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ORIGINAL ARTICLE

# Online survey about the STROBE statement highlighted diverging views about its content, purpose, and value

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## Abstract

**Background and objective:** The endorsement rates of The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) Statement are low and little is known about authors' opinions about this reporting guideline. We conducted an online survey with observational study authors on attitude toward and experiences with the STROBE Statement with the aim of understanding how to effectively implement STROBE.

**Methods:** A thematic analysis on the responses to an open-ended question was conducted using inductive coding. Two coders classified responses independently into themes using a codebook. The inter-rater agreement ranged from 87.7 to 99.9%.

**Results:** 15% ( $n = 150$ ) of survey participants ( $n = 1,015$ ) shared perceptions and insights on STROBE. We established four themes: 1) perceptions of the checklist, 2) academic confidence, 3) use in education and training, and 4) journal endorsement and use in peer review. Views were diverse and revealed multiple misunderstandings about the checklist's purpose and content, and lack of incentives for its use.

**Conclusions:** Better communication efforts are needed when disseminating STROBE and other reporting guidelines. These should focus on content, education for early career researchers, and encouragement of critical self-reflection on one's own work. In addition, results emphasized the need for better incentive and enforcement mechanisms. © 2020 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Keywords:** Observational studies; Epidemiologic research design; Guidelines as topic; Information dissemination/methods; STROBE Reporting guidelines

## 1. Background

Reporting guidelines (RGs) were created to help reduce research waste and promote reproducibility by providing a minimum set of items to be reported when describing the results of a study. Incomplete reporting contributes to a

“reproducibility crisis” where scientific progress is impeded because of an inability to replicate results and to accurately interpret findings [1,2]. Furthermore, reporting clear and complete information is an ethical responsibility as it informs clinical practice [3]. In addition, incomplete reporting causes studies to be excluded from systematic reviews and meta-analyses, resulting in research waste. With the rise in systematic reviews [4], more attention has been given to the necessity of complete reporting and therefore reporting guidelines [5–7].

The RG movement began in the mid-1990s and first focused on randomized control trials and systematic reviews, resulting in the Consolidated Standards of Reporting Trials (CONSORT) [8] and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [9] Statements. The focus then turned to observational studies which represent most of health research and are often “the most necessary and difficult” studies to conduct in epidemiology [10–14]. Observational studies can provide a large number of participants at an affordable cost, allowing for subgroup comparisons and longer follow-up periods to

Ethics approval and consent to participate: Ethical approval was granted by the University of Split (2181-198-03-04-18-0010).

Availability of data and material: The deidentified standalone qualitative responses will be made available on the Open Science Framework [35].

Conflict of interest: M.K.S. works with the STROBE Statement as a part of her doctoral studies. D.H. provides support and mentoring as a part of the Methods in Research on Research (MiRoR) project. K.G. is a doctoral student on the MiRoR project.

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**What is new?****Key findings**

- 150 authors of observational studies completed our online survey and shared their attitudes toward and experiences with the STROBE reporting guideline.
- Many participants noted that they use STROBE as a teaching tool for early career researchers and find its structure and content useful. However, for mid- to late-career researchers, there was an overwhelming response of self-assuredness that STROBE was not as useful given their level of expertise.

**What this adds to what was known?**

- This is the first survey done evaluating authors attitudes towards the STROBE Statement.
- Respondents reported mixed feelings about STROBE and expressed concerns about the perceived benefits of using it given additional time requirements of use.
- Authors also thought that there is a need for better incentive and enforcement mechanisms from journals. When journals request completed checklists, it should be ensured that it is used during editorial or peer review.

**What is the implication and what should change now?**

- We need to better communicate flexibility to authors who are investing extra time, often perceived to be at the sacrifice of one's ego, to complete reporting checklists.

determine long-term risks and benefits. However, they are prone to biases and confounding, making careful design and analysis invaluable [15].

In 2007, the STrengthening the Reporting of OBServational studies in Epidemiology (STROBE) Statement was developed to help address these problems. It has since been endorsed by the International Committee of Medical Journal Editors and a number of journals [16–18]. However, endorsement rates remain low [19–23] and, while some studies have been conducted on editors' perceptions [24,25], little is known about what authors think of reporting guidelines and how they perceive journal requests for completed checklists. To our knowledge, only one small-scale study, investigated author's perspectives on an RG, the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) Statement [25].

To address this research gap, we conducted an online survey asking observational study authors about their experiences with and attitudes toward the STROBE Statement.

**2. Methods***2.1. Data collection*

Details of study methods were previously published [26]. Briefly, data were drawn from a cross-sectional online survey on STROBE that was completed by authors of observational studies. The survey was distributed from March 5 to August 31, 2018 via social media, and emails to 257 biomedical journal editors and over 14,000 authors. Participants ( $n = 1,015$ ) comprised three groups including those who 1) had used the STROBE checklist before (group 3,  $n = 635$ ), 2) had heard of STROBE, but had not used it (group 2,  $n = 195$ ), and 3) were new to the concept of STROBE, and were asked to give their initial thoughts on it after a brief introduction (group 1,  $n = 185$ ).

The survey included questions about demographics, timing and frequency of use, awareness referral mechanisms, motivators, facilitators, and barriers to use. It concluded with an open-ended question: "Do you have any other comments? Please feel free to expand on anything related to STROBE or this survey. For example, your experiences with STROBE, thoughts about its usefulness, content, format, the extensions, etc."

Nearly 20% ( $n = 203$ ) of those who completed the survey responded to this open-ended question. After eliminating nonsubstantive responses (e.g., "N/A"), 150 participants gave detailed feedback. Owing to the number and richness of responses, we are discussing these separately in this article as it has implications for understanding how to effectively implement STROBE and other reporting guidelines.

*2.2. Analysis*

Open-ended responses were imported from SurveyMonkey into R and then into NVivo 12 [27]. Using inductive coding, one coder (M.K.S.) proposed the initial schema which the other coder (D.H.) used to code the first 100 responses (of the original 203); agreement was over 90% for all codes. Results were then discussed to identify any potential missing categories or disagreements. No issues were found and no changes were made.

**3. Results**

Demographic data for the full sample was reported previously [28]. Our full sample had roughly equal distributions for age, gender, and time spent in research across groups and the qualitative respondents generally did as well (Table 1). Of the 150 qualitative respondents, 65% ( $n = 98$ ) had used STROBE before (group 3), 17% ( $n = 26$ ) had heard

Table 1. Sample demographics

Variables	Qualitative Respondents (n = 150)				Entire Sample of Survey Respondents (n = 1,015)			
	Total sample	Never heard of STROBE, never used [group 1]	Heard of STROBE, Never used [group 2]	Heard of STROBE, have used [group 3]	Total sample	Never heard of STROBE, never used [group 1]	Heard of STROBE, Never used [group 2]	Heard of STROBE, have used [group 3]
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
	150 (100)	26 (17)	26 (17)	98 (65)	1,015 (100)	195 (19)	185 (18)	635 (62)
Time spent in research								
1–10 y	42 (28)	6 (23)	7 (27)	29 (30)	332 (33)	57 (29)	65 (35)	210 (33)
11–30	48 (32)	4 (15)	7 (27)	37 (38)	362 (36)	107 (55)	95 (51)	372 (59)
31 +	39 (26)	10 (38)	6 (23)	23 (23)	86 (10)	30 (15)	25 (14)	48 (8)
I do not work in research	15 (10)	3 (12)	5 (19)	7 (7)	3 (<1)	1 (0)	0 (0)	2 (<1)
Prefer not to say	6 (4)	3 (12)	1 (4)	2 (2)	3 (<1)	0 (0)	0 (0)	3 (<1)
Age								
18–34	29 (19)	4 (15)	4 (16)	21 (21)	185 (18)	36 (19)	38 (21)	111 (1)
35–54	74 (49)	9 (35)	11 (42)	54 (55)	589 (58)	101 (52)	83 (45)	405 (64)
55 +	46 (31)	13 (50)	11 (42)	22 (23)	235 (23)	58 (30)	64 (35)	113 (18)
Prefer not to say	1 (<1)	0 (0)	0 (0)	1 (1)	6 (<1)	0 (0)	0 (0)	6 (<1)
Gender								
Woman	69 (46)	12 (46)	12 (46)	45 (46)	469 (46)	97 (50)	82 (44)	289 (46)
Man	77 (51)	13 (50)	14 (54)	50 (51)	525 (52)	94 (48)	101 (55)	329 (52)
Trans	0 (0)	0 (0)	0 (0)	0 (0)	3 (<1)	0 (0)	0 (0)	3 (<1)
Prefer not to say	4 (3)	1 (4)	0 (0)	3 (3)	20 (2)	4 (2)	2 (1)	14 (2)
Region*								
Africa	3 (2)	2 (8)	0 (0)	1 (1)	22 (2)	5 (3)	2 (1)	15 (2)
Asiatic region	2 (1)	0 (0)	1 (4)	1 (1)	31 (3)	7 (4)	4 (2)	20 (3)
Eastern Europe	4 (2)	1 (4)	0 (0)	3 (3)	33 (3)	12 (6)	5 (3)	16 (3)
Latin America	5 (4)	0 (0)	1 (4)	4 (4)	54 (5)	14 (7)	10 (5)	30 (5)
Middle East	2 (1)	0 (0)	1 (4)	1 (1)	26 (3)	11 (6)	6 (3)	9 (1)
Northern America	57 (38)	13 (50)	6 (23)	38 (39)	283 (28)	58 (30)	57 (31)	168 (27)
Pacific Region	15 (10)	1 (4)	6 (23)	8 (8)	54 (5)	4 (2)	10 (5)	40 (6)
Western Europe	57 (38)	8 (31)	9 (35)	40 (41)	465 (46)	69 (35)	83 (45)	313 (49)
Not reported	5 (4)	1 (4)	2 (8)	2 (2)	47 (5)	15 (8)	8 (4)	24 (4)

\* Regions are defined by Scimago Journal & Country Rank [36] which groups countries into regions based on scientific-output.

of STROBE, but had not used it (group 2), and 17% ( $n = 26$ ) had never heard of STROBE before nor used it (group 1). Representation was roughly equal between groups with 15% of each subgroup responding to the open-ended question.

Thematic coding established four main content areas: 1) mixed perceptions of the checklist, 2) academic confidence and self-assuredness, 3) use in education and training, and 4) journal endorsement and use in peer review. Owing to group imbalances and in the interest of transparency, the participant's subgroup accompanies each quote.

### 3.1. Mixed perceptions of the checklist

General perceptions of STROBE were mixed, ranging from positive reviews that hailed STROBE for how it “helps in standardizing how research is reported and guides the author/researcher to ensure all the necessary

information (that the reader would be looking for) is included” (group 3) to harsh reviews that called it a “procedural straightjacket” (group 3).

Participants also had varied opinions on the additional time investment required to complete STROBE vs expected gain. Respondents referred to the uncertain impact on article publication despite the substantial amount of time required to complete the checklist which implicitly revealed their motivation for using the checklist: “it also adds to the time required to put together a manuscript, and I am not sure how much it improves the chances of a manuscript being published” (group 3). Conversely, the expected quality improvement was considered a key motivational aspect of using STROBE despite the additional working time required, “it does increase the quality of the articles, it is clearly worth the time” (group 3).

STROBE's length and content is a key factor influencing the time needed to complete it. Several authors expressed concerns

that the checklist is too exhaustive and “rigid,” (group 3) reporting fears of an “incomplete” checklist giving the impression that their study is “less than ‘perfect’...” (group 3).

These uncertainties stress the need for flexibility when using STROBE. Authors may “fear the ‘Checklist Manifesto’ becoming a rigid bureaucracy, and also becoming contrived” (group 1, ID1). Although Atul Gawande’s “Checklist Manifesto” argues for implementing checklists [29], our authors cautioned that “that balance between freedom and structure is important to consider” (group 1, ID1) and that it is “important to recognise that each study/analysis is unique and doesn’t always fit with the recommendations” (group 3, ID1).

In recognition of the variety of different types of observational studies, many field- and method-specific extensions to STROBE have been created to provide more nuanced guidance. However, some participants pointed out that these extensions have created needless complexity “... additional confusion in reporting of observational studies” (group 3) and that the “number of extensions has become excessive, especially given that multiple extensions may apply to a single study,” (group 3).

### 3.2. Academic confidence and self-assuredness

Although authors expressed the need for a general flexibility in use and assessments, they also conveyed strong beliefs in their abilities to adhere to the checklist and the standards that it contains. One of the most prevalent themes was the expression of self-assuredness.

“[I] follow the STROBE guidelines in my reporting reasonably well without actually referring to them or using a checklist” (group 3, ID1) and “[I] already apply the STROBE recommendations despite not having heard of it until today” (group 1).

Many authors claimed to be using or following the checklist when, in fact, as demonstrated by the quotes aforementioned, it became evident that they were not completing it or sometimes had never even seen it before.

Furthermore, several authors conveyed their beliefs that STROBE “is a waste of my time” (group 3) in light of their own training and experience. However, they were “glad that investigators with limited training are expected to use STROBE when they approach publication” (group 3).

Despite the prevailing attitudes of self-confidence, there was also recognition that STROBE can be helpful to experienced researchers for quality assurance: “even for those of us who have been researchers for many years, it is sometimes helpful to check a tool such as STROBE, to ensure that we have included everything” (group 3).

### 3.3. Use in education and training

Despite experienced researchers generally not seeing a benefit to personally using STROBE, there were strong

feelings that it is valuable to early-career researchers (ECRs). Many participants shared that they use STROBE’s structure and content as an educational tool for ECRs to instill good practice in writing manuscripts.

“STROBE is useful for any observational researcher, but exceptionally useful for new researchers... it can help them structure their drafts and develop a strong foundation and habits as they write their first papers. We use it in our epidemiologic analysis course and hope that students continue to use it” (group 3).

Aligned with an early intervention stance to intervene in the initial stages of one’s research career, some also suggested that STROBE should be used earlier in the research process itself, like when writing study protocols. Some respondents also thought that intervening earlier would have the most impact on the final quality of reporting: “To fully apply the criteria, I would need to systematically apply the STROBE criteria on the front end design of a project, grant, etc...rather than at the time of writing a project... Encouraging policy that focuses on a front end approach would be helpful” (group 2).

Intervening at the early stages of research and in one’s career could theoretically instill greater contemplation and caution in research planning. While in-depth analytical and epidemiological thinking is not embedded within STROBE, responses revealed that authors see an educational purpose in STROBE and expressed the need for optimization: “woefully deficient in encouraging...use of appropriate data analytic approaches. Strobe should, for example, encourage analysts seeking causal effect estimates to highlight their assumptions with a causal diagram” (group 3).

### 3.4. Journal endorsement and use in peer review

Aside from the personal and educational use of STROBE, many authors expressed beliefs that journals are largely responsible for properly implementing STROBE through mandatory enforcement “I think the main way to increase its use is to make it mandatory before submission,” (group 3) and “guidelines should need to be obligatory for every study. Better implementation is needed” (group 3).

However, it seems that a number of authors primarily looked at the administrative burden of using STROBE over its primary purpose, that is, ensuring that the study is completely reported. One participant noted that “there are so many guidelines like STROBE, it can be difficult to put the energy into using STROBE (or any other) one a priori since ultimately, it depends on the journal submitted to and accepted to” (group 3). While others expressed frustration that it is “annoying to upload the STROBE checklist with journal submissions” (group 3) that “the elucidation of exact pages where the criteria were met, which I found arduous and a bit pedantic” (group 3).

Although STROBE may be seen as an administrative burden to some, other reporting guidelines may not share similar harsh reviews as they are more broadly endorsed by journals. This difference in RG acceptance was pointed out by one participant: “I am sorry to say that PRISMA and CONSORT have become mandatory but STROBE isn’t?” (group 3).

One possible reason for this difference in acceptance might be the relationship to other implementation efforts. For example, one author noted that the conventional nature of trial or protocol registration might affect the acceptability of RGs: “since observational studies do not require prospective registration unlike RCTs or systematic reviews, I don’t think STROBE is used as much as CONSORT or PRISMA even though these reporting guidelines substantially improve study design and reporting” (group 3).

Key to the crux of the issue is again the perceived benefit and establishing a norm for requiring RGs. If an author spends time using a requested checklist, it should be used in the evaluation by peer reviewers and/or editors. However, one author noted a current problem with implementation: “I have never had (nor have I heard of) an editor or reviewer pushing back on a claim that all STROBE criteria were met. Therefore, when a STROBE checklist is required for manuscript submission, it seems to turn into a[n] exercise in additional administrative busywork without really improving the research.” (group 3, ID2).

Other survey respondents echoed concerns regarding the peer review process. When authors go through the trouble of completing a checklist, oftentimes there seems to be little benefit from using it as “the information provided does not matter as the reviewers do not know what to do with it” (group 3).

Despite these reported challenges, using STROBE in peer review can also be beneficial as it provides a reference of support when requesting additional information from authors: “As a junior scientist it gives me confidence to request the reporting of a certain piece of information knowing I have the backing of STROBE” (group 3).

#### 4. Discussion

Responses revealed multiple misunderstandings about STROBE’s purpose and content, and a lack of incentives for use. Our findings emphasize the need to better communicate the reasons for using STROBE and reporting guidelines in general—explaining their potential impact on reproducibility, clinical decision-making, and future research. It is important to convey the idea that complete and transparent reporting goes beyond perceived article publishability. Awareness and education campaigns are key to addressing skepticism and maladaptive beliefs regarding time requirements, benefits of use, and (over) self-confidence.

Part of these efforts must be focused on communicating the flexible nature of STROBE and the continued need for a strong epidemiological education which STROBE cannot replace. A reporting guideline cannot fix study aspects that were not thought about previously or were performed incorrectly. Related to this, some reported the need to use STROBE at earlier stages of research. This suggestion is aligned with a recent scoping review (2019) on interventions to improve adherence to reporting guidelines [30]. The authors found a general lack of attention given to interventions at the early stages of research and suggested that early-intervention policies (e.g., at the funder or ethical review board level) may be more effective in promoting more carefully designed studies.

Although reporting guidelines were not intended to be used for educational purposes, many authors reported that STROBE is useful for teaching early career researchers. STROBE can be a valuable tool to demonstrate how epidemiological concepts work together in practice and we encourage expansion and elaboration on its content. However, although suggestions for more detailed guidance are valid, there is only so much education that an RG can contain. STROBE is not meant to be a guideline on how to properly conduct research [31], but it appears as though many participants did not see education and reporting as distinct concepts. In-depth continuous education should be provided to researchers as epidemiological understanding and critical thinking cannot be taught through an RG alone.

There are many leverage points in the system to target for increased implementation of STROBE; but ultimately the task is placed on authors as they are the creators and owners of the research. Authors highlighted several areas of concern that must be addressed to better implement reporting guidelines. Above all, the perceived benefit and impact of using STROBE must be communicated and established. Authors need to be reassured that extra time spent will be personally rewarding and impact scientific literature as a whole, as it will help knowledge synthesis efforts. Unlike previous work focused on the TREND guideline [25], which found that authors did not think that their RGs took too long to complete, time and the perceived benefit of use was a recurring issue from our participants. Thus, there is a need for research investigating the impact of endorsement on completeness of reporting and on the submission process (e.g., likelihood of being published, speed of reviews, etc.).

To date, research on STROBE’s impact has shown mixed results—either showing no effect on the reporting of confounding [32] or insufficient evidence to determine an impact on overall completeness of reporting [33]. However, recent work by Vilaró et al. demonstrated that having a methodological reviewer dedicated to looking for missing reporting guideline items (not only STROBE) increased the number of article citations by 43% [34]. This could be seen as an incentive for authors but also a proxy for perceived higher quality/impact. We need more research in this area to provide convincing evidence that additional time spent using STROBE can have a positive impact.

Furthermore, when journals request a completed STROBE checklist, it should actually be used by editors and peer reviewers. Otherwise, authors may feel like they did extra work for no benefit. It is theorized that requiring a completed checklist is the most effective form of implementation by journals. However, most endorsement literature does not differentiate between requiring and recommending RGs, so it is unclear whether there are discernible differences on completeness of reporting [33]. Journal editors have also been reluctant to enforcing RGs, expressing concerns that authors will switch to journals with easier submission processes, that their instructions to authors are sufficient, and that implementation would place undue burdens on reviewers [24].

Survey responses solidified often-discussed benefits and issues with reporting guidelines. There is a great potential to increase transparency and reproducibility through complete reporting, provide structure to manuscript writing, and educate early career researchers on the proper conduct of observational research. However, we need to better communicate flexibility to authors who are investing extra time, often perceived to be at the sacrifice of one's ego, to complete reporting checklists. Perhaps the most challenging aspect is the culture change needed to shift away from ingrained personal (over)confidence. Recognizing that these beliefs are quite common is the first step to better acknowledging the importance of humility. Although the ivory tower of academia is still standing, we might be inadvertently missing a few bricks.

### CRedit authorship contribution statement

**Melissa K. Sharp:** Conceptualization, Methodology, Formal analysis, Data curation. **Ketevan Glonti:** Writing - review & editing. **Darko Hren:** Validation, Investigation, Resources, Writing - review & editing, Supervision, Funding acquisition.

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Authors' contributions: M.K.S. conceptualized the study and led the writing of the manuscript. K.G. contributed to the manuscript preparation. D.H. led the supervision of the manuscript preparation. M.K.S. and D.H. performed all analyses. All authors read and approved the final manuscript.

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