Smith's normative sample[1,2] of 34 undergraduates instructed to respond honestly to the SIMS, a sample of 16 doctoral university students described by Rogers *et al.*[10] who formed a group of normal controls (honest responders), two samples of normal controls (N=174 and N=30) reported in Santamaría Fernández [12], 20 normal controls in a study by Giger's team [13], and 30 in a study by Clegg's team [14]. All these were instructed to respond to SIMS items honestly. The meta-analysis also included 3 samples of university students reported in a study by Edens, Otto, and Dwyer [15]. In Edens's study, all participants completed the SIMS twice: at first with the instruction to respond honestly and then again to feign a medical condition. The first group (N=65) were to feign depression, the second (N=59) psychosis, and the third (N=72) a cognitive impairment. Only the data on honest responses by these 3 groups (i.e., from the first round of their SIMS sessions) were included in our meta-analysis.

Table 1: Published means and SDs of normal non-simulating controls

Control Samples	N	SIMS total	NI	AM	LI	AF	P
Smith & Burger (1997) [1], Widows & Smith (2005) [2]	34	7.7 (3.7)	1.0 (1.0)	1.2 (1.5)	1.4 (1.2)	3.3 (2.0)	0.8 (1.0)
Rogers *et al*., (2005) [10]	16	7.6 (5.0)	0.6 (1.3)	0.7 (0.9)	0.9 (0.9)	5.1 (3.0)	0.3 (0.6)
Santamaría Fernández (2015)[12], page 192-194	174	7.4 (3.1)	0.7 (1.0)	0.7 (1.1)	1.8 (1.3)	3.8 (1.7)	0.4 (0.7)
Santamaría Fernández (2015)[12], page 223-226	30	7.3 (3.0)	0.7 (0.9)	0.7 (1.2)	1.5 (1.2)	3.8 (1.8)	0.6 (0.7)
Giger *et al*. (2010) [13]	20	5.8 (3.7)	0.9 (0.8)	0.8 (0.8)	1.2 (1.0)	2.2 (2.2)	0.8 (1.1)
Clegg *et al*., (2009) [14]	30	7.7 (2.9)	1.3 (1.6)	0.5 (0.8)	1.4 (1.5)	4.4 (1.5)	0.2 (0.4)
Edens *et al*., (1999) [15], group 1	65	7.8 (4.5)	1.0 (1.3)	0.9 (1.4)	1.7 (1.5)	3.8 (1.9)	0.5 (0.8)
Edens *et al*., (1999) [15], group 2	59	8.1 (3.8)	0.9 (1.0)	1.1 (1.5)	1.8 (1.5)	3.9 (1.8)	0.4 (0.7)
Edens *et al*., (1999) [15], group 3	72	7.9 (4.7)	0.9 (1.2)	0.8 (1.6)	2.0 (1.5)	3.5 (1.9)	0.7 (1.4)
Combined Sample of Controls	500	7.6 (3.8)	0.9 (1.1)	0.8 (1.3)	1.7 (1.4)	3.7 (1.9)	0.5 (0.9)

Meta-analytic combining of averages from several samples involves calculation of the weighted mean as described in Downie and Heath (p. 38-39) [11]. Downie and Heath also provide the formula for properly averaging standard deviations (p. 51) [11]. Their formulae for calculation of the weighted mean and of average SD take in account the size of each sample.

In the tabular summary, all data are rounded to one decimal point.

3. Results and Discussion

3.1 Excessively high proportions of estimated false positives in some normal samples

It is noteworthy that some of the sample means listed in Table 1 approach very closely the cutoffs specified for the given SIMS scale. For example, the already mentioned average of 5.1 points on the AF scale in the study led by Richard Rogers exceeds the cutoff stipulated in SIMS manual [2] as 5 points. As already explained, this could mean that 51.2% of his students are classified by the AF scale as "malingering affective disorder."

Similarly, using z score calculation followed by conversion of the z score to the corresponding percentile, 42.1% of normal undergraduates in the normative sample by Glenn Smith [1, 2], 42.9% of normal controls in the study by Giger's team, and 41.7% of university students reported by Edens's team for their third group of normal controls are classified as "malingerers of psychosis" by the SIMS P scale.

Similarly sobering results are obtained for the Low Intelligence (LI) scale: in the study by Edens's team on normal university students, 42.1% of honest responders are classified by SIMS LI scale as malingering "low intelligence" in Edens's first group, 44.8% in the second, and 50.0% in the third group. In the data reported in Santamaría Fernández [12] for 174 normal responders, 44.0% are classified by SIMS LI scale as malingering "low intelligence."

These are all data on normal controls, responding honestly. It is not clear why these alarmingly high rates of false positives on SIMS scales (as visually implied already by the high means and SDs) in samples of healthy normal controls remained unnoticed by the editors and reviewers who have been accepting such SIMS based articles for publication in their journals, or by the translators or publishers of the SIMS in Germany, Spain, Italy, the Netherlands, Portugal, and Turkey.

3.2 Published rates of SIMS false positives in survivors of high impact car accidents

These are data on normal controls, responding honestly. As already explained, the SIMS is only a list of legitimate medical symptoms (AF, NI, AM, and P scales) and of 15 cognitive tasks (LI scale): legitimate medical patients are very likely to endorse such medical symptoms and also to fail on the cognitive tasks more frequently than normal controls. This is especially true about patients such as those tired by chronic pain, pain related insomnia, and post-concussive and whiplash symptoms, as common in persons injured in serious motor vehicle accidents. Briefly, they are even more likely to be misclassified than healthy persons. Our own published data on survivors of high impact car accidents indeed showed that 87.5% of these patients were misclassified by SIMS cutoffs as malingering affective disorder, 73.9% as malingering neurologic impairment, and 65.2% as malingering low intelligence [3, 4, 6]. With respect to SIMS Psychosis scale, our yet unpublished data on 23 survivors of high impact car accidents indicate that 12 of the 23 (i.e., 47.8%) were misclassified by the P scale as malingering psychosis.

The total SIMS score of the 23 survivors was 26.5 (SD=16.0): 78.3% of them were misclassified as malingerers via SIMS usual cutoff of > 14 points, and 73.9% if the cutoff is raised to > 16 points.

More data on legitimate patients are needed. Some data in this respect were reported on patients injured in car accidents in a study by Capilla Ramírez, González Ordi, Santamaría Fernández, and Casado Morales [16], however, their sample of 47 patients was carefully preselected to exclude those with more than minor injuries. The selection criteria indicated that only post-accident patients with minor injuries were included: "Como criterios de inclusión, los pacientes debían cumplir los siguientes requisitos: poseer una exploración física AP y lateral sin alteraciones de la columna cervical, aunque admitimos la hipolordosis cervical; EMG sin signos clínicos de afectación radicular; y, finalmente, una RM sin lesiones que justificaran la clínica dolorosa cronificada que presentaban los pacientes." [16] In an English translation: "Inclusion criteria specified that all patients had the following: normal results in their physical examination; AP and lateral radiography not indicating changes in cervical spine (though patients with cervical hypolordosis were not excluded); EMG without clinical signs of radiculopathy; and finally, MRI without lesions that would justify the chronic pain complaints clinically presented by these patients." Such patients with only minor injuries might report fewer symptoms on lists of essentially legitimate medical symptoms such as the SIMS than would more injured persons. As a result of excluding those with more than minor injuries from the data set, the mean SIMS total score of Capilla Ramírez's 47 patients (10.4, SD=5.3) was below the usual cutoff of 14 points, unlike the one of persons with more serious injuries [17].

3.3 Estimate of false positives in Smith's original normative sample of undergraduates

Using the assumption of normal distribution, the estimated proportions in Smith's original normative sample of undergraduates (normal controls) that exceeded the cutoffs for the 5 SIMS scales and of the SIMS total score are listed in upper half of the Table 2. Three out of the 6 SIMS scores in Smith's normative data appear to be associated with professionally unacceptably high rates of false positives in normal controls, ranging from 29.8 to 42.1%.

Table 2: Proportions of normal controls classified as malingerers

Glenn Smith's normative sample of 34 undergraduates:	Mean (SD)	Scale cutoff	z score calculated for each cutoff point	% of persons above cutoff
Neurologic Impairment (NI)	1.0 (1.0)	2	1.00	15.9%
Amnestic Disorders (AM)	1.2 (1.5)	2	0.53	29.8%
Low Intelligence (LI)	1.4 (1.2)	2	0.50	30.9%
Affective Disorders (AF)	3.3 (2.0)	5	0.85	19.8%
Psychosis (P)	0.8 (1.0)	1	0.20	42.1%
Total SIMS score	7.7 (3.7)	14	1.70	4.5%
Meta-analytic data based on means and SDs in Table 1				
Neurologic Impairment (NI)	0.9 (1.1)	2	1.00	15.9%
Amnestic Disorders (AM)	0.8 (1.3)	2	0.92	17.9%
Low Intelligence (LI)	1.7 (1.4)	2	0.21	41.7%
Affective Disorders (AF)	3.7 (1.9)	5	0.68	24.8%
Psychosis (P)	0.5 (0.9)	1	0.56	28.8%
Total SIMS score	7.6 (3.8)	14	1.68	4.6%

3.4 Estimates of false positives in meta-analytic data for normal samples

Similarly, the meta-analytically obtained means and SDs from the last line of Table 1 (i.e., the results of our meta-analysis of the 9 samples of normal controls) were used to estimate the proportions of the normal persons exceeding the cutoffs of the 5 SIMS scales and of the SIMS total score, see lower half of Table 2. The cutoffs recommended in SIMS manual for each scale are listed in the 3rd column. The 4th column indicates the z score calculated for the scale's particular cutoff point. The estimated proportions of false positives in these normal persons (not instructed to malinger and presumably having no reason to malinger) are listed in the 5th column. For example, the z score calculated for the cutoff of 2 points in the meta-analytic data for the Low Intelligence (LI) scale (mean of 1.7, SD=1.4) was 0.21. This z score falls, in our Figure 1, to the right of the curve's peak (i.e., to the right of the average for the normal controls), somewhere between the peak and the Greek lowercase letter sigma (σ) of 1. The area under the curve on right side of this z score indicates the estimated proportion of persons scoring above the cutoff stipulated in SIMS manual, i.e., 41.7%: these normal persons (false positives) would be branded as "malingering low intelligence." They were not instructed to malinger and also presumably had no interest in feigning cognitive impairment or low IQ. Many were college or university students.

3.4 Published suggestions to raise SIMS cutoffs to "improve specificity"

As already discussed, the estimated proportion of false positives in the group of doctoral university students on the AF scale in the study led by Richard Rogers[10] (see the 2nd row of data in Table 1) was 51.2% when the cutoff stipulated in SIMS manual[2] as 5 points is applied: these persons are classified by the AF scale as "malingering affective disorder."

To avoid similar high rates of false positives on SIMS AF scale, Santamaría Fernández (page 241-242)[12] suggested raising the cutoff for the AF scale to 7 points; however, even this cutoff would classify as malingerers 27.4% of Rogers's normal university students.

Serious concerns about substandard diagnostic specificity of SIMS total scores for separating samples of instructed malingerers from those of legitimate patients were expressed already in 2014 in an expert review by van Impelen, Merckelbach, Jelicic, and Merten[18]: ".... *specificity rates in samples of honest patients, claimants, and defendants using cut scores of > 14 and > 16 varied extensively (.37 to .70) and indicate that the SIMS can yield high false positive rates in these groups (i.e., misclassify honest responders as feigners).*" Van Impelen's team discussed possibilities of raising the cutoff for SIMS total score as high as to 24 points, but they cautioned that then SIMS sensitivity (i.e., ability to detect feigners) can be too adversely affected [18].

With respect to the total SIMS score, its cutoff of 14 points stipulated in SIMS manual as used in our meta-analytic study is associated with low estimated rates of false positives in normal controls, the rates below 10%. This could make the SIMS appear professionally acceptable to persons without advanced training in methodology of test construction. However, the logically truly important rates of false positives are those observed in legitimate patients, not in healthy normal controls. The purported task of the SIMS is to differentiate legitimate patients from malingerers. The irremediable flaw of SIMS total score is its lack of specificity, obviously due to lack of items that would differentiate malingerers from legitimate patients. Legitimate patients are likely to obtain much higher SIMS scores than normal controls because the SIMS contains a list of legitimate medical symptoms (scales AF, NI, AM, and P) endorsed more frequently by real patients than by normal controls and also because the SIMS also includes 15 cognitive tasks (the LI scale) on which injured persons such as those with post-concussion syndrome from a vehicular accident[6,7,8] or patients tired by a serious illness or chronic pain would perform more poorly than healthy persons.

Thus, raising the SIMS cutoffs is not a methodologically and ethically acceptable alternative for preventing false positives. With higher cutoffs, the patients with most symptoms, i.e., those most injured, would still be falsely branded as malingerers. In their case, the iatrogenic consequences of such misdiagnosis could be far more extreme than in less injured persons.

The results of our own statistical studies[7, 17] indicate that the SIMS does not differentiate "instructed malingerers" from patients injured in high impact car collisions: statistical comparisons usually showed no statistical differences in total SIMS scores of these two groups. Legitimate patients and the malingerers may report similar numbers of symptoms and obtain similar total SIMS scores[17].

Unfortunately, the SIMS is still routinely used by many North American psychologists in their role as expert witnesses in insurance litigations: to a psychologist adequately trained in elementary statistics, this constitutes a malpractice that tends to falsely classify the more injured persons as malingerers.

3.5 Comparisons of meta-analytically derived scores of normal controls to those of injured patients

Our data from studies[3, 4, 7] on false positives among legitimate patients, those injured in high impact car accidents, are listed in Table 3. The 2nd column of Table 3 lists their means and SDs on SIMS scales. The meta-analytically derived means and SDs for normal persons are in the 6th column. A comparison via t-tests of the injured patients' means and SDs to those obtained meta-analytically in the present study (see t-test results in the last column of Table 3) was highly significant on all SIMS scales because the SIMS measures legitimate symptoms rather than malingering: the patients reported more symptoms than normal controls.

Table 3: Comparisons of the meta-analytic means to those of injured patients

SIMS scales	Patients injured in high impact MVAs (N=23)				Meta-analytic results / present study (N=500)		Comparison of averages (t-tests, p value): Meta-analysis vs injured patients (N=23, N=500)
	Mean (SD)	Estimated % above cutoff	Observed % above cutoff	Estimated Minus Observed	Mean (SD)	Estimated % above cutoff	
Neurologic Impairment (NI)	5.2 (3.9)	79.4%	73.9%	5.5	0.9 (1.1)	15.9%	t=5.3, p<.0001, df=22.2
Amnestic Disorders (AM)	5.0 (4.4)	75.2%	73.9%	1.3	0.8 (1.3)	17.9%	t=4.6, p<.0001, df=22.2
Low Intelligence (LI)	4.8 (4.4)	73.9%	65.2%	8.7	1.7 (1.4)	41.7%	t=3.4, p=.0014, df=22.2
Affective Disorders (AF)	7.7 (2.2)	89.1%	82.6%	6.5	3.7 (1.9)	24.8%	t=9.8, p<.0001, df=521
Psychosis (P)	3.7 (5.3)	69.5%	47.8%	21.7	0.5 (0.9)	28.8%	t=2.9, p=.0042, df=22.1
Total SIMS score	26.5 (16.0)	78.2% > 14	78.3% > 14	-0.1	7.6 (3.8)	4.6% > 14	t=5.7, p<.0001, df=22.1
		74.5% > 16	73.9% > 16	0.6		1.4% >16	
Average overestimate (estimated minus observed):				6.3%			

Note to Table 3: In the t-tests, the variances were homogenous only for the AF scale (all other t-tests are based on assumption of unequal variances)

Some habitual SIMS users might object strongly to this interpretation. They might propose, on the basis of the 4th column of Table 3, that the high observed frequencies of total SIMS scores exceeding SIMS cutoff in the sample of these patients indicate that 78.3% (if using cutoff > 14) or 73.9% (if using cutoff > 16) were malingerers. Such assumption is inconsistent with the fact that all these 23 patients were in high impact MVAs in which their vehicle was subsequently deemed (by their car insurance provider) not worthy of repair.

Some of them were in a car owned by another person and so the age of their vehicle was unknown. The age of their vehicle was known in 12 cases: on the average, the vehicle was 6.2 years old (SD=5.0). Vehicles of that age usually still retain their market value to the extent that they are repaired unless damaged in the MVA to the degree that the repair costs would exceed the pre-MVA market value of that car. The physical nature of their accident (high impact, with major damage to the vehicle) makes the accusation of malingering less plausible, even though some distressed patients could strongly emphasize or overreport their symptoms in a (not unrealistic) fear of otherwise receiving no help from their insurer, in particular no paid treatments.

As reported in a previous publication [7] in respect to this sample of 23 patients, "their average scores were 17.2 (SD=11.0) on the Post-MVA Neurological Symptoms scale [19], 37.4 (SD=13.2) on the Rivermead Post-Concussion Symptoms scale [20], 6.3 (SD=1.3) on the average pain item of the Brief Pain Inventory [21], and 23.7 (SD=3.0) on the Insomnia Severity Index [22]. Their scores on the Insomnia Severity Index were known for 22 of the 23 patients: these scores were in the category of moderate insomnia for 6 patients (27.3%) and in the category of severe insomnia for 16 patients (72.7%). All patients in this sample could be classified as experiencing the post-concussion syndrome (scores ranging from 24 to 58 on the Rivermead scale) [20]." Thus, their symptoms were well documented via measures other than the SIMS.

Some insurance contracted psychologists, in particular those unfamiliar with concussion studies by Bennet Omalu, might insist that probably no concussion occurred in those of the 23 patients who perhaps did not even sustain a visible external head injury. They would conclude that the Rivermead measures of these patients are likely false. However, as explained elsewhere [4, 8], recent research by neuropathologist Bennet Omalu [23, 24] on players of American football demonstrated that cerebral damage in concussions occurs with sudden acceleration or deceleration of the head even in persons who neither sustained any visible head injuries nor fully lost consciousness. These persons, within minutes after the concussion, may still appear able to perform at least some simple physical tasks such as those involved in playing football. However, microvascular injuries and axonal shearing with subsequent neurotoxicity occur in such incidents while the gray and the white parts of the brain slide over each other during the sudden excessive acceleration or deceleration of the skull that is usually associated with a slight rotational movement.

This cerebral damage can be assessed via psychological clinical measures such as the Rivermead Post-Concussion Symptoms scale [20]. The whiplash spectrum symptoms in such patients can be assessed via PMNS [19].
The observed frequencies of persons exceeding SIMS cutoffs in our 23 patients were indeed much higher than those estimated here via meta-analytically obtained means and SDs for combined samples of normal controls: the 23 patients indeed reported more symptoms on the SIMS.

3.6 Errors involved in estimating frequencies of persons above SIMS cutoffs

We were unable to obtain the actual observed frequencies on the normal controls (some authors of studies reviewed here in Table 1 did not reply to our requests for raw data).
The procedure of estimating proportions of normal persons misclassified as malingerers depends on the assumption of normal distribution. Since the actual distribution of SIMS scores may be skewed, errors are to be expected. Our Table 3 lists, in the 3rd and 4th column, the estimated and observed frequencies above SIMS cutoffs in our sample of the 23 patients; the 5th column lists the difference between the two.
The difference was calculated to provide here the size of overestimates (the observed frequency was subtracted from the estimated frequency): these overestimates ranged from - 0.1% to 21.7%, with the average at 6.3%. Except for the Psychosis scale, all these overestimates are less than 9%.
It is not clear if the meta-analytically derived estimated frequencies of normal persons above SIMS cutoffs on LI, P, AF, AM, and NI scales would perhaps be more precise or less precise if corrected by subtracting a coefficient such as 6.3% from the estimated rates: even with such correction, the proportions of false positives on LI, P, AF, AM, and NI scales in normal controls could still appear somewhat absurd, especially on Low Intelligence scale (41.7% minus 6.3 = 35.4%) even in the averaged meta-analytical data.
The correction of estimated rates might be even less successful in the results of some individual SIMS studies. For example, as already pointed out, the calculation of a z score for AF cutoff (specified as 5 in SIMS manual) from the mean and SD in the group of doctoral university students on the AF scale in the study led by Richard Rogers [10] (see in the 2nd row of data in Table 1) indicates that the estimated proportion of false positives is 51.2%. If subtracting 6.3% to correct the result, the estimated rate of false positives corrected to 44.9% still remains professionally unacceptable, especially when it is considered that this rate of false positives was in healthy graduate university students not instructed to malinger and presumably having no reason to overreport their symptoms.
Briefly, it would be beneficial if authors such as Glenn Smith and Richard Rogers would report not only the arithmetic average and SDs on the SIMS of their normal samples, but also the rates of false positives, to more adequately describe the score distribution. It is obviously of much importance to clearly state the proportion of persons above the stipulated cutoffs, i.e., the proportion of false positives on all 5 SIMS scales. Such data would presumably stop further spread of the current pandemic of false psychological reports based on the SIMS, especially in legal proceedings.

3.7 Rates of endorsement by university students of depressive symptoms on SIMS AF scale

As already explained, all items of the AF (Affective Disorders) scale are descriptive of various legitimate symptoms of depression [3]. In 6 of 9 “normal samples” listed in Table 1, from 24.0% to 51.2% of participants scored above the cutoff, i.e., endorsing > 5 symptoms of depression. Many of these normal samples in Table 1 consisted of college or university students. Such high proportions of reports of depressive symptoms are consistent with results of recent mental health surveys of university students which showed high rates of depression or suicidal ideation in such student samples not only in North America [25], but also in countries such as Mexico [26], China [27], Malaysia [28], Nigeria [29], Iran [30], and Turkey [31]. Their rates of depression are a worrisome public health problem that needs more intensive attention by clinical psychologists working with university students.
If such university students are assessed in the context of insurance claims, such as after motor vehicle accidents, the insurance contracted psychologists might erroneously recommend, due to elevated SIMS scores, rejection of their insurance claims. Their pre-MVA depressive symptoms would probably contribute, together with post-MVA injuries, to SIMS scores exceeding the usual cutoffs.
The SIMS should no longer be used in assessments in clinical, forensic, or other legal contexts.

4. Conclusions

The SIMS Neurological Impairment (NI), Amnestic Disorders (AM), Affective Disorders (AF), and Psychosis (P) scales list medical symptoms that are likely to be endorsed more frequently by legitimately ill patients than by healthy normal controls and the SIMS Low Intelligence scale includes cognitive tasks likely to be failed more frequently by the ill or injured patients than by the controls. Our meta-analysis shows that even already too many normal healthy controls are misclassified as malingerers by SIMS NI, AM, AF, P, and LI scales (proportions ranging from 15.9% to 41.7%); it is very likely that these scales have even higher rates of false positives among legitimate patients.
The available data suggest that SIMS scales are a pseudopsychological diagnostic instrument with potential iatrogenic consequences (false denials of treatments and insurance benefits to injured patients).

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