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Review

Analysis of the Use of Sample Size and Effect Size Calculations in a Temporomandibular Disorders Randomised Controlled Trial—Short Narrative Review

Grzegorz Zieliński * and Piotr Gawda *

Department of Sports Medicine, Medical University of Lublin, 20-093 Lublin, Poland
* Correspondence: grzegorz.zielinski@umlub.pl (G.Z.); piotr.gawda@umlub.pl (P.G.)

Abstract: Background/Objectives: Temporomandibular disorder (TMD) is the term used to describe a pathology (dysfunction and pain) in the masticatory muscles and temporomandibular joint (TMJ). There is an apparent upward trend in the publication of dental research and a need to continually improve the quality of research. Therefore, this study was conducted to analyse the use of sample size and effect size calculations in a TMD randomised controlled trial. Methods: The period was restricted to the full 5 years, i.e., papers published in 2019, 2020, 2021, 2022, and 2023. The filter article type—"Randomized Controlled Trial" was used. The studies were graded on a two-level scale: 0–1. In the case of 1, sample size (SS) and effect size (ES) were calculated. Results: In the entire study sample, SS was used in 58% of studies, while ES was used in 15% of studies. Conclusions: Quality should improve as research increases. One factor that influences quality is the level of statistics. SS and ES calculations provide a basis for understanding the results obtained by the authors. Access to formulas, online calculators and software facilitates these analyses. High-quality trials provide a solid foundation for medical progress, fostering the development of personalized therapies that provide more precise and effective treatment and increase patients' chances of recovery. Improving the quality of TMD research, and medical research in general, helps to increase public confidence in medical advances and raises the standard of patient care.

Keywords: U test; medicine; sample size; Mann–Whitney U test; effect size; TMD; *t* test; statistics; *p*-value; TMDs

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1. Introduction

Temporomandibular disorders (TMDs) is the term used to describe pathology (dysfunction and pain) in the masticatory muscles and temporomandibular joint (TMJ). The prevalence of TMDs in the world population is estimated to be 34%. This varies by continent, with South America at 47%, Asia at 33%, Europe at 29% and North America at 26%. Regardless of the continent, women are more likely to suffer from TMDs [1]. The aetiology of TMDs is multifactorial [2]. Factors leading to TMDs are primarily poor TMJ biomechanics and the occurrence of trauma. Perpetuating factors include behavioural, social, emotional, and cognitive factors [3].

The difficulties in treating TMDs arise from this multifactorial aetiology, requiring a comprehensive and individually tailored approach. Combining pharmacological therapy (e.g., analgesics, anti-inflammatory drugs) with physiotherapy, behavioural therapy, and even surgical interventions is often necessary in advanced cases [4–7]. The effectiveness of treatment is variable and often requires a long-term commitment from both the patient and the treatment team. In the treatment of TMDs, due to the complex aetiology of the condition, a multidisciplinary approach is often utilized. Treatment of TMDs may involve various interventions including psychotherapy, pharmacotherapy, physical therapy, and injection with hyaluronic acid [7–10]. The estimated cost of treating TMDs in the United States is USD 4 billion [1,11].

Randomised controlled trials (RCTs) are considered the gold standard in clinical research and are essential in the treatment of multifactorial conditions, including TMDs [12–14]. RCTs minimise error and bias by randomly assigning participants to a treatment or control group. For multifactorial diseases, where multiple factors (genetic, environmental, lifestyle) may influence the development and course of the disease, RCTs allow the assessment of whether a new treatment is effective compared to current treatments or placebo. The results of RCTs are often used to produce clinical guidelines that inform medical practice worldwide. With robust evidence from RCTs, these guidelines can provide the best possible treatment recommendations for multimorbidity [12–15].

Statistical analysis plays a key role in improving the quality of RCTs by calculating sample size (SS) and effect size (ES) to enable accurate and reliable inferences about the effectiveness of interventions. The SS, calculated at the start of the study, is critical to ensuring that the study has adequate statistical power to detect a significant difference, if any. A sample that is too small may result in the study having insufficient power to detect significant effects, while a sample that is too large may be inefficient in terms of cost and resources [16,17]. Andrade points out that it is unethical to try too large and too little [17]. ES, a measure of the strength of the association between variables, helps to determine whether statistically significant differences are clinically meaningful. For example, Li et al. reviewed the potential benefits of incorporating patient-reported outcomes (PROs) into routine clinical practice for oncology patients [18]. Although they found studies with statistically significant results, the authors note that these had small to moderate ES. This did not allow the authors to confirm that routine incorporation of PROs into clinical practice has a definitive benefit [18]. Another example is Belcher et al., who reviewed the literature on what is known about psychological distress in adults with multiple primary cancers (MPC) [19]. A study reported a potentially significant increase in psychological distress among MPC survivors compared to single cancer survivors, although the ES was small [19]. One of the most popular examples of significance in ES calculations concerns hereditary cardiology. The case is also described by Sullivan and Feinn [20] where a small ES was shown despite significance at $p < 0.00001$ [20,21].

There is an apparent upward trend in the publication of dental research and a need to continually improve the quality of research [22]. Therefore, this study was conducted to analyse the use of SS and ES calculations in TMDs RCTs.

2. Materials and Methods

It was decided to search the PubMed (National Library of Medicine) [1,23,24] database from 10 January to 30 January 2023 for publications using the acronym: "TMD". The period was restricted to the full 5 years, i.e., papers published in 2019, 2020, 2021, 2022, and 2023. The time frame of 5 years was chosen due to the designation of this period as the most current scientific literature [25–27]. The filter article type—"Randomized Controlled Trial" was used [28].

The studies were graded on two-level scale: 0 or 1. In the case of 1, SS and ES were calculated. A score of 0 indicated that no information was found.

Additionally, each article was assigned a quartile (Q1, Q2, Q3, and Q4) based on the journal's ranking according to the Scimago Journal & Country Rank [29] for the publication year. In cases where the journal was classified into several different journal ranks, the discipline that best matched the article's theme was chosen through consensus.

A summary of the PICO standards (population, intervention, comparison, outcome), including inclusion and exclusion criteria, is found in Table 1 [30,31].

Table 1. PICO summary of inclusion and exclusion criteria.

	Inclusion	Exclusion
Patient		
	Adult and Pediatric population	
Intervention		
	Treatment and investigation of TMDs	
Outcome		
	Classification of the research as a randomised controlled trial in the PubMed database.	
Comparison		
	TMDs vs. Health Subject TMDs vs. TMDs	
Study Design		
		Clinical Trial Narrative Review Systematic Articles Meta-analysis Opinions Case reports or series patients Animal or biomechanical studies Publications in a language other than English Post-conference abstracts

TMDs—Temporomandibular disorders.

3. Results

Table 2 presents the qualified papers and the corresponding analysis. In 2019, SS calculations accounted for 46% of the studies, followed by 51%, 56%, 55%, and 81% in 2023. The statistics are less favourable for ES calculations, with 4% in 2019, and subsequently 21%, 19%, 15%, and 10% in 2023. Across the entire sample, SS was used in 58% of the studies, while ES was used in 15%. The simultaneous use of SS and ES occurred in 4% of the studies in 2019, 18% in 2020, and then 17%, 12%, and 10% in subsequent years. In the entire surveyed group, this amounted to 13%

Table 2. Presentation of results on the use of sample size calculations and effect size in the analysed studies.

	2019				2020				2021				2022				2023			
No.	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**
1	[32]	Q1	1	0	[33]	Q3	0	0	[34]	Q2	0	0	[35]	Q3	0	0	[36]	Q2	1	0
2	[37]	Q2	1	0	[38]	Q3	0	0	[39]	Q3	0	0	[40]	Q4	0	0	[41]	Q1	1	0
3	[42]	Q1	1	1	[43]	Q2	1	1	[44]	Q1	0	0	[45]	Q2	1	1	[46]	Q1	1	0
4	[47]	Q1	0	0	[48]	Q1	1	0	[49]	Q1	1	0	[50]	Q1	0	0	[51]	Q1	0	0
5	[52]	Q3	0	0	[53]	Q1	0	0	[54]	Q2	1	0	[55]	Q3	1	0	[56]	Q1	1	0
6	[57]	Q1	0	0	[58]	Q2	0	0	[59]	Q2	0	0	[60]	Q1	1	0	[61]	Q1	1	0
7	[62]	Q1	1	0	[63]	Q1	1	0	[64]	Q2	0	0	[65]	Q2	0	0	[66]	Q1	1	1
8	[67]	Q1	1	0	[68]	Q3	0	0	[69]	Q3	0	0	[70]	Q3	0	1	[71]	Q1	1	0
9	[72]	Q1	0	0	[73]	Q1	0	1	[74]	Q1	1	1	[75]	Q2	0	0	[76]	Q1	0	0
10	[77]	Q1	1	0	[78]	Q1	1	0	[79]	Q3	1	0	[80]	Q2	1	0	[81]	Q1	0	0

Table 2. *Cont.*

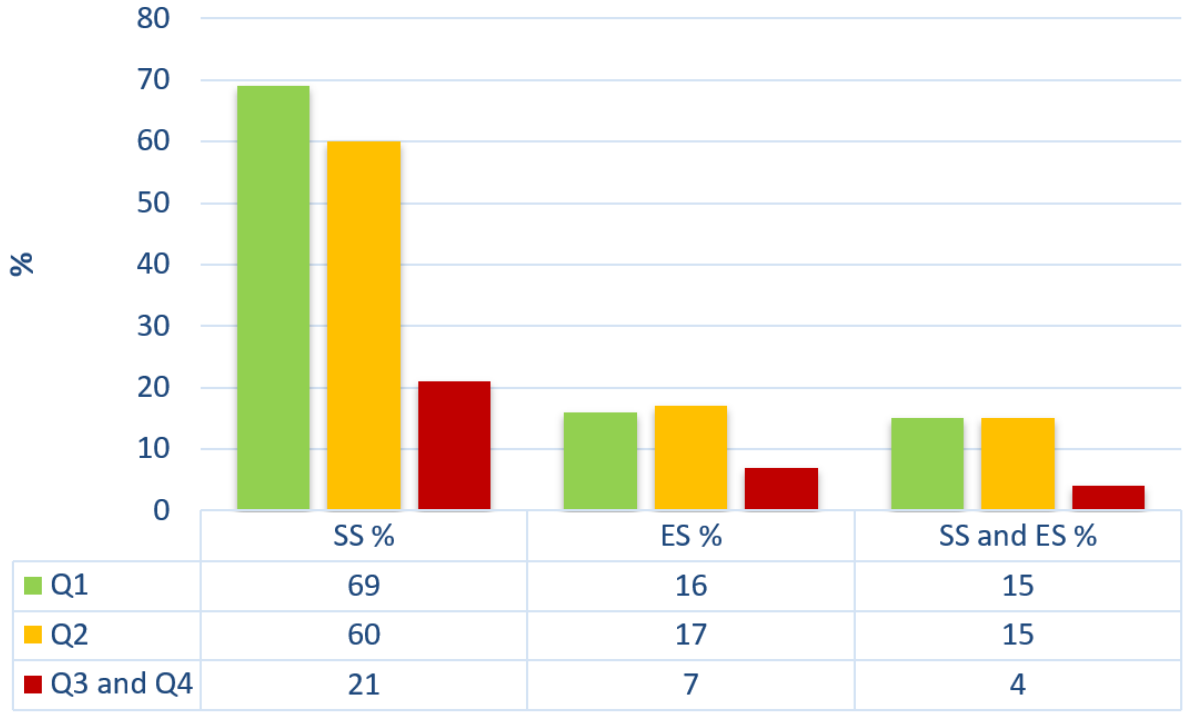
	2019				2020				2021				2022				2023			
No.	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**	**ID**	**Q**	**SS**	**ES**
11	[82]	Q1	0	0	[83]	Q2	0	0	[84]	Q3	1	1	[85]	Q3	0	0	[86]	Q1	1	1
12	[87]	Q1	0	0	[88]	Q1	0	0	[89]	Q3	0	0	[90]	Q1	0	0	[91]	Q1	1	0
13	[92]	Q1	1	0	[93]	Q2	1	1	[94]	Q3	1	0	[95]	Q3	1	0	[96]	Q1	1	0
14	[97]	Q2	1	0	[98]	Q1	0	0	[99]	Q1	0	0	[100]	Q1	1	0	[101]	Q1	1	0
15	[102]	Q2	0	0	[103]	Q1	1	1	[104]	Q2	0	1	[105]	Q1	1	0	[106]	Q1	0	0
16	[107]	Q2	1	0	[108]	Q2	0	0	[109]	Q3	0	0	[110]	Q2	1	0	[111]	Q1	1	1
17	[112]	Q2	0	0	[113]	Q1	0	0	[114]	Q1	1	1	[115]	Q2	1	1	[116]	Q1	1	0
18	[117]	Q3	0	0	[118]	Q2	0	0	[119]	Q2	1	0	[120]	Q2	1	0	[121]	Q1	1	0
19	[122]	Q1	1	0	[123]	Q3	0	0	[124]	Q1	1	0	[125]	Q2	1	0	[126]	Q1	1	0
20	[127]	Q3	0	0	[128]	Q1	1	0	[129]	Q2	0	0	[130]	Q2	1	0	[131]	Q1	0	0
21	[132]	Q1	0	0	[133]	Q1	1	0	[134]	Q2	0	0	[135]	Q1	1	1	[136]	Q1	1	0
22	[137]	Q2	0	0	[138]	Q2	1	0	[139]	Q1	1	0	[140]	Q3	0	0	[141]	Q1	1	0
23	[142]	Q1	1	0	[143]	Q2	1	1	[144]	Q1	0	0	[145]	Q2	1	0	[146]	Q1	0	0
24	[147]	Q2	0	0	[148]	Q3	0	0	[149]	Q2	1	0	[150]	Q3	0	0	[151]	Q1	1	0
25					[152]	Q2	1	0	[153]	Q3	0	0	[154]	Q2	1	1	[155]	Q2	1	0
26					[156]	Q1	1	1	[157]	Q2	1	0	[158]	Q3	0	0	[159]	Q1	1	0
27					[160]	Q2	0	0	[161]	Q1	1	0	[162]	Q2	0	0	[163]	Q1	1	0
28					[164]	Q1	1	1	[165]	Q2	1	1	[166]	Q1	0	0	[167]	Q1	1	0
29					[168]	Q1	0	0	[169]	Q2	1	0	[170]	Q2	0	0	[171]	Q1	1	0
30					[172]	Q1	1	0	[173]	Q2	1	1	[174]	Q2	1	0	[175]	Q1	1	0
31					[176]	Q2	1	0	[177]	Q1	1	0	[178]	Q2	1	0	[179]	Q1	1	0
32					[180]	Q1	1	0	[181]	Q3	0	0	[182]	Q3	1	0				
33					[183]	Q3	0	0	[184]	Q1	1	0	[185]	Q2	0	0				
34					[186]	Q1	1	1	[187]	Q1	1	0								
35					[188]	Q2	1	0	[189]	Q1	1	1								
36					[190]	Q2	0	0	[191]	Q3	0	0								
37					[192]	Q1	0	0												
38					[193]	Q2	1	0												
39					[194]	Q2	1	0												
Total In Year			11	1			20	8			20	7			18	5			25	3
%			46	4			51	21			56	19			55	15			81	10

Total SS calculation	n	94	58	%
Total ES calculation	n	24	15	%

SS—sample size calculations; ES-effect size; Q—Quartiles according to Scimago Journal & Country Rank.

An analysis of the usage of SS, ES, and the combined use of SS and ES in scholarly papers was conducted based on the quartile assigned to the journal according to the Scimago Journal & Country Rank. The sample analysed consisted of 81 papers published in Q1, 53 papers published in Q2, 28 papers in Q3, and 1 in Q4. It was decided to combine quarters Q3 and Q4. A similar percentage of papers using SS, ES, and the combined use of SS and ES was shown to be published in journals placed in Q1 and Q2. However, the lowest

usage of SS, ES, and the combined use of SS and ES was indicated in papers published in quarters Q3 and Q4. The results are presented in Table 2 and Figure 1.



	SS %	ES %	SS and ES %
Q1	69	16	15
Q2	60	17	15
Q3 and Q4	21	7	4

Figure 1. Analysis of the usage of SS, ES, and the combined use of SS and ES depending on the quartile determined by Scimago Journal & Country Rank. SS—sample size calculations; ES—effect size; Q—Quartiles according to Scimago Journal & Country Rank.

4. Discussion

There is an evident upward trend in the publication of dental research, highlighting the ongoing need to enhance research quality [22]. Consequently, this study was conducted to analyse the use of SS and ES calculations in TMDs RCTs. The findings indicate a continued necessity for incorporating SS and ES calculations in research methodologies. However, few authors currently perform these calculations.

The added value of including information on SS and ES calculation in standardized places is a key element of reporting research results. The first important reason is to ensure the transparency and replicability of the research. Detailed information on SS allows readers to accurately assess the statistical power of the analysis so that the study can be repeated to confirm the results. In addition, the inclusion of ES data helps to understand the practical significance of the results obtained, which is important for the scientific community and practitioners.

In standardized sections, such as Methodology and Statistics, this information is readily accessible and comprehensible to readers. Additionally, the clear presentation of this data helps prevent the misinterpretation of results that can arise from insufficient information about the study conditions. Standardized reporting of this information also facilitates research for other scholars, particularly those conducting literature reviews and meta-analyses. In the subsequent part of this work, we demonstrate the methods for calculating SS and ES.

Numerous formulas are available for SS calculation, some of which are presented in Table 3. Other formulas can be found in the articles of Charan and Biswas [16], Noordzij et al. [195] and Das et al. [196].

Table 3. Example formulas that can be used to calculate the SS.

	Name	Formula for Sample Size	Example of Use
1	*Formula for Proportions (Binomial)*	$\mathbf{n = \frac{Z^2 p(1-p)}{E^2}}$	The formula for proportions (binomial), can be used to study the effectiveness of treatments or medical interventions, to study the incidence or prevalence of diseases and to study the efficacy of a drug, etc.
2	*Formula for Mean (Homogeneity)*	$\mathbf{n = \frac{Z^2 \sigma^2}{E^2}}$	The mean (homogeneity) formula can be used in studies that measure health parameters (hormone levels, blood pressure, blood sugar levels, etc.), the effectiveness of diagnostic or therapeutic interventions, and studies that focus on average treatment outcomes.

n—sample size; Z—confidence level; p—estimated population proportion; E—margin of error; σ^2—value is the population variance; Based on publications [16,197–200].

Parameters such as *p*-value, power, etc., must be included in calculations and formulae. It is therefore worth noting that the most commonly used values are 0.05 (5%) and 0.01 (1%) [201,202]. Statistical power refers to the likelihood of identifying a significant effect or difference, if present, within the population [203,204]. The power level of a test is usually set at 0.80 [205–207].

It is necessary to explain why sample size calculations should be conducted for each study. For example, in the studies on TMDs RCTs, the following sample sizes were used: Calixtre et al., n = 61 [42]; Huth et al., n = 40 [66]; Şahin et al., n = 50 [74] Serrano-Hernanz et al., n = 72 [86]; Gikić et al., n = 84 [114]. This example demonstrates that although the field pertains to dental patients, the number of participants appropriate for each study will depend on the study design.

The SS determination also applies to retrospective studies, but the process may be somewhat more complex. When planning SS for retrospective studies, it is important to understand that limited data availability may affect the ability to estimate SS. To estimate SS in retrospective studies, the formulas in Table 3 can be used, but Johnston et al. have also provided an SS computation in descriptive retrospective burden investigations [208].

A different approach is presented by Kim and Seo in the form of post hoc power analyses in retrospective studies [209]. In retrospective studies, it is often not possible to change the SS because the data have already been collected. Post hoc power analysis can help to understand how robust the observed effects are in the context of already collected data when SS calculation is difficult.

Tables 4 and 5 show the main formulas for ES. Other formulas can be found in the work of Lakens [210], Tomczak and Tomczak [211], and Fritz [212].

Table 4. Example formulas that can be used to calculate the ES.

	Formula For Effect Size	Example of Use
1	$\mathbf{d = \frac{t}{\sqrt{n}}}$	ES for Student's *t*-test
2	$\mathbf{d = \frac{\overline{X}_1 - \overline{X}_2}{s}}$	ES for Student's *t*-test
3	$\mathbf{g = d\left(1 - \frac{3}{4n-9}\right)}$	Hedges's g correction for bias (Student's *t*-test) recommended when $n < 50$
4	$\mathbf{\delta = \frac{\overline{X}_1 - \overline{X}_2}{s_2}}$	Glass's δ
5	$\mathbf{r = \frac{Z}{\sqrt{n}}}$	ES for the Mann–Whitney U test or Wilcoxon test
6	$\mathbf{r = \frac{2(\overline{R}_1 - \overline{R}_2)}{n_1 + n_2}}$	ES for the Mann–Whitney U test or Wilcoxon test
7	$\mathbf{d = \frac{2r}{\sqrt{1-r^2}}}$	Formula for converting r into Cohen's d effect size

Table 4. *Cont.*

	Formula For Effect Size	Example of Use
8	$\varphi = \sqrt{\frac{x^2}{n}}$	ES for the Chi-Squared test
9	$V = \sqrt{\frac{x^2}{n_{min}(R-1)(C-1)}}$	ES for the Chi-Squared test
10	$\eta 2 = \frac{H-k+1}{n-1}$	ES for a Kruskal–Wallis test

Table based on publications [210–219]. d—Cohen's index; t—value of Student's *t*-test; n—sample size; $\overline{X}_1$ and $\overline{X}_2$ —the average values for the two groups; s— the pooled standard deviation; s_2 —the standard deviation of the second group; φ—Phi effect size; δ —Glass's index; r—correlation coefficient (−1.00 to 1.00); z—value of U-test; $\overline{R}_1$ and $\overline{R}_2$ —mean range for group 1 and group 2; n_1 and n_2 —represent the number of observations in each group; U—stands for the Mann–Whitney; V—Cramer's V effect size; x^2—the chi-squared statistic; R—number of rows; C—number of columns; n_{min}—the minimum number of observations (the minimum value among two values: the number of rows and the number of columns in a given contingency table); $\eta 2$—index; H—value of H-test; k—number of groups. chi-squared test statistic.

Table 5. The most commonly used coefficients for effect size, based on publications.

Coefficients	Small	Medium	Large	What is/When to Use
Cliff's δ	0.15	0.33	0.47	It is a measure that compares two groups in the case of ordinal or ranked variables. It is used to assess the difference in distribution between two groups, but unlike many other effect measures, it is more robust to sample imbalance, data skewness and non-linear relationships.
Cohen's d	0.20	0.50	0.80	This measure works best for comparisons between two groups, for example, an experimental group and a control group (comparison of two groups or differences between averages).
Cohen's d	0.15	0.40	0.75	Brydges' recommendation in gerontology [220].
Cohen's d	0.25	0.55	0.95	Gaeta and Brydges' recommendation in audiology and speech-language pathology [221].
Cohen's d	0.15	0.36	0.65	Lovakov and Agadullina's recommendation in social psychology and sub-disciplines within social psychology [222].
Cohen's g	0.05	0.15	0.25	Cohen's g is a less common variant of Cohen's d and is used to measure the difference between 2 groups (for example in McNemar's test).
Cohen's f	0.10	0.25	0.40	It is used when there is a comparative analysis of more than two groups.
Cohen's ω	0.10	0.30	0.50	Cohen's ω is used in regression analyses, particularly for linear regression, to measure how strongly factors are related.
Cramér's V and phi (φ)			df	Cramér's V—it is used to assess the strength of the relationship between 2 or more categorical factors in tables of different sizes, allowing comparison across different contingency table sizes. It s a more general measure applicable to tables of different dimensions (different numbers of rows and columns). phi (φ)—specifically used for 2 × 2 contingency tables, ϕ measures the strength of the connection between categorical variables in contingency tables. It focuses on tables of a fixed size, making it suitable for more specific contexts like two-factor analysis in medical studies or qualitative research.
	0.1	0.3	0.5	1
	0.07	0.21	0.35	2
	0.06	0.17	0.29	3
	0.05	0.15	0.25	4
	0.04	0.13	0.22	5
Glass's δ	0.20	0.50	0.80	It is used in the context of experimental analysis, where one group is treated as the control group and the other as the experimental group.
Hedges' g	0.20	0.50	0.80	This coefficient is a measure of ES similar to Cohen's d, but with a correction for SS. Used for intergroup analyses with small samples.
Hedges' g	0.15	0.40	0.75	Brydges recommendation in gerontology [220].

Table 5. *Cont.*

Coefficients	Small	Medium	Large	What is/When to Use
Hedges' g	0.25	0.55	0.95	Gaeta and Brydges' recommendation in audiology and speech-language pathology [221].
Pearson's r	0.10	0.30	0.50	It is used to measure the strength and direction of a relationship between 2 continuous factors. It is employed to quantify the intensity and orientation of a connection between 2 continuous variables.
Pearson's r	0.10	0.20	0.30	Brydges' recommendation in gerontology [220].
Pearson's r	0.25	0.40	0.65	Gaeta and Brydges' recommendation in audiology and speech-language pathology [221].
Pearson's r	0.12	0.24	0.41	Lovakov and Agadullina's recommendation in social psychology and related disciplines [222].
Pearson's r	0.10	0.20	0.30	Gignac and Szodorai's recommendation [223].
Odds Ratio	1.44	2.48	4.27	Odds ratio is a measure used in statistics, especially in epidemiology and other areas of medical research, to determine the strength of the relationship between 2 variables, usually in the context of a case–control study.
Odds Ratio	1.68	3.47	6.71	Recommended by Chen et al. [224].
η^2	0.01	0.06	0.14	It is a measure of ES used mainly in the analysis of variance (ANOVA). It is used to assess the strength of the connection between the independent and dependent variables when we have more than two groups of data.
ω^2	0.01	0.06	0.14	It is a measure of ES in the analysis of variance (ANOVA). This is a more sophisticated measure that takes into account the number of groups and the number of observations in each group. It is considered to be a more accurate and less biased measure of effect size in ANOVA than η^2.

Table based on [210,213,220–236].

Let us consider examples from studies analysed in this research. In the study by Calixtre et al., an effect size of d > 0.8 was observed, which further validated the obtained results [42]. In the study by Huth et al., the ES demonstrated that aqualizer system-based occlusal splints led to a better improvement in TMJ pain with maximum opening compared to chin point guidance-based occlusal splints (d = 0.9; chin point guidance d = 0.13) [66]. Here, the ES helped differentiate the outcomes. In the study by Şahin et al., which aimed to compare the effects of 4 weeks of exercise combined with ischemic compression and exercise alone in patients with TMDs [74], the ES was small for maximum assisted mouth opening (ES = 0.27) and moderate for painless mouth opening (ES = 0.51) [74]. This indicates that despite the significance, the phenomenon requires further research.

An extension of the concept of ES Cohen's d was proposed by Sawilowsky in 2009. He added the ES categories "Very Small, Very Large, and Huge" [237]. This extension aims to increase the statistical power and reduce the risk of erroneous data interpretation (Table 6).

Table 6. Extension of Cohen's d effect size concept proposed by Sawilowsky.

	Very Small	Small	Medium	Large	Very Large	Huge
Cohen's d		0.20	0.50	0.80		
Sawilowsky	0.01				1.20	2.00

Table based on [227,237].

In the main text of the paper, in addition to tables with formulas for SS and ES, there are tables with free calculators for these values available online (Table 6) as a form of supplement to the paper Serdar et al. [238] or Charan and Biswas [16]. However, there were no academic calculators or government websites to help with the analyses in the above studies, so Table 7 was created. In addition to the online tools, statistical software tools

such as G*Power, R, GraphPad Prism, and SPSS are also available to assist in the analysis of the above variables. Based on the relevance of SS and ES, and the accessibility of their calculation (formulas, online calculators, software tools), it is recommended that they be included in medical research.

Table 7. Online sample size and effect size calculators.

Institution	Link Accessed on 16 May 2024
Australian Bureau of Statistics	https://www.abs.gov.au/websitedbs/d3310114.nsf/home/sample+size+calculator
Cambridge University	https://www.cem.org/effect-size-calculator
Harvard University	http://hedwig.mgh.harvard.edu/sample_size/size.html
Johns Hopkins University	http://www.rad.jhmi.edu/jeng/javarad/samplesize/
Missouri State University	https://www.missouristate.edu/RStats/mote-effect-size-calculator.htm
Universität Wien	https://homepage.univie.ac.at/robin.ristl/samplesize.php
Universiti Sains Malaysia	https://medic.usm.my/biostat/en/articles/118-sample-size-calculator
University College London	https://www.ucl.ac.uk/child-health/short-courses-events/about-statistical-courses/sample-size-estimation-and-power-calculations
University of British Columbia	https://www.stat.ubc.ca/~rollin/stats/ssize/
University of California, San Francisco	https://sample-size.net/means-sample-sizeclustered/
University of Colorado	https://lbecker.uccs.edu/
University of Michigan	https://csg.sph.umich.edu/abecasis/cats/gas_power_calculator/

Clinical studies on TMDs require careful planning and analysis to provide meaningful insights for clinical practice. Key aspects of these studies include calculations regarding SS and ES, which help ensure the reliability and utility of the results. The ES is a crucial indicator for assessing the clinical significance of the findings and can be expressed in various ways depending on the study's characteristics and outcomes. Conclusions drawn from these analyses can aid in delivering better treatment strategies for patients with TMDs, by enhancing the effectiveness and precision of therapeutic interventions and improving understanding of their impact on patients' quality of life.

Given the numerous tools available to researchers for performing SS and ES calculations, it is essential to explore why so few studies address this topic. Our discussion has highlighted several studies emphasizing the importance of SS and ES calculations [20,197,209,211]. The lack of these calculations may be attributed to a multifaceted issue.

One factor could be the lack of adequate training in statistics, leading to an incomplete understanding of SS and ES calculation methods. The significance of collaboration between medical specialists and statisticians was observed by Sprent in 2003 [239]. Another issue relates to sample size, which can be impacted by the application of new therapies [57,190] and participants' concerns about potential adverse effects, resulting in lower recruitment numbers [240,241]. Challenges in collaboration, such as conducting single-centre studies with selected and hard-to-recruit patients due to various inclusion and exclusion criteria, further complicate this issue [58,191].

The examples mentioned above suggest that the infrequent use of SS and ES calculations may be linked to publication pressure. Kearney et al., who investigated this phenomenon in medical research, summarized their findings as follows: "Pressure in the world of academic medicine to publish contributes to the potential for research misconduct and authorship misrepresentation" [242]. This summary also aptly explains our results.

5. Conclusions

Quality should improve as research increases. One factor that influences quality is the level of statistics. SS and ES calculations provide a basis for understanding the results

obtained by the authors. SS post hoc calculations should also be used in retrospective studies. Access to formulas, online calculators and software facilitates these analyses. High-quality trials provide a solid foundation for medical progress, fostering the development of personalized therapies that provide more precise and effective treatment and increase patients' chances of recovery. Improving the quality of TMD research, and medical research in general, helps to increase public confidence in medical advances and raises the standard of patient care.

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