

The Impact of Internet Health Information on Patient Compliance: A Systematic Review and Meta-analysis

ABSTRACT

Background and Objectives: Patient compliance plays an important role in the relationship between the patient and the physicians. The purpose of this systematic review and meta-analysis was to determine the impact of internet health information on patient compliance.

Materials and Methods: Comprehensive searches of the databases were used to identify potentially eligible studies. No year range was set in this study. PRISMA guidelines have carried out this systematic view and meta-analysis. The two authors reviewed the studies based on inclusion criteria for systematic review. Statistical analysis was performed using CMA, version 2.0.

Results: The results of this meta-analysis showed that the satisfaction and quality of Internet health information can have a positive effect on patient compliance with treatment.

Conclusions: Internet health information is widely available and interpreted in different ways, so it can positively or negatively affect patients' decision and performance to compliance to treatment. Therefore, physicians need to identify credible and understandable and the quality of health information websites, so that patients have access to quality information.

Paper Type: Systematic Review and Meta-analysis

Keywords: internet health information, patient compliance, quality, satisfaction

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Mahdie ShojaeiBaghini

* Assistant Professor of Health Information Management, Medical Informatics Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran. (Corresponding author): mahdiehsh@gmail.com

Sedighe ShojaeiBaghini

District Education, Education Department of Kerman Province, Kerman, Iran.

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Introduction

Patient compliance an important role in the relationship between patients and physicians. The most common way to describe a patient is to follow the physician's treatment instructions(1) (2). Trostle quotes Haynes Medical compliance was defined in the late 1970s as "the extent to which the patient's behavior (in terms of taking medications, following diets, or executing other lifestyle changes) coincides with medical or health advice".(3) According to World Health Organization (WHO), compliance is affected by these factors: patient, treatment, health system, socioeconomic conditions, and environment(4). Compliance is very important (5). With the increasing number of patients with chronic diseases, patient compliance becomes increasingly important(6). Evidence shows that patients compliance to treatment, even if the placebo, has better health outcomes than poorly patients compliance (5). However, many patients do not follow treatment recommendations for various reasons (7). According to the WHO forecast for 2023, only about 50% of patients with chronic diseases (especially asthma, diabetes, and hypertension) seek medical care (4). Patient non-compliance may lead to adverse medical, and psychosocial consequences and increased health care costs and reduced productivity, especially in the case of chronic diseases (8) (9)(10)(11) (6).

Compliance has relationships with some concepts, including physician-patient communication and interactions (1). Although physicians' information is the most reliable source, people receive medical information from a variety of sources, such as physicians, friends, mass media, news, books, journals and magazines, pamphlets, and now more frequently and conveniently, accessibility and immediacy from the Internet (12) (13)(14)(15). Internet

health information Compared to other sources, health information from sources can be published promptly and easily and at a lower cost(16).

It should be noted that internet health information contains different types of information and can positively and negatively affect patient-physician communication, this affects patient compliance (15)(1)(17) (18)(1)(19) (20)(21). The patients' trust in the physician may be affected by Internet health information and affect their compliance (22). On the other hand, the extensive volume of information contrasts with insufficient patient comprehension(23). Therefore, many people are concerned about the quality of Internet health information(24).

In addition, in internet health information, patients' satisfaction is important. Information' satisfaction includes the quality of perceived information, ease of use, and usefulness of Internet health information. Therefore, the level of satisfaction with the health information of the Internet is also effective in achieving positive or negative health consequences(25).

Previous studies have proposed an indirect relationship between the quality of internet health information and patient compliance (1). By combining those primary studies in a meta-analysis, the study power can be increased substantially. Meta-analysis can be a useful tool for summarizing the increasing amount of knowledge gained from scientific articles on a particular topic (26). In addition, the purpose of a meta-analysis is to increase the strength and accuracy of conclusions from studies to help better extract accurate and good quality data from the volume of data produced (27). The purpose of this systematic review and meta-analysis was to determine the impact of internet health information on patient compliance.

Materials and Methods

Selection of Studies

PRISMA guidelines have carried out this systematic view and meta-analysis(28). The search strategy is presented in Appendix Table A1. In order to access studies related to patient compliance, a search was conducted of the PubMed, Cochrane, EMBASE, IEEE, Web of Science, ProQuest, and Scopus databases. As well as three Persian language databases named SID, Irandoc, and Magiran were searched (until 31 March 2021). In order to complete searches, we also searched SIGHCI 2011 PROCEEDINGS and <https://rpis.research.ac.ir/>. In the literature, the terms “adherence” and “compliance” have been used interchangeably(29). Therefore, in order to fully cover the articles, both terms were searched and reviewed in this study. The search strategy is presented in Appendix Table A2.

Using the search strategy, we identified 320 reviews. After removing duplicates and excluding reviews that did not meet our inclusion criteria, six studies remained. Of course, one of the studies measured both the quality and satisfaction of Internet health information. Therefore, seven items were analyzed in the software.

Analysis Data Extraction, And Quality Assessment

Two authors reviewed the titles and abstracts of each citation. Then reviewed all full texts and identified those that met inclusion criteria for the systematic review. A third reviewer was consulted when there was uncertainty regarding eligibility, and the decision for inclusion was made by consensus. The following information was extracted from studies that met the inclusion criteria: name of the authors, year of publication, the country of study, demographic data about participants, sample size, correlation, t-value, and p-value, Studies with different satisfaction and quality variables were considered independent studies.

Selection Criteria Publication Bias

Inclusion criteria were as follows: (1) It was to be published in peer-reviewed journals, book chapters, dissertations, and conference proceedings. (2) It was a quantitative study that reported correlation coefficients, path coefficient, regression coefficients, and respondents' sample size. (3) It assessed the effect size of the relationship (correlation) between patient compliance and internet health information (satisfaction/ quality) (Or statistics that would enable the calculation of the effect size). (4) It had a probability sampling was possible and the sample size was determined by software.

Exclusion criteria were as follows: (1) Non-English and non-Persian publications. (2) the publication was a non-peer-reviewed journal articles, pre-publication drafts letter, comment, editorial, or case report. (3) Qualitative and experimental and quasi-experimental studies. (4) Nonprobability Sampling and thumb determining sample size.

Publication Bias

In a meta-analysis, publication bias is particularly problematic, as meta-analysis provides a more accurate assessment of the research literature than traditional narrative reviews(30). In this meta-analysis, two approaches were adopted to deal with this potential publication bias: the funnel plot and the “Classic Fail-safe N” test.

Outcome Measures and Statistical

Heterogeneity among the studies was assessed by the Cochran Q and the I-squared statistic and Tau-squared, respectively. The heterogeneity tests indicated significant variabilities among studies; thus, the studies are completely heterogeneous and the random-effects model utilized (Table 3). However, there may be heterogeneity between studies due to the presence of a moderating variable. Statistical analysis was performed using

comprehensive meta-analysis (CMA) statistical software, version 2.0.

Results

Literature Search

The literature search results are summarized in Figure 1. In total, 292 articles were identified in the initial search, and after duplicate removal, and 220 articles were subsequently removed,

and 72 were reviewed for full-text inclusion. Finally, six studies were analyzed; of course, one of the studies measured both the quality and satisfaction of Internet health information. Therefore, seven items were entered and analyzed in the software. It should be mentioned, these studies complied with the protocol and its clauses and were screened (Appendix Table A2).

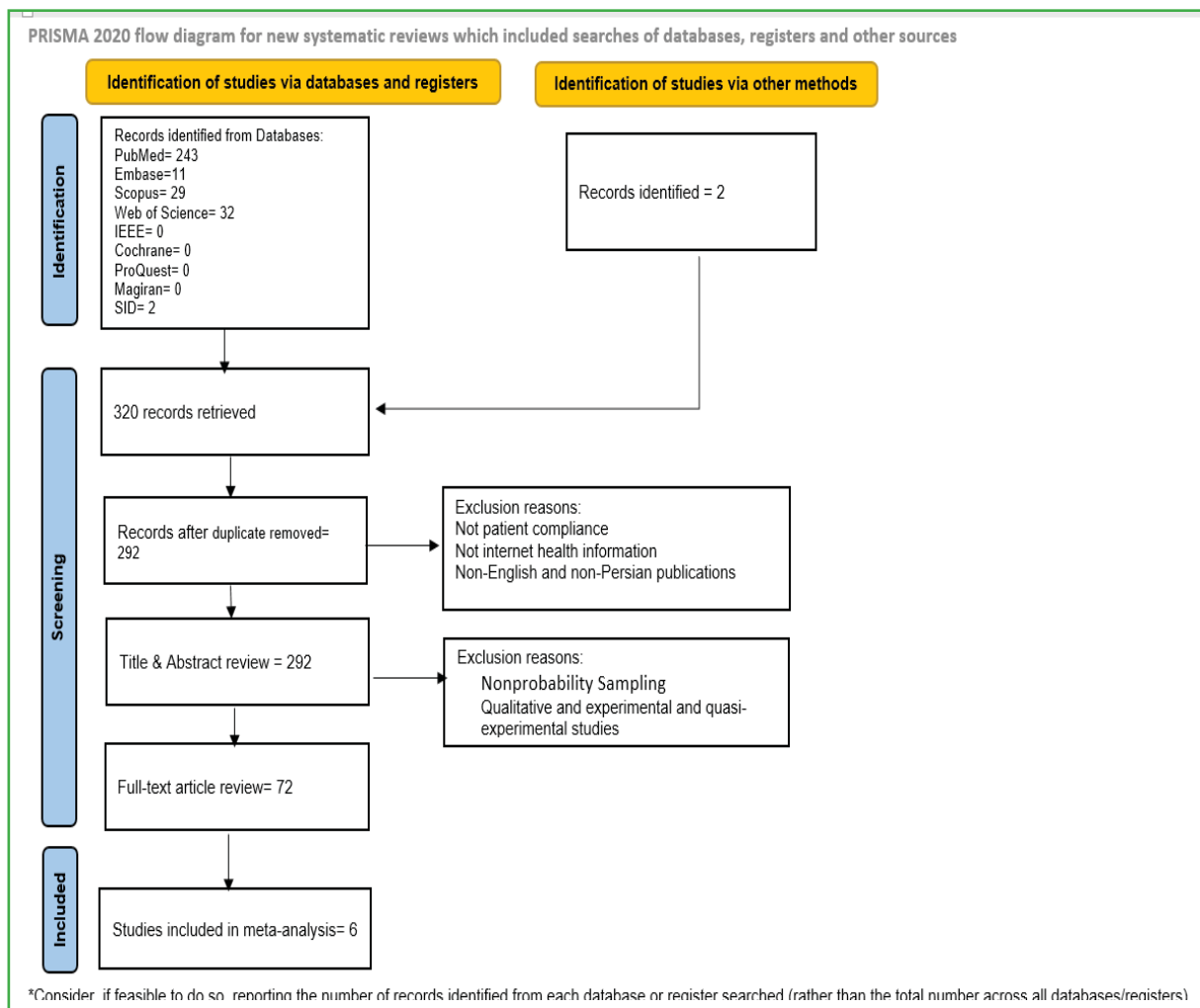


Fig. 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flow diagram detailing the process of study selection.

Study Characteristics

Overall, six studies were included in the systematic review, and the study characteristics are summarized in Table 1.

Table 1. Summary of the Studies Included in the Systematic Review

N	Study Name	Authors	Type	Country (Year)	Sample Size	Gender		Education			Age			Correlation	T Value	P Value
						Male	Female	School	Under Graduate	Post Graduate	<30	30-50	>50			
1	The Impact of Internet Health Information on Patient Compliance: A Research Model and an Empirical Study	John Laugesen; Khaled Hassanein; Yufei Yuan	Quality	Canada 2015	225	83 (38.4)	133 (61.6)	9 (4.2)	139 (64.3)	68 (31.5)	28 (12.6)	84 (37.7)	111 (49.7)	0.054	2.139	.03
2	Impact of Personal Trust Tendency on Patient Compliance Based on Internet Health Information Seeking	Hongran Zhang, Runtong Zhang, Xinyi Lu, BEng, Xiaomin Zhu	Satisfaction	China 2020	336	156 (46.4)	180 (53.6)	127 (37.8)	195 (58)	12 (4.2)	105 (31.3)	166 (49.4)	65 (19.3)	0.237		<0.00
3	Impact of Physician-Patient Communication in Online Health Communities on Patient Compliance: Cross-Sectional Questionnaire Study	Xinyi Lu, B. Eng; Runtong Zhang	Quality	China 2019	423	203 (48.0)	220 (52.0)	88 (19.4)	283 (66.9)	58 (13.7)	146 (34.5)	221 (52.2)	56 (13.3)	.333	4.569	<.001
4	Is the Internet Different from Traditional Mass Media in Promoting Patient Compliance with Mature Treatments?	Xinyi Lu, B. Eng; Runtong Zhang, Wen Wu, Xiaopu Shang, Lily Sun, Xiaomin Zhu	Quality	China 2020	384	163 (42.45)	221 (57.55)	130 (33.85)	228 (59.38)	28 (6.77)	139 (36.2)	178 (46.35)	67 (17.4)	0.235 (0.733)		0.001
5A	How does Health Website Influence Patient Compliance: An Empirical Study	Lu, X. Zhang, R. Wu, W. Shang, X.	Quality	China 2018	401	183 (45.46)	218 (54.36)	157 (41.39)	206 (49.13)	38 (9.48)	143 (35.66)	195 (48.63)	63 (15.7)	0.224		<.005
5B	How does Health Website Influence Patient Compliance: An Empirical Study	Lu, X. Zhang, R. Wu, W. Shang, X.	Satisfaction	China 2018	401	183 (45.46)	218 (54.36)	157 (41.39)	206 (49.13)	38 (9.48)	143 (35.66)	195 (48.63)	63 (15.7)	0.045		>.005
6	Relationship Between Internet Health Information and Patient Compliance Based on Trust: Empirical Study	Xinyi Lu, B Eng; Runtong Zhang, Wen Wu, Xiaopu Shan, Manliu Liu	Quality	China 2018	336	156 (46.4)	180 (53.6)	127 (37.8)	195 (58)	14 (4.2)	105 (31.3)	166 (49.3)	65 (19.4)	.393 (.067)		<.001

All the remaining studies in the meta-analysis used SEM software in addition to SPSS. Based on the frequency observed in the six remaining studies in the meta-analysis, 2105 people had participated in these studies, 944 (44.8%) of whom were men. Moreover, in terms of frequency of educational status, 638 people (30.3%) did not have any university education, and the rest had a university education, 218 (10.4%) of whom had postgraduate degrees. Moreover, 666 (31.6%) patients were under 30, 1010 (48.1%) were between 30 and 50, and the rest were over 50 years old.

Outcome Evaluation

The effect size r was measured for the studies included in the meta-analysis to create common criteria for comparability. A lower value of this effect size in research means that the research is more valuable in terms of sample size, accuracy, and generalizability of the results (31). Therefore, the studies were prioritized based on this parameter (Table 2). Prioritizing the studies based on the effect size is merely done to specify the strong, average, and poor studies in terms of the accuracy and generalizability of results (32).

Table 2. The effect size of studies and their interpretation and prioritization

Study Name	Effect size	lower limit	upper limit	Z value	P value	Interpretation	Priority
Xinyi Lu, B Eng; Runtong Zhang, Wen Wu, Xiaopu Shan, Manlu Liu	0.393	0.299	0.480	7.579	0.000	large	1
Xinyi Lu, B. Eng; Runtong Zhang	0.333	0.245	0.415	7.095	0.000	Large	2
Hongran Zhang, Runtong Zhang, Xinyi Lu, BEng, Xiaomin Zhu	0.237	0.133	0.335	4.409	0.000	Medium	3
Xinyi Lu, B. Eng, Runtong Zhang, Wen Wu, Xiaopu Shang, Lily Sun, Xiaomin Zhu	0.235	0.138	0.327	4.674	0.000	Medium	4
Lu, X. Zhang, R. Wu, W. Shang, X. (Quality)	0.224	0.129	0.315	4.546	0.000	Medium	5
John Laugesen; Khaled Hassanein; Yufei Yuan	0.054	-0.077	0.183	0.805	0.421	Small	6
Lu, X. Zhang, R. Wu, W. Shang, X. (Satisfaction)	0.045	-0.053	0.142	0.898	0.369	Small	7

After combining the effect sizes of the six studies in the meta-analysis, it was observed that the outcomes were combined and that they represented the combined outcomes in the form of either fixed- or random-effects models. In the fixed-effects model, assuming the homogeneity of the studies, the combined effect size was 0.228; by generalizing it to the study population with this hypothesis using inferential statistics, both the Z-value and P-value indicated that with a confidence level of 99%, satisfaction with and quality of health information on the internet had a significant positive effect on patient compliance.

Moreover, in the random-effects model, assuming the heterogeneity of the studies, the combined effect size was 0.222; with a confidence

level of 99%, satisfaction with and quality of health information on the internet significantly affected patient compliance (Table 3). Therefore, both models confirmed the hypothesis under examination. According to the forest plots, fortunately, most works did not deviate much from the mean value, both in fixed and random models (Figure 2).

Table 3. The Combined analysis models

Model	Effect size	lower limit	upper limit	Z value	P value
Fixed	0.228	0.190	0.265	11.555	0.000
Random	0.222	0.126	0.314	4.476	0.000

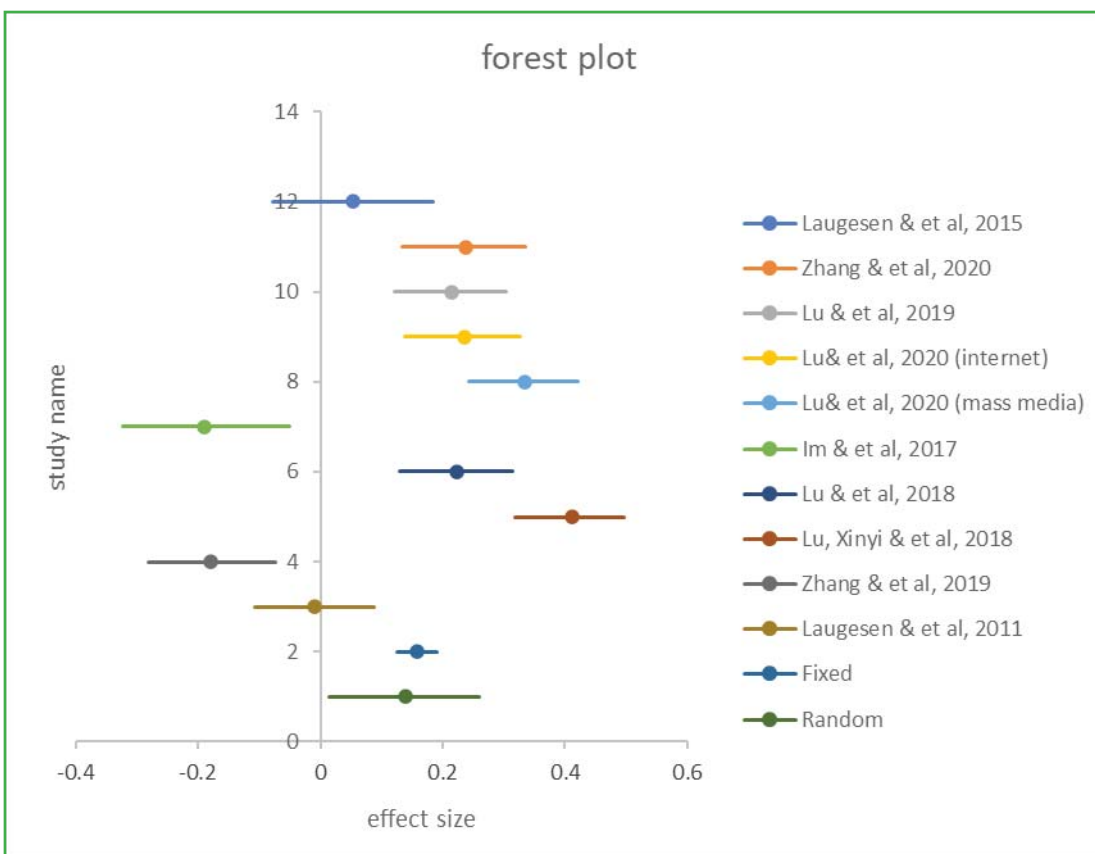


Fig. 2. Forest plots of the studies

Publication Bias and Quality Assessment

There was no significant evidence of publication bias for the patient compliance score change by “Egger’s test” ($t = 0.659$, $df = 5.00$, $p = 0.270$). Also, the results of “Duval and Tweedie’s trim and fill” showed that there was no publication bias in the fixed-effects method; however, in the random-effects model, two missing studies caused publication bias. Since the random model was chosen due to the heterogeneity of the studies, if these two studies were added to the collection of studies, they could moderate the results of the research and change the effect size from 0.222 to 0.162 (Figure 3).

The results of “Classic Fail-safe N” test to determine the stability of meta-analysis results by calculating the number of missed studies showed that for Alpha of 0.05, another 228 studies should be performed to err in the final

results of calculations and analyses. This result shows the high accuracy of the information and results obtained in this study.

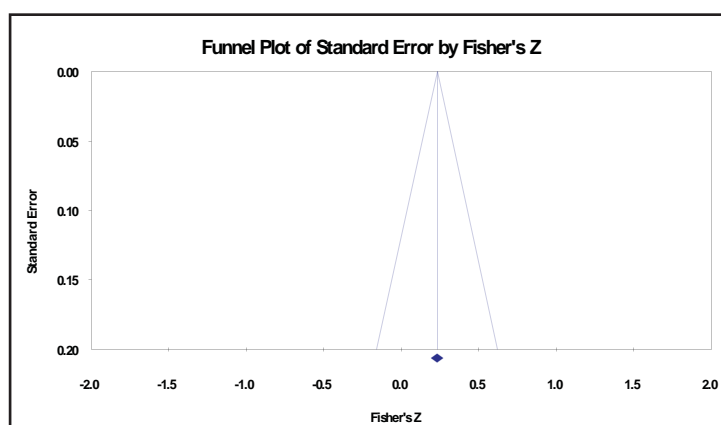


Fig. 3. Funnel plot evaluating publication bias for all studies

Discussion

When systematic review and meta-analysis are performed properly, it can have powerful results.

Therefore, it is necessary to properly evaluate the quality of studies and examine their results more closely (27). For this purpose, we present the results of the qualitative evaluation of studies.

Heterogeneity Tests of the Studies

Although both models had the same outcomes, the researcher performed heterogeneity tests to determine which model would provide more realistic outcomes. The most significant test was the Q-value test. Since the P-value was less than 0.05 in this test, with a confidence level of 99%, hypothesis H_0 was rejected, and hypothesis H_1 was confirmed. In other words, it was proven that according to this test, the studies were not homogeneous.

The value of I-square was reported as 84.073 by the software, which indicated a significant heterogeneity among the studies. Ortega

attributes the three values of 25, 50, and 75 to low, average, and high heterogeneity (33).

The value of tau was 0.122; this is in the first category of Castle and represents poor homogeneity (34). Furthermore, the square of tau was 0.015, and according to the three values introduced by Chin, it was even significantly lower than the poor value, which is 0.19. This proved a lack of correlation among the studies or, in other words, demonstrated their heterogeneity (35).

Summing up the heterogeneity tests showed that the studies were completely heterogeneous, and the random-effects model provided a more realistic response. Moreover, it showed the possibility that there was a moderator variable; the researcher needed to determine this variable by reading the studies and performing a moderator analysis (Table 4).

Table 4. The heterogeneity tests of studies

Model	Effect size	lower limit	upper limit	Z value	P value	Q-value	I-squared	Tau-squared	Tau
Fixed	0.228	0.190	0.265	11.555	0.000	37.673	84.073	0.015	0.122
Random	0.222	0.126	0.314	4.476	0.000				

Moderator Analysis

Analysis indicated that much research on the internet was conducted on the quality of health information; some research was conducted on satisfaction with health information. It may be concluded, as the moderator, can be the reason, or part of the reason, for the heterogeneity of the studies. Therefore, this model was implemented to provide quality and satisfaction with health information on the internet, separately. However, unfortunately, the results showed that despite the researcher's expectation, this was not the moderator variable (Figure 4). Moreover, evaluations indicated that one study had been conducted in Canada and the others in China. Therefore, the researcher considered the study location as the moderator and separately

performed the model for each research location. It was concluded that both in the fixed- and random-effects models, the effect size of the study group in China was twice or more than twice that of the study in Canada. Therefore, the researcher succeeded in discovering the moderator variable, which is one of the main reasons for the heterogeneity of the studies (Figure 5).

Limitations: Although meta-analyses are an accepted study in clinical research, this study also may have some limitations, such as Language bias; Most of the studies reviewed in our meta-analysis were reported in English and some in Persian. Future studies published in other languages can be used to increase the

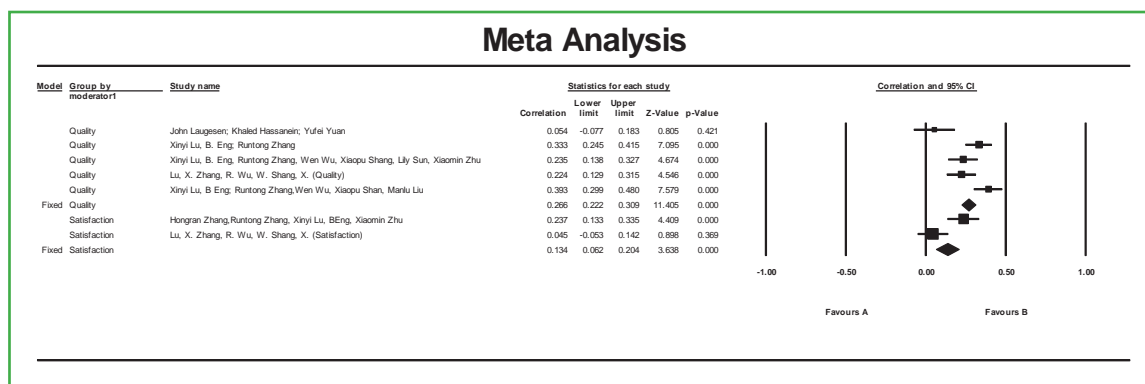


Fig. 4. The moderating role of quality and satisfaction internet health information between internet health information and patient compliance

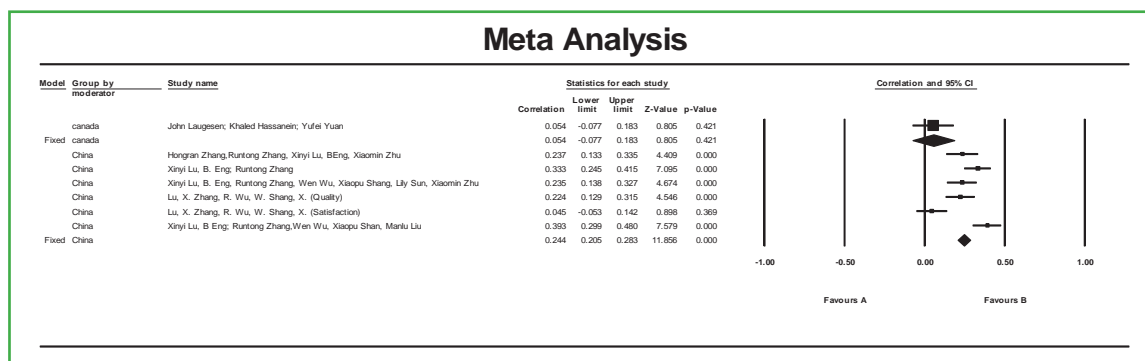


Fig. 5. The moderating role of study location between internet health information and patient compliance

generalization of the findings. Database bias, due to the choice of search sources because the initial search of our study was limited to common databases, and some studies may be indexed only in local databases. Reporting bias because our meta-analysis only included studies that measured outcomes with standardized and validated tools.

Conclusion

The meta-analysis results showed that satisfaction with and quality of health information on the internet could positively affect patient compliance to treatment. As the internet is extensively accessible, enabling people to search for health information worldwide, more studies must be conducted in other countries to provide more compelling evidence on this subject. This extensive availability of health information causes concerns

for physicians regarding incorrect and invalid information and patients' misinterpretation of online content. Therefore, the quality of health information must also be considered. Moreover, patients' satisfaction with how they access and use health information on the internet affects the amount of information they acquire and how they use it; patients interpret the acquired information differently, which affects their decision-making and performance in different ways. Some patients use the internet merely to acquire information, but in some cases, this information can affect their compliance to the physicians' instructions. Therefore, physicians need to identify valid and comprehensible health information websites so that their patients may benefit from the opportunities universal internet access can offer.

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Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflict of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Consent for publication: Our manuscript

does not contain individual data, therefore this category does not apply.

Ethical consideration: The authors considered common forms of search biases, such as database bias, citation bias, availability bias, language bias, country bias, and familiarity bias.

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Authors' contributions: M.ShB. devised the project, the main conceptual ideas and proof outline. S.ShB. was in charge of overall direction and planning. M.ShB. and S.ShB. wrote the manuscript with input from all authors.

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