University of Thessaly

School of Health Sciences - Faculty of Medicine

MSc Program: "Research Methodology in Biomedicine, Biostatistics & Clinical Bioinformatics"

Master of Science Thesis

"Assessment of the reporting quality of observational studies about cross linking in keratoconus published from 2013 to 2022 using the STROBE statement "

by

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"Αξιολόγηση της ποιότητας αναφοράς μελετών παρατήρησης σχετικά με τη διασύνδεση κολλαγόνου στον κερατόκωνο δημοσιευμένων από το 2013 έως το 2022 με χρήση της δήλωσης STROBE "

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1. Abstract

- **Introduction:** Keratoconus is a noninflammatory ocular disease affecting both eyes leading to irregular astigmatism and decreased visual acuity. Recently, a technique called collagen cross linking has been introduced for treatment with successful results. Adequately reported observational research helps improve the understanding of these results. However, no research on evaluating the reporting quality of observational studies about cross liking in keratoconus has been found.
- **Objectives:** assessment of the aforementioned quality for the period between 2013 and 2022 using the STROBE statement and identify factors associated with high-quality reporting.
- **Methods:** PubMed was searched for observational studies involving cross linking in keratoconus published from 2013 to 2022. The STROBE statement was adopted to evaluate the reporting quality of the selected studies.
- **Results:** The mean of overall adherence to the STROBE statement was 80.77%.The mean of the studies' STROBE score was 16,32 ± 1,57(SD). The mean of adherence to "Methods" was 79.25% and to "Results" was 73.76%. Larger patient sample size studies and studies with a higher impact factor of publication journal produced higher STROBE scores. Binary logistic regression analyses presented no significant results.
- **Discussion:** The reporting quality of observational studies was relatively adequate, although certain items were underreported. In summary, further improvement is required.

KEY WORDS: STROBE, observational study, quality, cross linking, keratoconus

1. Περίληψη

- **Εισαγωγή:** Ο κερατόκωνος είναι μία μη φλεγμονώδης ασθένεια του οφθαλμού, που επηρεάζει και τους δυο οφθαλμούς αμφοτερόπλευρα και οδηγεί σε ανώμαλο αστιγματισμό και μείωση της οπτικής οξύτητας. Πρόσφατα μια νέα θεραπευτική τεχνική, η διασύνδεση κολλαγόνου, εισήχθη στη θεραπευτική φαρέτρα με αισιόδοξα αποτελέσματα. Οι ποιοτικά επαρκώς αναφερόμενες μελέτες παρατήρησης βοηθούν να κατανοήσουμε καλύτερα τα αποτελέσματα αυτής της τεχνικής. Μια τέτοια μελέτη για την αξιολόγηση της ποιότητας αναφοράς μελετών παρατήρησης σχετικά με τη διασύνδεση κολλαγόνου στον κερατόκωνο δεν έχει διενεργηθεί.
- **Στόχοι:** Η αξιολόγηση της προαναφερθείσας ποιότητας για το χρονικό διάστημα 2013 έως το 2022 με χρήση της δήλωσης STROBE και ο προσδιορισμός παραγόντων που σχετίζονται με υψηλή ποιότητα αναφοράς.
- **Μέθοδοι:** Έγινε αναζήτηση στην PubMed για μελέτες παρατήρησης που αφορούσαν τη διασύνδεση κολλαγόνου στον κερατόκωνο, δημοσιευμένων από το 2013 έως και το 2022. Η αξιολόγηση της ποιότητας αναφοράς των επιλεγμένων μελετών έγινε με τη χρήση της δήλωσης STROBE.
- **Αποτελέσματα:** Η μέση τιμή του συνολικού ποσοστού υιοθέτησης της δήλωσης STROBE ήταν 80,77%. Η μέση τιμή του STROBE score των μελετών ήταν 16,32 ± 1,57 **:** Η μέση τιμή του ποσοστού υιοθέτησης της δήλωσης STROBE για το τμήμα ''Μέθοδοι'' ήταν 79,25% και για το τμήμα ''Αποτελέσματα'' ήταν 73,76%. Οι μελέτες με μεγαλύτερο δείγμα ασθενών και οι μελέτες που δημοσιεύτηκαν σε περιοδικά με μεγαλύτερο παράγοντα επιρροής είχαν υψηλότερα STROBE scores. Η λογαριθμιστική παλινδρόμηση δεν ανέδειξε σημαντικά αποτελέσματα.
- **Συμπέρασμα:** Η ποιότητα αναφοράς των μελετών παρατήρησης ήταν σχετικά επαρκής αν και ορισμένα σημεία είχαν χαμηλότερη από αυτήν που ενδείκνυται. Συμπερασματικά, απαιτείται περαιτέρω βελτίωση.

ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ: STROBE, μελέτη παρατήρησης, ποιότητα, διαχωρισμός κολλαγόνου, κερατόκωνος

2. Introduction

The word keratoconus is derived from the Greek words ‘’keras’’ and ‘’ konus’’, meaning the corneal conus. Keratoconus is an ocular disease affecting both eyes, not symmetrically. It is associated with cornea’s progressive thinning and steepening. Irregular astigmatism and decreased visual acuity are its main results. The central or paracentral cornea are the regions most prone to cornea thinning. Keratoconus is known as a noninflammatory disease. However, some studies have indicated that eyes with keratoconus often involve some kind of inflammation. One eye is typically more severely affected than the other, even though keratoconus is a bilateral condition. All ethnicities and both sexes are equally affected by the disease. Epidemiological studies have estimated keratoconus's prevalence and incidence rates to be between 0.2 and 4.790 per 100,000 persons. 20 to 30-year-olds are mostly prone to this condition involvement. Keratoconus affects histopathologically all corneal layers, with a more obvious effect in the central cornea compared to the peripheral cornea. Only the anterior cornea appeared to be compromised in early forms of the disease. These distortions are found in the epithelium, Bowman’s layer and stroma, while Descement’s membrane appears to be less affected. Keratoconus patients often appear to have increased visibility of their corneal nerves at the sub-basal corneal nerve plexus, because of corneal thinning. Furthermore, they present decreased corneal sensation in comparison to the normal population. Localized nerve thickening within the epithelium has also been observed, as well as deterioration of corneal transparency, due to changes in the very well-organized architecture of the corneal stroma. Several environmental and familial factors have been associated with keratoconus such as allergy and atopy with the reported prevalence being 11 to 30% [1] Chronic eye rubbing and contact lens wear are strongly associated risk factors, too [2].

Different treatment methods have been developed for the management of keratoconus. An innovative procedure called collagen cross-linking (CXL) has recently been developed. It improves successfully visual acuity and leads to regression in the progression of keratoconus. This is achieved by preventing enzymatic degradation of stromal collagen [3]. The procedure also increases biomechanical corneal stability aiming to prevent keratoconus progression. CXL consists of the removal of the central 6–7 mm area of corneal epithelium followed by the subsequent application of 0.1% riboflavin solution and corneal radiation of ultraviolet-A light at 370 nm. Ultraviolet-A radiation activates riboflavin, forming covalent bonds between collagen fibrils and the corneal stroma [1]. Cross linking is safe and may be effective in decelerating the progression of keratoconus for at least one year [4, 5].

CXL, being a relatively new treatment method, impels further research to improve our understanding of its treatment results [3]. Much of this medical research is observational. Observational studies have an important role in the research of medical treatments. Randomized trials are unable to answer all the necessary questions and observational studies tend to indicate what is achieved in daily medical practice much

more effectively [6]. That is why it is crucial that observational studies are reported transparently so that readers can better understand both the study designs and medical information [7]. The credibility of research relies on assessing the strengths and weaknesses in study design, conduct, and analysis, as well as the transparent reporting of the study[6]. However, the reporting of such observational research is often inadequate. This fact leads to the generalizability of study results and credibility restriction [8].

In 2008, the Strengthening of the Reporting of Observation Studies in Epidemiology (STROBE) statement was published for observational studies to improve their transparency in reporting [7]. STROBE statement consists of 22 criteria to which observational studies should conform in order to increase their conclusion generalisability [8]. These recommendations are not strict prescriptions for conducting studies. In addition, the STROBE statement is not meant to evaluate the quality of observational research [6].

To our knowledge, there are no assessments of the quality of reporting about cross linking in keratoconus. In Ophthalmology, there is a great number of observational studies used in clinical research. As a result, our objective is to assess the quality of reporting of observational studies about cross linking in keratoconus for the period between 2013 and 2022 using the STROBE statement and to identify factors associated with high-quality reporting.

3. Methods

Search strategy and studies selection

PubMed was searched for observational studies involving cross linking in keratoconus published from 2013 to 2022. The search strategy required the phrase ‘‘cross linking’’ (and all similar spellings) and the word ‘‘keratoconus’’ to appear in the title. Articles that met the following criteria were selected: observational studies (including cross-sectional studies, case-control studies, and cohort studies), accessibility, and studies on humans, including both adults and children. 10 studies were retrieved, all of which were cohort studies (9 cohort studies and 1 registry-based cohort study) [9,10].

Data extraction

Numerous pieces of information were extracted from each study such as the type of study, publication year, publication journal, the continent of origin, funding support and patient sample size. The journals’ impact factors were extracted from the Academic Accelerator website. Then STROBE statement criteria were applied to the extracted studies.

Quality assessment

The STROBE statement consists of 22 items: title and abstract (item 1), introduction (items 2 to 3), methods (items 4 to 12), results (items 13 to 17), discussion (items 18 to 21), and other information (item 22). A score of 1 was assigned to items for which the information was reported adequately-fully, a score of 0.5 was assigned to items for which the information was partly reported, and a score of 0 was assigned to items for which none of the information was reported [7]. For items with sub-parts, fractional points were assigned depending on the number of sub-items' criteria adherence. If a sub-item did not apply to the study design, it was scored as ''not applicable''(N/A). As a result, every study had an overall STROBE score rated from 0 to a maximum score of 22. The grading was performed by only one reviewer. This fact may account for a source of bias.

Statistical methods

Data subjected to normal distribution were presented as the mean with standard deviation (SD) and 95% confidence interval (CI). The percentage of adherence was calculated for each STROBE item and sub-item for all included observational studies. To simplify the statistical analysis, a combination (sum) of "reported" and "partly reported" was created to calculate the reporting rate of items and sub-items. A comparison of STROBE scores between dichotomous groups was conducted by using the independent Student's t-test after the Shapiro–Wilk test was used to assess normality. The included articles were further divided into high and low-reporting quality groups according to the cut-off value=16,69 in STROBE score (the 66,6th percentile of the STROBE score – the top third of studies). Binary logistic regression was used to analyze the associations between high reporting quality and study type (retrospective/prospective), publication year (2017 was chosen as cut off point by separating our studies into two five years periods, 2013-2017 and 2018-2022), publication journal's impact factor (IF), (journals' impact factors' mean=3,17 was chosen as cut off point), funding support (yes/no), and patient sample size (studies' patient sample sizes' mean=140 was chosen as cut off point). Calculation of the odds ratio (OR) and 95% confidence interval (CI) was executed from the binary regression analyses. The limited number of studies that were extracted and evaluated (N=10) may account for potential bias in the binary regression analyses. A p-value ≤ 0.05 was considered to be statistically significant. Statistical analyses were performed by SPSS 26 Statistics Software (IBM Corporation).

4. Results

Studies selection and characteristics

After a search of the database, 10 studies were retrieved that met the inclusion criteria. These were 10 cohort studies (9 cohort studies and 1 registry-based cohort study). Several pieces of information were extracted from these studies. These characteristics are presented in Table 1.

Table 1.

Studies	1 [11]	2 [12]	3 [13]	4 [14]	5 [15]	6 [16]	7 [17]	8 [18]	9 [19]	10 [20]
Journal's IF	1,82	2,18	0,93	4,8	7,38	0,93	4,21	2,37	4,96	2,14
Type	retrospective	retrospective	retrospective	prospective	prospective	retrospective	prospective	prospective	retrospective	prospective
Date	2017	2017	2017	2014	2016	2015	2022	2019	2022	2020
Sample size	33	241	74	45	19	31	794	18	112	35
Location	Asia	Europe/Oceania	South America	Europe/Oceania	Europe/Oceania	South America	Europe/Oceania	Europe/Oceania	North America	Africa
Funding	Yes	No	No	-	Yes	No	Yes	-	No	-

STROBE Statement adherence

The percentage adherence to the STROBE statement's 22 items of the included observational studies, is presented in Table 2.

Table 2.

Adherence to the STROBE Reporting Criteria

	Item No	Recommendation	Fully Reported (%)	Partly Reported (%)
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	8 (80)	1 (10)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	10 (100)	0 (0)
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	10 (100)	0 (0)
Objectives	3	State-specific objectives, including any prespecified hypotheses	10 (100)	0 (0)
Methods				
Study design	4	Present key elements of study design early in the paper	10 (100)	0 (0)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8 (80)	2 (20)
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria and the sources and methods of selection of participants	8 (80)	2 (20)
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give	1 (50) *	1 (50) *

		matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10 (100)	0 (0)
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9 (90)	1 (10)
Bias	9	Describe any efforts to address potential sources of bias	4 (40)	2 (20)
Study size	10	Explain how the study size was arrived at	1 (10)	6 (60)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	2 (20)	1 (10)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10 (100)	0 (0)
		(*b*) Describe any methods used to examine subgroups and interactions	8 (100) *	0 (0) *
		(*c*) Explain how missing data were addressed	2 (33.3) *	0 (0) *
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	2 (33.3) *	0 (0) *
		(*e*) Describe any sensitivity analyses	0 (0)	0(0)

Results				
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	0 (0)	9 (90)
		(b) Give reasons for non-participation at each stage	0 (0) *	2 (33.3) *
		(c) Consider use of a flow diagram	0 (0)	0 (0)
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	0 (0)	10 (100)
		(b) Indicate number of participants with missing data for each variable of interest	4 (66.6) *	1 (16.6) *
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	9 (90)	1 (10)
Outcome data	15	*Cohort study*—Report numbers of outcome events or summary measures over time		
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	10 (100)	0 (0)
		Cross-sectional study—Report numbers of outcome events or summary measures		
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	2 (20)	1(10)
		(*b*) Report category boundaries when continuous variables were categorized	2 (100) *	0 (0) *
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	0 (0)	0 (0)
Other analyses	17	Report other analyses done— eg analyses of subgroups and interactions, and sensitivity analyses	9 (90)	0 (0)
Discussion				
Key results	18	Summarise key results with reference to study objectives	10 (100)	0 (0)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	7 (70)	0 (0)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,	10 (100)	0 (0)

		other relevant evidence		
Generalisability	21	Discuss the generalisability (external validity) of the study results	3 (30)	3 (30)
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	7 (70)	0 (0)

*percentages were calculated using only the studies that the sub-items were applicable

The mean of overall adherence to the STROBE statement is 80.77%. The calculation of the mean of overall adherence was based on the means of all 22 items that were first calculated by their sub-items' adherence percentages. In more detail, the mean of adherence to "Title and Abstract" is 95%, to "Introduction" is 100%, to "Methods" is 79.25%, to "Results" is 73.76%, to "Discussion" is 82.5% and to "Other Information" is 70%. The most frequently sufficiently reported items among all studies were items 2, 3, 4, 5, 6, 7, 8, 15, 18 and 20 with a 100% rate. In contrast, items 11, 12, 13 and 16 were only reported correctly in 30%, 53.3%, 41.1% and 43.3% respectively.

STROBE Statement score

The assessed studies' STROBE score is presented in Table 3. The mean of the studies' STROBE score was 16,32 (range: 13,98 – 18,97) with a standard deviation of 1,57. Fig 1 shows the frequency of the STROBE score.

Table 3.

STROBE CHECKLIST		Study 1 [11]	Study 2 [12]	Study 3 [13]	Study 4 [14]	Study 5 [15]	Study 6 [16]	Study 7 [17]	Study 8 [18]	Study 9 [19]	Study 10 [20]
1 (1)	a	0,5	0,5	0,5	0	0,5	0,25	0,5	0,5	0,5	0,5
	b	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
2 (1)		1	1	1	1	1	1	1	1	1	1
3 (1)		1	1	1	1	1	1	1	1	1	1
4 (1)		1	1	1	1	1	1	1	1	1	1
5 (1)		1	1	1	1	0,5	1	1	1	0,5	1
6 (1)	a	1	1	1	1	0,5	1	1	0,5	1	1
	b	N/A	N/A	N/A	N/A	0,5	N/A	N/A	0,25	N/A	N/A
7 (1)		1	1	1	1	1	1	1	1	1	1
8 (1)		1	1	1	1	1	0,5	1	1	1	1
9 (1)		0	0	0	1	1	0	0,5	1	1	0,5
10 (1)		1	0,5	0,5	0,5	0	0,5	0,5	0	0,5	0
11 (1)		0	0	0	0	0	0	0,5	1	1	0
12 (1)	a	0,5	0,2	0,33	0,33	0,2	0,2	0,2	0,33	0,25	0,2
	b	N/A	0,2	0,33	0,33	0,2	0,2	0,2	0,33	N/A	0,2
	c	N/A	0	N/A	N/A	0	0	0,2	N/A	0,25	0
	d	N/A	0	N/A	N/A	0	0	0,2	N/A	0,25	0
	e	0	0	0	0	0	0	0	0	0	0
13 (1)	a	0	0,16	0,25	0,25	0,16	0,16	0,16	0,25	0,16	0,16
	b	N/A	0,16	N/A	N/A	0	0	0	N/A	0	0,16
	c	0	0	0	0	0	0	0	0	0	0
14 (1)	a	0,25	0,16	0,25	0,25	0,16	0,16	0,16	0,25	0,16	0,16
	b	N/A	0,33	N/A	N/A	0,16	0,33	0,33	N/A	0,33	0
	c	0,5	0,33	0,5	0,5	0,33	0,16	0,33	0,5	0,33	0,33
15 (1)		1	1	1	1	1	1	1	1	1	1
16 (1)	a	0	0	0	0	0,5	0	0,33	0	0,16	0
	b	N/A	N/A	N/A	N/A	N/A	N/A	0,33	N/A	0,33	N/A
	c	0	0	0	0	0	0	0	0	0	0
17 (1)		0	1	1	1	1	1	1	1	1	1
18 (1)		1	1	1	1	1	1	1	1	1	1
19 (1)		1	1	0	1	1	0	1	0	1	1
20 (1)		1	1	1	1	1	1	1	1	1	1
21 (1)		1	0	0	1	0,5	0	1	0	0,5	0,5
22 (1)		1	1	1	0	1	1	1	0	1	0
STROBE SCORE (22)		16,25	16,06	15,17	16,67	16,73	13,98	18,97	15,42	18,75	15,23

Fig 1.

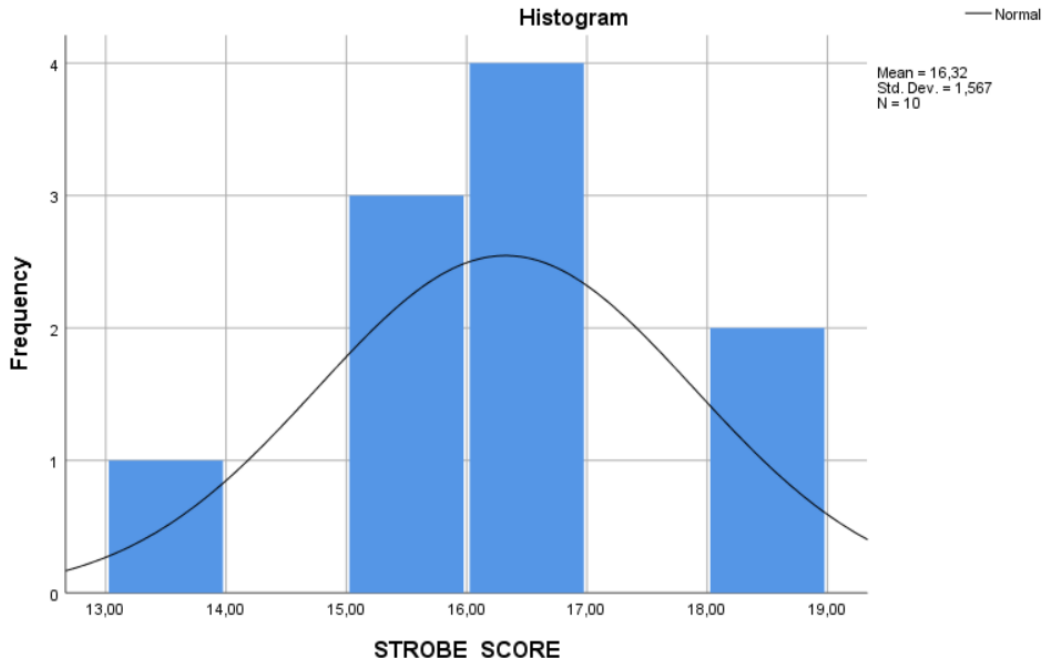

Fig 2 presents STROBE score according to studies' continent of origin. Europe - Oceania: mean=16,77 with SD= 1,34 and n=5 and South America: mean=14,57 with SD= 0,84 and n=2.

Fig 2.

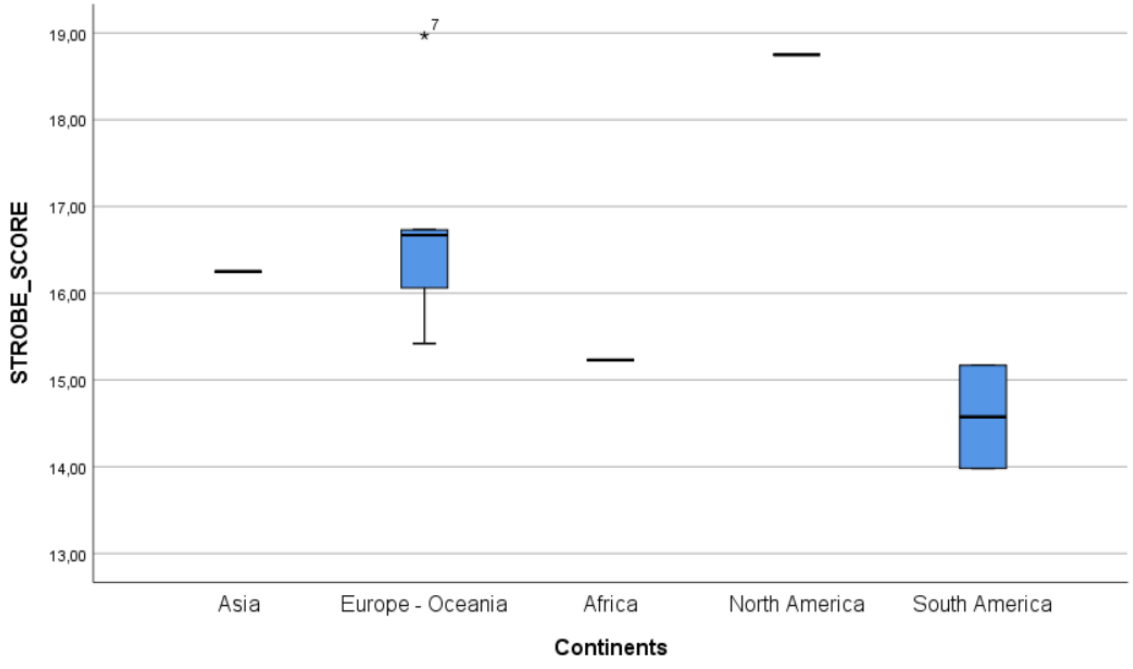

Table 4 shows the tests of normality that were conducted before the t-test. T-test results are presented in table 5. A statistically significant difference was noticed between the means of STROBE scores of studies that listed bigger patient sample sizes and the other ones that did not (p=0,022 < 0,05). The same difference was found between the studies with higher and lower publication journal's impact factor (0,005 < 0,05). The mean of the STROBE score of studies published ≤ 2017 did not present a significant difference from that of those published > 2017. Similarly, the type of study (retrospective/prospective) and funding support (Yes/No) did not present any significant difference.

Table 4.

Test of normality - Shapiro - Wilk	P value
STROBE score - type	0,738/0,315
STROBE score - funding	0,727/0,317
STROBE score - sample size	0,465/0,130
STROBE score - date	0,222/0,069
STROBE score - IF	0,497/0,075

Table 5.

Characteristic	Mean (SD)	P value	95% CI of Difference
Type			
retrospective	16,04 ± 1,76	0,601	(-2,94 - 1,82)
prospective	16,60 ± 1,49		
Funding support			
No	15,99 ± 2,03	0,384	(-2,24 - 4,90)
Yes	17,32 ± 1,45		
Patient sample size			
<140	15,64 ± 0,98	0,022*	(-4,16 - -0,42)
≥ 140	17,93 ± 1,62		
Date			
≤ 2017	15,81 ± 1,06	0,311	(-4,34 - 1,77)
>2017	17,09 ± 2,04		
Journal's IF			
< 3,17	15,35 ± 0,80	0,005*	(-3,91 - -0,95)
≥ 3,17	17,78 ± 1,25		

*statistically significant p<0,05

Other analyses

According to the cut-off value of the STROBE score (16,69), the included studies were divided into low (n = 7) and high (n=3) reporting quality groups. The binary logistic regression analyses presented no statistically significant result about the factors' associations that were analyzed. Table 6.

Table 6.

Variables	Univariate		
	OR	95% CI	P value
Type			
retrospective	1		
prospective	2,67	(0,16 - 45,14)	0,497
Funding support			
No	1		
Yes	6	(0,22 - 162,53)	0,287
Patient sample size	1,005	(0,99 - 1,01)	0,289
Date	1,66	(0,85 - 3,27)	0,139
Journal's IF	5,61	(0,51 - 62,31)	0,16

5. Discussion

Summary of findings

Ten observational studies about cross linking in keratoconus over the period 2013 to 2022 were assessed by our study. The overall reporting quality was relatively adequate (13 items were reported by 90% or more of the studies). There was a statistically significant difference between the evaluations of studies that listed more patients and those that did not and between the studies that were published in journals with higher impact factors and those that did not. The studies that listed a larger patient sample size produced higher STROBE scores. Studies that were published in journals with higher impact factors did too.

Reporting of ’’Title and abstract” and ”Introduction’’ was adequate with a reporting rate of 95% and 100% respectively. In contrast, the reporting rate of ”Methods” and “Results” were 79.25% and 73.76% respectively. In particular, item 11 “quantitative variables“, sub-item 12c ”missing data”, sub-item-12d ”loss to follow”, sub-item 12e ” sensitivity analyses”, sub-item 13b ”non-participation at each stage”, sub-item 13c ” flow diagram”, sub-item 16a ”95% confidence interval” and sub-item 16c ”absolute risk for a meaningful time period” presented a reporting rate of 30%, 33.3%, 33.3%, 0%, 33.3%, 0%, 30% and 0% respectively. Inadequate reporting of several ”Methods” and ” Results” items and sub-items was noticed with low adherence to the STROBE Reporting criteria.

Comparison with other studies

To our knowledge, this is the first time that STROBE Statement criteria are being used to assess the reporting quality of observational studies concerning cross linking in keratoconus. Two other studies in the wider Ophthalmology field produced similar results. Fung A. E et al. evaluated the reporting quality of neovascular age-related

macular degeneration studies and presented reporting rates of sub-items 12c, 12d, 13c and 16a being 12%, 38%, 3% and 32% [21]. Ramke J. et al. assessed reporting in blindness prevalence surveys using the STROBE statement and exhibited reporting rates of 3%, 34% and 44% for sub-items 12c, 12d and 13b. Also, they reinforced our conclusion that studies published by journals with a higher impact factor had higher STROBE scores than those that were published in journals with a lower impact factor [22].

Several studies concerning other Medical fields agreed with our results. Sorensen A. A et al. assessed reporting of observational studies in Hand Surgery. The reporting rates, they presented, for sub-items 12c, 12d and 16a were 6%, 21% and 11% respectively [23]. Adams A. D et al. assessed the quality of reporting of observational studies in Obstetrics and presented item 11 and sub-items 12c, 13c, 16a and 16c as poorly reported items [24]. Langan S. et al. assessed the same studies in Dermatology. Item 11 and sub-items 12c, 12d, 12e, 13b and 13c were assessed by reporting rates of 38%, 6%, 17%, 6%, 8% and 21% respectively, in their study [25]. Ahmed Agha R. et al. evaluated the reporting quality of observational studies in Plastic Surgery and they presented rates of adherence of 3%, 0%, 2%, 10%, 4%, 19% and 2% for sub-items 12c, 12d, 12e, 13b, 13c, 16a and 16c respectively [26]. Papathanasiou A. A et al. assessed the reporting quality of similar studies in Cancer. 12c, 12d, 13c and 16c reporting rates were 23%, 46%, 2% and 3% respectively [8]. Ziemann S. et al. assessed the reporting quality of studies about treatments of COVID-19 and they reported rates of adherence for sub-items 12c, 12d, 13c and 16a of 27.9%, 33.3%, 41.5% and 25.2% [27].

Study strengths and limitations

For the studies assessment, both adherence to STROBE items and the STROBE score were included. This fact strengthened our results' validity. To minimize biases, we identified items as fully reported, partly reported, not reported and not applicable and assigned the scores accordingly. There are, also, some limitations. The scoring of items remains subjective and easily leads to subjective bias. However, during the assessment, both the name of the authors and the name of the publication journal remained hidden from the reviewer to diminish the potential bias. Another limitation is there is no literature to be found on using the STROBE statement to assess the reporting quality of observational studies about cross linking in keratoconus, so it is not possible to compare the reporting quality of these studies with that of the studies in other assessments. The limited number of studies that were extracted and evaluated may be a limitation. However, this sample size constitutes a significant part of all the observational studies concerning cross linking in keratoconus between 2013 and 2022.

Conclusion

In summary, observational studies about cross linking in keratoconus between 2013 and 2022 present a relatively good reporting quality. However, it is necessary to improve the reporting of methods and results sections, in particular, the "Quantitative

variables", "Statistical methods", "Participants" and "Main results" reporting. Larger patient sample size studies and studies with a higher impact factor of publication journal produced higher STROBE scores. Finally, we recommend ophthalmology journals adopt the principles of the STROBE statement and to encourage their usage by researchers in order to provide scientists with high-quality observational studies.

6.References

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