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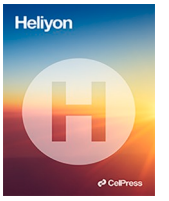

Review article

Empirical and quantitative studies of Feng Shui: A systematic review **(PRISMA 2009 item 1)**

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ABSTRACT

Despite a long period of scholarly interest in Feng Shui, there has been no systematic review of this subject. The objective of this study was, therefore, to conduct a systematic review of empirical and quantitative Feng Shui journal articles written in Chinese or English to shed light on the nature of Feng Shui. This study identifies both existing empirical and quantitative studies of Feng Shui and directions for further research. It is the first to provide a synthesis of empirical and quantitative findings on the specific outcomes of Feng Shui, and more importantly, to explore its reliability and validity. We searched four databases, two in Chinese (Taiwan Periodical Literature and WANFANG DATA) and two in English (Web of Science and SCOPUS), and reviewed 36 articles following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA 2009). The eligibility criteria were: (1) any kind of participants or study samples; (2) any Feng Shui-related intervention; (3) comparators belonging to the same study samples or between different study samples; (4) the outcome of any empirical and quantitative measurement of Feng Shui; and (5) any study design except for qualitative studies. We used the Joanna Briggs Institute's Critical Appraisal Tools to analyze the research quality of the included articles. We found that Feng Shui was associated with housing prices in societies influenced by Chinese culture. Other findings suggested that: (1) Feng Shui was associated with the decisions of house-buyers growing up in societies influenced by Chinese culture; (2) Feng Shui forests had greater habitat diversity than other forests in China; (3) Feng Shui environments in Asia had more comfortable wind fields than non-Feng Shui settings; (4) in Asia, Feng Shui was related to sunlight; (5) Feng Shui had good reliability; and (6) Feng Shui was valid with respect to environmental features but its influence on humans has not been determined. We therefore conclude that Feng Shui is neither a superstition nor a science. Given that the research quality of the included articles was less than ideal and the number of each specific outcome and their samples were also limited, their findings should be interpreted with caution. We look forward to more good quality empirical studies of Feng Shui in the future, particularly those involving *de facto* field experiments recruiting non-Asian participants to provide further insights into the quasi-science of Feng Shui.

(PRISMA 2009 Item 2)

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1. Introduction

1.1. Background

Feng Shui, often known as Chinese geomancy, is an ancient folk practice of traditional Chinese societies. Feng Shui comes from the ancient Chinese belief that Qi [氣] was the origin of all life. Nonetheless, "Qi is blown away by the wind [風] and bordered by water [水]. The ancients enclosed Qi to prevent it from getting blown away and properly managing it; so this was called Feng Shui" [1]. The original goal of Feng Shui was to find a specific piece of land, where water exists, with protection against the wind. Archaeological evidence shows that site selection for warding off the wind and acquiring Qi originated in the Yang Shao [仰韶] culture, located in the mountainous regions of the Loess Plateau, at sites such as the Ban Po Village [半坡村] heritage site, during the Neolithic period [2].

Feng Shui evolved into the philosophy and technology of locating, designing, and constructing indoor and outdoor settings to seek harmony between people and the environment to, its adherents contend, obtain fortune and avoid bad luck. Over the last few hundred years, Feng Shui has evolved complicated sets of symbolic theoretical systems, drawing on ideas such as Yin [陰] and Yang [陽], the Five Elements [五行] with their related theories of mutual generation and mutual restraint [相生相剋], the eight trigrams [八卦], the nine-square division [九宮], the Chinese sexagenary cycle [干支], astronomy, astrology, and numerology [3]. Feng Shui has deep influences and wide applications in societies influenced by Chinese culture. It is even practiced in the West [3].

1.2. Rationale *(PRISMA 2009 item 3)*

Late in the nineteenth century, with the influence of positivism, scientism, and Christian beliefs, Feng Shui came to be regarded as a superstition, which led to criticism of it [4]. Studies of Feng Shui, however, opened a new page in the middle of the twentieth century, when many researchers began to explore the science, aesthetics, and culture of Feng Shui from the perspectives of architecture, landscape architecture, ecology, and environmental science [4,5]. The impacts of both Chinese and Western cultures have generated a growing number of studies on Feng Shui since the 1980s [6]. However, despite the long period of scholarly interest in the topic, there has been no systematic review of Feng Shui. This article addresses that gap. Furthermore, the greatest challenges to Feng Shui in relation to modern science lie in its reliability and validity, which are fundamental principles of science. Reliability refers to the ability to obtain consistent results, while validity refers to the ability to truly inquire into the nature of a problem [7].

This study strived to be an objective, transparent, and comprehensive systematic review [8] of empirical and quantitative studies of Feng Shui, rather than an introduction to or a narrative review of Feng Shui. We conducted this systemic review of Feng Shui intending to focus on the physical and tangible phenomenon and taking a scientific perspective, rather than on beliefs, spirituality, and religions. We hope that this study can provide insights into the nature of Feng Shui, particularly regarding its reliability and validity. Readers interested in an introduction to or a narrative review of Feng Shui may refer to the following scholarly books for detailed information: (1) An Introduction to Feng Shui [3]; (2) Scientific Feng Shui for the Built Environment: Theories and Applications [9]; and (3) Sacred Landscapes of Imperial China: Astronomy, Feng Shui, and the Mandate of Heaven [10].

1.3. Objectives *(PRISMA 2009 item 4)*

The objective of this study was to conduct a systematic review, following the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA 2009) [11], of empirical and quantitative Feng Shui journal articles written in Chinese or English to shed light on the nature of Feng Shui, particularly its reliability and validity. This systematic review may provide a comprehensive perspective on such studies and serve as a reference for future research. The study identifies what empirical and quantitative studies of Feng Shui have been performed and what and how further research could be performed. It is the first study to provide a synthesis of the empirical and quantitative findings on the specific outcomes of Feng Shui. When a systematic review synthesizes several studies and presents an overview of comprehensive results, it offers a higher level of evidence than a single study [12]. By synthesizing the findings of the empirical and quantitative studies of Feng Shui, this review may shed light on the evidence for the reliability and validity of Feng Shui and the question of whether Feng Shui is a superstition. A superstition may lack reliability and certainly has no validity, and is without any positive or practical value [13] or rational elements [14]. In this systematic review, we consider Feng Shui to be a science if it demonstrates reliability and validity. If it does not demonstrate reliability, validity, positive or practical value, or rational elements, we will consider it a superstition. We therefore examined the reliability, validity, positive or practical value, and rational elements of Feng Shui to judge whether it is a superstition.

2. Methods

PRISMA is a reporting standard of systematic review and meta-analysis accepted by scholars worldwide, which covers seven sections and 27 checklist items. Except for the eight checklist items applicable to meta-analysis (27-8 = 19), this review conforms to 18 items (18/19 = 94.7%). The only unmet checklist item is "Protocol and registration". Although we had had a protocol, we did not conduct a registration. Other than that item, we reported this systematic review and structured this article by following each item of the PRISMA 2009 in order (Appendix Table A1).

2.1. Eligibility criteria *(PRISMA 2009 item 6)*

The eligibility criteria for this review were as follows: (1) any kind of participants or study samples, not limited to people; (2) any Feng Shui-related intervention; (3) comparators belonging to the same study samples or between different study samples; (4) the outcome of any empirical and quantitative measurement of Feng Shui; (5) any study design except for qualitative and narrative studies (aforementioned are Participants, Interventions, Comparators, Outcomes, Study design; abbreviated as PICOS); and (6) the language of articles being either written in Chinese or English. We intended to specify a relatively broad set of eligibility criteria to include a wide range of empirical and quantitative Feng Shui studies. We selected Chinese and English articles to minimize language bias [8], since they are among the most common languages in the world. Additionally, because Feng Shui was developed in China, we expected that there would be more Feng Shui literature in Chinese than in other languages.

2.2. Information sources *(PRISMA 2009 item 7)*

This review searched four electronic databases. Two were Chinese databases: Taiwan Periodical Literature (1970-present) and WANFANG DATA (1980-present), and two English databases, Web of Science (1900-present) and SCOPUS (1970-present). The last searches of Taiwan Periodical Literature and Web of Science were conducted on January 31, 2020. The last search in SCOPUS was on February 25, 2020 and the last search of WANFANG DATA was on March 20, 2020. We also conducted a follow-up search in the four electronic databases on April 5, 2020.

2.3. Search *(PRISMA 2009 item 8)*

The search terms included the Chinese terms *feng shui* [風水] and *kan yu* [堪輿] and the English expressions "Feng Shui" and "Chinese geomancy". Our search strategy for the four electronic databases was very simple. In the Boolean search, only "OR" was adopted as the operator, as in (1) *feng shui* [風水] "OR" *kan yu* [堪輿], or (2) Feng Shui "OR" Chinese geomancy. Except for the broad eligibility criteria, we did not have any restrictions such as topics, keywords, or dates. Although Feng Shui is neither identical to nor a substitute for Kan Yu, the two terms are closely related, particularly in daily usage. We chose these search terms to widen the search for relevant literature.

2.4. Study selection *(PRISMA 2009 item 9)*

This review focused only on empirical and quantitative studies published in journals. Books and unpublished master's theses and doctoral dissertations were not included. Empirical research involves actual data and analyses, while quantitative research uses computational, mathematical, and/or statistical methods [15]. Published journal articles are more rigorous than non-journal articles, as they are subject to peer review. For the drawing of inferences about causal relationships among variables in quantitative studies, random assignment experimental methods are superior to non-random assignment quasi-experimental methods, which in turn are better than survey methods [7]. Field experiments conducted in real-world settings have better ecological validity, however, than experiments conducted in controlled laboratories, which have better internal validity than field experiments [16]. Internal validity refers to whether a study establishes a faithful cause-and-effect relationship, while ecological validity refers to whether the findings of a study are generalizable to naturalistic situations [16].

2.5. Data collection process *(PRISMA 2009 item 10)*

There were four steps of the data collection process. The first step was Identification, in which the search terms were used to search the electronical databases. The second was Screening, in which the titles and abstracts of the journal articles retrieved by the search terms were screened in accordance with the above-mentioned eligibility criteria. The third step was Eligibility. We assessed whether the title and abstract were insufficient to make a judgment. The entire text of the article was retrieved and assessed. Each study in every article was taken into consideration. The fourth was Inclusion. In this step the full-text articles that met the eligibility criteria were included. Two authors independently conducted the data extraction and quality appraisal. Disagreement between the two authors was solved by discussion.

2.6. Data items *(PRISMA 2009 item 11)*

To provide a quick overview of the articles, which enables readers to understand the perspectives and key elements of each study included in this review, we adopted the following 15 data items: researcher, publication year, study objectives, participants/samples, intervention, comparator, study design, outcomes, research method, geographical location, research orientation, professional application, relevance to reliability and/or validity, databases, and publication language.

These 15 data items encompassed the basic information on the articles (researcher, publication year, and study objectives), PRISMA-recommended PICOS, research methods and the geographical locations in which the studies were conducted. Additionally,

the data items included the classification of the research orientations of Feng Shui proposed by Chang and Chiou [17] and Tsao [18], which included legends and customs, culture, residence [陽宅], site selection, environmental planning and design, knowledge and operational systems, concepts and attitudes, and ideology. This review also included the professional applications of Feng Shui proposed by Huang [19] regarding history, geography, philosophy, landscape architecture, environment, aesthetics, and anthropology. We followed the studies of Han and Hong [20] and Han [21], moreover, in classifying empirical and quantitative Feng Shui studies into groups based on whether they were related to reliability or validity. As mentioned above, reliability refers to the ability to obtain consistent results [7], such as between outcomes of different measurements, between measurements and Feng Shui principles, and between outcomes of Feng Shui applications and Feng Shui theories, while validity refers to the ability to truly inquire into the nature of a problem [7], such as the effects of Feng Shui on people's responses.

2.7. Risk of bias in individual studies *(PRISMA 2009 item 12)*

We used the Joanna Briggs Institute's (JBI) Critical Appraisal Tools to analyze the risk of bias and the quality of research in the included articles. The JBI is a recognized global leader in evidence-based endeavor organization. Its appraisal tools were specifically developed for systematic review and meta-analysis to assess the methodological quality of the included studies. The JBI provides different assessment tools based on different study designs. For example, the JBI Critical Appraisal Checklist for Analytical Cross Sectional Studies has eight questions regarding: (1) sample inclusion criteria, (2) study subjects and setting, (3) exposure measurement, (4) measurement criteria, (5) confounding factors, (6) confounding factor management, (7) outcome measurement, and (8) statistical analysis, each with four options (yes, no, unclear, and not applicable). Receiving a yes, therefore, represents 12.5% (1/8) of the total possible score [22]. In addition, the JBI Checklist for Randomized Controlled Trials has 13 questions regarding: (1) randomization assignment, (2) concealed allocation, (3) treatment group baseline, (4) participant blindness of treatment assignment, (5) deliver blindness of treatment assignment, (6) outcomes assessors blindness of treatment assignment (7) identical treatment except for intervention, (8) follow up, (9) randomized participant analysis, (10) identical outcome measurement, (11) reliable outcome measurement, (12) appropriate statistical analysis, and (13) appropriate trial design, each with four options. A yes represents 7.69% (1/13) of the total possible score [23].

The two assessment tools have detailed explanation of the questions. For example, the first questions of the JBI Critical Appraisal Checklist for Analytical Cross Sectional Studies and the JBI Checklist for Randomized Controlled Trials are, respectively:

> Were the criteria for inclusion in the sample clearly defined?
>
> *The authors should provide clear inclusion and exclusion criteria that they developed prior to recruitment of the study participants. The inclusion/exclusion criteria should be specified with sufficient detail and all the necessary information critical to the study* [22].
>
> Was true randomization used for assignment of participants to treatment groups?
>
> *The differences between participants included in compared groups constitutes a threat to the internal validity of a study exploring causal relationships. If participants are not allocated to treatment and control groups by random assignment there is a risk that the allocation is influenced by the known characteristics of the participants and these differences between the groups may distort the comparability of the groups. A true random assignment of participants to the groups means that a procedure is used that allocates the participants to groups purely based on chance, not influenced by the known characteristics of the participants. Check the details about the randomization procedure used for allocation of the participants to study groups. Was a true chance (random) procedure used? For example, was a list of random numbers used? Was a computer-generated list of random numbers used?* [23]

Therefore, making a judgment of yes, no, unclear, or not applicable was straightforward. When the reviewed articles had explicitly positive descriptions in response to the questions, they received a yes. When they had explicitly negative descriptions in response to the questions, they received a no. When they had no explicit descriptions in response to the questions, they received an unclear. When they had descriptions that were unrelated to the questions, they received a not applicable. Two authors independently conducted this quality appraisal. Only studies scoring more than 50% were considered satisfactory.

3. Results

3.1. Study selection *(PRISMA 2009 item 17)*

The search identified 8319 articles, 129 from Web of Science, 313 from Taiwan Periodical Literature, 7539 from WANFANG DATA, and 338 from SCOPUS. No articles were included from other sources. After screening the titles and abstracts, 406 duplicate articles were deleted. The remaining 7913 were further screened and 7877 excluded. Excluded studies included studies that did not use numbers to describe their outcomes and studies not related to Feng Shui. Narrative studies of Feng Shui included the studies on legends and customs, culture, residence, site selection, environmental planning and design, knowledge and operational systems, concepts and attitudes, and ideology [17,18]. Ultimately, 36 empirical and quantitative articles were included. The specific steps of the screening process and the flow chart of the study selection are shown in Fig. 1.

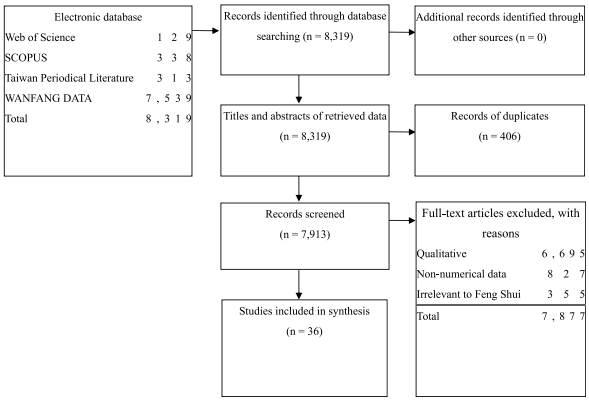

Fig. 1. Flow chart [24].

3.2. Study characteristics *(PRISMA 2009 item 18)*

First of all, we give an overall summary of these 36 journal articles. We used both quantitative and qualitative approaches to systematically review these journal articles. In total fifteen data items were used to provide an organized compendium of the characteristics of the 36 journal articles (Table 1). Two authors independently conducted this data extraction.

We then compiled basic statistics on the 36 articles specifically with respect to how many, when, what, how, who, and where to systematically explore the characteristics of the empirical and quantitative studies of Feng Shui, using the articles as the unit of analysis. We thus illuminated the current status of the empirical and quantitative studies of Feng Shui and shed light on directions for future research.

3.2.1. Number of journal articles and their publication year

Of the included 36 articles, 19 (52.7%) were from Web of Science [26–28,31,32,34–36,38,43,45,47,48,50–52,55–57], 10 (27.8%) from Taiwan Periodical Literature [20,21,29,30,33,37,40–42,44], five (13.9%) from SCOPUS [25,39,53,54,58], and two (5.6%) from WANFANG DATA [46,49]. The year of publication ranged from 1996 to 2019. The number of articles increased substantially after 2011. The Web of Science had nine articles published after 2016 [45,47,48,50–52,55–57], the highest number, followed by Taiwan Periodical Literature with six articles published between 2011 and 2015 [21,37,40–42,44] (Fig. 2).

3.2.2. Number of journal articles and their publication language

A total of 12 articles (33.3%) were published in Chinese [20,21,29,30,33,37,40–42,44,46,49] and 24 (66.7%) in English [25–28, 31,32,34–36,38,39,43,45,47,48,50–58]. No Chinese language articles were found in the period from 2001 to 2005 (Table 2).

3.2.3. Participants/samples from the journal articles

People, geographical locations, real estate data, and buildings mentioned in the 36 articles were used as study samples: 16 (44.4%) articles focused on people [20,26,29,30,32,33,35,37,39,41,42,45,47,52–54], 11 (30.6%) on geographical locations [28,31,36,38,40, 43,46,48,49,51,56], four (11.1%) on real estate data [44,50,55,57], and three (8.3%) on buildings [27,34,58] (Fig. 3). Two articles (5.6%) studied both humans and environments [21,25].

3.2.4. Study design of the journal articles

Of the 36 articles, 34 (94.4%) used surveys as their study design [20,21,25–36,38–46,48–58]. One (2.8%) conducted experiments [37] and one (2.8%) conducted field experiments [47]. Studies based on surveys were most common in the Web of Science database, with a total of 18 articles (50.0%) [26–28,31–36,38,43,45,48,50–52,55–57]. Nine articles (25.0%) were from Taiwan Periodical Literature [20,21,29,30,33,40–42,44], two (5.6%) from WANFANG DATA [46,49], and five (13.9%) from SCOPUS [25,39,53,54,58] (Table 3).

3.2.5. Locations studied in the journal articles

Since the research of one article was conducted in two locations [26], we calculated the number of studies instead of the number of articles. The distribution of study locations included 14 (37.8%) in Taiwan [20,21,25,29,30,33–35,37,40–42,44,48], nine (24.3%) in China [27,38,46,49–51,55–57], four (10.8%) in Hong Kong [26,28,31,32], and two (5.4%) in Singapore [39,54] and two (5.4%) in South Korea [36,58]. We also indicated the continent of the locations to provide a global perspective of Feng Shui research. For the study locations in Taiwan, three articles (21.4%) were found in Web of Science [34,35,48], 10 (71.4%) in Taiwan Periodical Literature [20,21,29,30,33,37,40–42,44], and one (7.1%) in SCOPUS [25] (Table 4).

Table 1
Summary of the study characteristics of the empirical and quantitative Feng Shui journal articles.

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
Han and Sinha [25]	1996	To compare and contrast Feng Shui and modern landscape assessment theories and methods.	5 Feng Shui sites in Taiwan, 5 American environmental experts, 20 college students (12 males, 8 females from North and South America, Europe, and Asia)			Survey	Feng Shui was consistent with the "prospect and refuge theory," "formal aesthetic model," "psychophysical model," and "phenomenological model."	Theories and methods developed in environmental psychology were used to examine the landscapes of the actual good Feng Shui locations in terms of reliability and validity.	Taiwan (Asia)	Site selection	Landscape architecture	Reliability, validity	S	E
Chen, Feng, and Wang [27]	1997	To design interior environments for healthy living.	Characteristics of ancient Chinese quadrangular buildings (thermal environment, natural lighting, noise, infrared absorption and radiation, and insulation, indoor air quality)			Survey	Quadrangular buildings provided good indoor air quality and moderated indoor temperature that improved energy-saving and building standards.	Optimal performance of the ancient Chinese quadrangular building was mathematically analyzed.	China (Asia)	Residence	Environment	Validity	W	E
Zhuang and Gorlett [28]	1997	To investigate forest types and forest evolution in Hong Kong.	44 sample areas of 400 square meters between 1989 and 1992			Survey	The Feng Shui forest behind the village had the most complex structure and unique tree species.	On the basis of site history and elevation, forests were divided into three classifications for sampling and data analyses: Feng Shui forest, lowland secondary forest, and mountainous forest.	Hong Kong (Asia)	Environmental planning and design	Ecology		W	E
Huang [29]	1998	To study the possibility of Feng Shui	393 citizens of Kaohsiung			Survey	Different age groups showed differences in Feng	One-way ANOVA was used to examine	Taiwan (Asia)	Concepts and attitudes	Environment		T	C

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		improving modern environmental protection.					Shui beliefs, judgements, and their relationship between Feng Shui and environmental protection. The majority agreed with the application of Feng Shui to environmental protection.	the differences in behavioral orientation (beliefs and attitudes) and application orientation of Feng Shui (using Feng Shui concepts to promote environmental protection) among four age groups.						
Wen, Lin, and Peng [30]	1999	To discuss the influence of the Feng Shui principles of water management on the living satisfaction of riverside residents.	235 residents (aged 20 or older) living along the Jingmei River, Taipei			Survey	Inside the river bend, 37.6% of the residents were highly satisfied with their living environment and 17.8% were lowly satisfied. The average satisfaction rating was 5.21. Outside the river bend, only 6.5% of the residents were highly satisfied with their living environment and 47.8 were lowly satisfied. The average satisfaction rating was 4.55.	The living satisfaction (living standards and living environment assessment indicators) was collected using questionnaires, the results of which were statistically analyzed. Since satisfaction was subjective, the personal conditions of the participants were also taken into account in the analysis.	Taiwan (Asia)	Concepts and attitudes	Environment	Validity	T	C
Tam, Tso, and Lam [31]	1999	To investigate the factors (Feng Shui, building age, and accessibility) that influence the regional housing price.	15 villages with similar local and socio-economic characteristics in Tai Po New Town, Hong Kong			Survey	The correlation between housing prices and Feng Shui was the highest, with a regression coefficient of 0.95. The regression coefficient between building age and Feng Shui was −0.699. Thus, areas	Multiple regression analysis was conducted on the three factors affecting regional housing prices.	Hong Kong (Asia)	Residence	Environment		W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
							having better Feng Shui had more new houses.							
McGrath, Liu, and Lam [32]	2002	To study the attitude towards and perception of traditional physiognomy (judging a person's character based on facial features) of teeth.	400 adults in Hong Kong			Survey	Among young (17–26 years old) and middle-aged adults (35–44 years old) in Hong Kong, 63% were aware of traditional physiognomy of teeth, and 24% believed in it.	Hong Kong adults' perceptions of Chinese physiognomy were surveyed by questionnaires drafted after consultation with Feng Shui experts and literature review. The survey was conducted with random samples of telephone numbers provided by the Social Sciences Research Centre of the University of Hong Kong.	Hong Kong (Asia)	Concepts and attitudes	Medicine		W	E
Mak and Ng [26]	2005	To study whether the five elements of Luan Tou [巒頭] theory (dragon, sand, water, cave, and orientation) were consistent with architects' ideas of ideal residential designs.	76 architects from Australia and 46 from Hong Kong			Survey	Although there were cultural and geographical differences between Eastern and Western architects, there was no significant difference in their preference for the environments of the ideal Feng Shui residence. There were also no significant differences in interior arrangement between the architects from both countries, all of	A survey for architects from Australia and Hong Kong was conducted. They were asked to illustrate the layout of a lounge room. The Luan Tou Feng Shui model was used as the yardstick to examine the views of architects from both countries.	Australia (Oceania), Hong Kong (Asia)	Residence	Environment	Reliability	W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
							whose ideas conformed to Feng Shui principles.							
Lin [33]	2007	To study the relationship between negative Feng Shui and house-buying behaviors, including whether negative Feng Shui affected real estate prices, and how appraisers handled the impacts of Feng Shui factors when valuing a real estate.	Real estate brokers in Taipei			Survey	The Feng Shui factor mostly considered by house buyers and appraisers was Wai Sha [外煞]. Nearly 70% of people would not buy a house with serious Feng Shui problems, and the impact on the price of real estate was about 10% of the total price.	Interviews with appraisers in Taipei were conducted.	Taiwan (Asia)	Residence	Environment		T	C
Han and Hong [20]	2008	To examine whether the judgements of Feng Shui experts regarding the environment were consistent in terms of Feng Shui quality.	First questionnaire: 95 Feng Shui experts Second questionnaire: 70 Feng Shui experts			Survey	Feng Shui experts' ratings of the environment in terms of Feng Shui quality were consistent ($0.99 \geqq \alpha \geqq 0.76$) and did not differ significantly in terms of gender, occupation, Feng Shui school, time interval, and presence or absence of photos.	The results of the two questionnaire surveys were analyzed for reliability, multivariate variance, and covariance.	Taiwan (Asia)	Knowledge and operational system	Environment	Reliability	T	C
Chang, Lee, Hung, Tsai, and Perng [34]	2009	To use the Efficient Fuzzy Weighted Average (EFWA) in the design of office layouts.	Office layout			Survey	EFWA was more efficient than Fuzzy Weighted Average in providing reliable and informative decisions.	EFWA was used to examine office layout following Luan Tou Feng Shui theory.	Taiwan (Asia)	Knowledge and operational system	Environment		W	E
Huang and Teng [35]	2009	To understand the differences between Chinese superstition and traditional	Study 1: 363 people in Taiwan Study 2: 395 people in Taiwan			Survey	Women were more likely to believe in traditional customs and horoscopes than men. People tended to follow	Questionnaire surveys were conducted in accordance with Proportionate Quota Sampling	Taiwan (Asia)	Concepts and attitudes	Culture		W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		Western superstition. The Chinese Superstitious Belief Scale was developed with six dimensions: traditional customs, homonym, power of crystals, Feng Shui, horoscope, and luck at gambling					rituals of traditional custom for important events, because they were afraid of having bad luck in the future as a result of disobedience of the tradition.	in northern, central, southern, and eastern Taiwan. The scale was developed by Exploratory Factor Analysis. The validity and reliability of the scale were examined by Structural Equation Modeling.						
Um [36]	2009	To assess the relationship between spatial parameters and grave density.	5549 grave locations in South Korea			Survey	In accordance with the Spatial Regression Model, the grave density was assessed to be R^2 of 0.751 with four topographic parameters. Solar index was the most important factor, followed by elevation, while slope and orientation were less important.	GIS and Spatial Regression Modeling were used to investigate the major control factors of Feng Shui graves.	South Korea (Asia)	Site selection	Environment	Reliability	W	E
Wang, Lin, and Chang [37]	2011	To clarify the relationship between science education and the development of integrated thinking and to examine the extent of acceptance of	Experiment 1: 280 students in Taiwan Experiment 2: 293 students in Taiwan Experiment 3: 298 students in Taiwan	Two contradictory statements	Elementary school students, middle school students, and college students	Experiment	Science education with an emphasis on scientific knowledge failed to promote scientific and rational thinking, although it increased skepticism among the educated participants.	Three experiments were conducted by using two contradictory statements. The extent of acceptance of fortune-telling, Feng Shui, and ghosts and gods	Taiwan (Asia)	Concepts and attitudes	Education		T	C

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		two contradictory statements from the participants regarding fortune telling, Feng Shui, and ghosts and gods.						were respectively evaluated by five-point scales.						
Hu, Li, Liao, and Fan [38]	2011	To investigate the forest patches of village Feng Shui forest in China by measuring the forest community parameters.	32 well-protected village Feng Shui forest patches in the Pearl River Delta, China			Survey	Village Feng Shui forest patches retained rich diversity of habitats and tree species, which was important for regional biodiversity.	Feng Shui forest patches in the Pearl River Delta were sampled and investigated. The relationship between forest community parameters, patch size and elevation was examined. Evergreen broadleaf forest, coniferous forest, and mixed forest in the region were also compared.	China (Asia)	Environmental planning and design	Ecology		W	E
Pheng, Xiaopeng, and Ting [39]	2012	To assess the similarities between Feng Shui principles and scenarios and their applicability to Total Building Performance (TBP).	32 architecture professionals in Singapore			Survey	25 Feng Shui principles and 12 Feng Shui scenarios were applicable to TBP requirements. This finding indicated that there was common ground between Feng Shui and TBP.	The relationship between Feng Shui users' well-being and building performance and the applicability of Feng Shui to building performance were investigated. Analysis was	Singapore (Asia)	Residence	Environment	Reliability	S	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
								performed of the data collected by the questionnaire survey of architecture professionals.						
Han and Lo [40]	2012	To investigate whether there was any objectively measurable difference between good and bad Feng Shui environments.	18 Feng Shui environments in Taiwan			Survey	Good and bad Feng Shui environments showed significant differences in geographical features (distances from Dragon cave [龍穴] to Qing Long [青龍], Xuan Wu [玄武], and streams, stream width, and ratio of Qing Long Mountain volume to Bai Hu [白虎] Mountain volume), and in meteorological conditions (average air pressure, relative humidity), and in negative ion level.	After on-site investigations and discussions with a Feng Shui expert, the methods for measuring the geographical features of actual Feng Shui environments were developed. The validity of Feng Shui in terms of the geographical features, meteorology, and negative ions of the environments was statistically analyzed with effect size taken into account.	Taiwan (Asia)	Site selection	Environment	Validity	T	C
Hsu, Ho, and Lo [41]	2012	To examine the correlations between house purchase factors and house purchase decisions and to rank the importance of	27 Feng Shui experts in Taiwan			Survey	The top five important house purchase factors were type of house, quality of residency, situation [形勢], ventilation and lighting, and orientation.	Interviews and analyses were conducted by using DEMATEL with Analytic Network Process theory of multi-criteria-decision-	Taiwan (Asia)	Residence	Environment	Reliability	T	C

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		house purchase factors.						making approach.						
Huang, Liu, and Ku [42]	2012	To investigate the perceptions of negative Feng Shui factors among house-buyers and whether these factors affected their willingness to buy.	100 clients of real estate agencies in Tainan			Survey	House-buyers were divided into two groups: those who thought Feng Shui important (68%) and those who did not (32%). Those who thought Feng Shui important had greater perceptions of Sha Qi [煞氣], and facility Wai Sha [設施外煞], which negatively affected their willingness to buy a house.	Factor analysis using the data obtained from face-to-face survey was conducted with the Varimax method to determine the extent of Feng Shui perceptions.	Taiwan (Asia)	Concepts and attitudes	Environment		T	C
Chen, Yuei, and Takakazu [43]	2014	To understand the scale of the Feng Shui forest, to investigate the actual landscape composition, and to map the distribution and layout of the landscape elements.	Feng Shui forests on Tarama Island, Okinawa			Survey	The cultural landscape with ecological characteristics was taken into account in village planning on the island, which should be upgraded to tourist attractions for better protection.	After a comprehensive investigation of the landscape units of the traditional village in Okinawa, the Feng Shui forest of Talama Island was selected as the study sample. Two hamlets in the selected Feng Shui forest were viewed as a holistic landscape, which underwent a landscape element analysis.	Japan (Asia)	Environmental planning and design	Landscape		W	E
Lin and Huang [44]	2014	To investigate the influence of various Feng Shui factors on commercial real estate prices.	10,993 actual items of transaction price data from Taiwan from February 2002			Survey	Four Feng Shui factors (a building directly facing the road [路沖], proximity to viaducts, proximity to temples and	Based on Hedonic Pricing theory, analyses were conducted using actual items of trading price data with	Taiwan (Asia)	Residence	Environment		T	C

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
			to December 2007				altars, and dead-end street [無尾巷]) had negative impacts on commercial real estate prices (office, office and residence, and shop), among which high-priced commercial real estates were the most affected.	the Quantile Regression Model.						
Han [21]	2015	To examine the reliability and validity of Feng Shui through empirical and quantitative methods.	70 Feng Shui experts and 18 Feng Shui sites in Taiwan			Survey	The reliability and validity of the Luan Tou school were demonstrated. Both subjective judgements of Feng Shui experts (good Feng Shui principles such as "protection from the wind and gathering Qi" [藏風聚氣] and "behind Yin and in front of Yang" [負陰抱陽]) and objective geographic features (buildings, dragons, sand, caves, water, aspect, and overall) met the Feng Shui principle of "protection from the wind" [藏風].	The subjective judgements of 70 Feng Shui experts on 18 sites and the data of objective geographic features of the 18 sites were examined.	Taiwan (Asia)	Site selection	Environment	Reliability, validity	T	C
Bazley, Vink, Montgomery, and Hedge [45]	2016	To assess the comfort of outpatients in the waiting areas of medical centers and the impact of appropriate placement of Feng Shui elements.	81 participants from 3 different medical centers			Survey	Waiting areas designed by Feng Shui experts were rated as the most comfortable, followed by doctor-designed waiting areas, while traditional or conventional waiting areas were	Outpatients' comfort after they woke up, arrived at the waiting areas, and saw doctors were compared.	United States (North America)	Concepts and attitudes	Medicine	Validity	W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
							rated as the least comfortable.							
Yao, Yan, and Wu [46]	2016	To analyze, on the basis of Feng Shui and psychological field theories, the village layout, landscape element functions, and spatial structure features of a village in order to improve the traditional landscape structure analysis.	Chengkan village, Anhui province			Survey	The 3D landscape indices were an improvement on the traditional 2D landscape indices in terms of area, perimeter, shape, and diversity. 3D landscape indices showed that Chengkan village was an ideal ecosystem model.	By calculating the surface area and perimeter of landscape patches instead of the 2D landscape features, the village landscape pattern was quantitatively analyzed.	China (Asia)	Environmental planning and design	Ecology		WF	C
Charles, Glover, Bauchmüller, andWood [47]	2017	To investigate the relationship between caregivers' emotions and surrounding environments by applying Feng Shui.	108 caregivers in Yorkshire	Wind group, water group, bed space, and cake consumption	Caregivers not assigned to Feng Shui bed space	Field experiment	The layout, based on Feng Shui principles, of the bed space in the critical care unit did not improve the emotional well-being of the caregivers.	Following Ba Gua [八卦] principles, bed space in the critical care unit was classified into either wind or water orientation. Caregivers who were not assigned to the beds of the two groups served as the control group. The influence of cake consumption on the emotions of caregivers was also analyzed as a secondary outcome in the two-week experiment.	United Kingdom (Europe)	Concepts and attitudes	Medicine	Validity	W	E
Chu, Hsu, and Hsieh [48]	2017	To investigate through scientific	Huazhai village, Wanan Island, Penghu			Survey	Topography and water were the basis of Feng Shui	A computer model was used to restore early	Taiwan (Asia)	Site selection	Environment	Validity	W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		analysis whether ancient Feng Shui designs lead to good living environments.					principles used to identify living places in order to improve the quality of living environments. Buildings should be planned according to microtopography, regional needs, and the wind field features to create a sustainable living environment that could adapt to the climate.	conditions of the village. Then CFD was used to simulate the long-term wind field to analyze the impact of the surrounding environment on village wind fields.						
Wang and Zhang [49]	2018	To discuss the scientific methods for applying geomantic layout to the outdoor wind environment of green buildings.	Tianjin			Survey	Geomantic layout was an important reference for the creation of outdoor wind environments of green buildings. Application strategies should combine practical analysis, water and greenery analysis, and other design elements.	Based on the theories of situation [形勢] and "protection from the wind and gathering Qi" of the geomancy, a 3D computer model was created using AutoCAD and Sketchup. Then CFD was used to simulate the wind environments during summer and winter.	China (Asia)	Site selection	Environment	Validity	WF	C
Lu [50]	2018	To investigate the relationship between the orientation of apartments and their prices in Shanghai.	2996 items of data from the real estate database from December 2013 to May 2014			Survey	South-facing houses had an increase in real estate prices by an average of 14%. Prices of houses with views of landmark buildings in Shanghai had an increase of 5.7%. When the houses also faced south, the price increased an additional 4.2%. The problem of dust	A comprehensive database (apartment attributes, air quality, and urban spatial structure) was used to analyze the relationship between the surrounding environments and the real	China (Asia)	Residence	Environment		W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
							may reduce the prices of south-facing houses, while $PM_{2.5}$ had little effect.	estate prices in Shanghai.						
Almodovar-Melendo and Cabeza-Lainez [51]	2018	To investigate the environmental features that formed Chinese historical architectural patterns from a cultural perspective.	Traditional urban layout in Beijing			Survey	Facing south was the only orientation that had the advantage of more sunshine in winter than in summer. Because of the hot summer afternoon sunlight, the most favorable orientation was not facing the south; instead, it was slightly to the southeast.	Microclimatic factors and comfort conditions of the urban layout in Beijing were analyzed.	China (Asia)	Environmental planning and design	Environment	Validity	W	E
Wang, Hong, and Abdul-Rahman [52]	2018	To investigate whether the layout of a bedroom designed by architects was similar to that accorded with Feng Shui principles.	16 architects of different cultural backgrounds			Survey	The major consideration of a bedroom was bed arrangement. Most bedroom designs were associated with good Feng Shui conditions.	Semi-structured interviews were used to collect architects' perspectives and experiences regarding bedroom interiors and layouts.		Residence	Environment	Reliability	W	E
Sia, Yew, and Siew [53]	2018	To examine the influence of Feng Shui factors on the decisions of Chinese house-buyers in Malaysia.	160 respondents from two areas (Kuala Lumpur and Sandakan) in Malaysia.			Survey	Regardless of geographical differences, respondents in Kuala Lumpur and Sandakan shared very similar perspectives on Feng Shui. Feng Shui factors, as well as house price and location influenced house-buyers' decisions.	A questionnaire survey on 24 Feng Shui principles was conducted with respondents from two different locations. The collected data were statistically analyzed.	Malaysia (Asia)	Concepts and attitudes	Environment		S	E
Pheng, Gao, and Ang [54]	2018	To study whether the application of Feng Shui principles in	2 Feng Shui practitioners, 1 facility manager, and 1 facility			Survey	All 15 Feng Shui principles significantly affected 3 types of facility	A questionnaire survey was conducted to verify the effectiveness of	Singapore (Asia)	Residence	Environment	Validity	S	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		building design affected cleaning activities during facility operations and maintenance.	manager and Feng Shui practitioner				management activities (cleaning of building exterior, daily external site/ extensive cleaning, and road and pavement cleaning).	Feng Shui principles and facility operations and maintenance principles. Three groups of experts were interviewed to examine the questionnaire results.						
Song, Wilhelmsson, and Zheng [55]	2019	To investigate the impact of different orientations of houses on buyers' willingness to buy in Beijing.	63,306 resale apartment transactions in 10 districts in Beijing from October 2011 to September 2014 recorded in the real estate database			Survey	The average selling price of apartments facing south was 7.8% higher than those facing west. The price of apartments in the old town was more sensitive to orientation than that of apartments in other areas.	The Ordinary Least Squares Model and the Spatial Econometric Model were used to estimate the effect of attributes of structure, location, and neighborhood on the housing price per square meter.	China (Asia)	Concepts and attitudes	Environment		W	E
Wang, Liu, Dai, Cao, Wang, and Wang [56]	2019	To investigate the relationship between the genetic diversity of an endangered species, *Erythrophleum fordii*, in Feng Shui forests and its population gene flow.	1061 plants of *Erythrophleum fordii* in 8 Feng Shui forests in Guangzhou			Survey	*Erythrophleum fordii* was not going to be extinct in the near future. Because of the lack of suitable habitat for regeneration, however, a large and continuous population was required to ensure great gene flow to maintain species sustainability.	Samples were taken from 8 Feng Shui forests in Guangzhou, and were compared with samples from protected natural areas.	China (Asia)	Environmental planning and design	Ecology		W	E
Liu, Wang, Gu, Liu, and Zhou [57]	2019	To investigate the interactive effect of water and mountain landscapes of Feng Shui theory to assess the impact of	14,789 items of apartment transaction data in downtown Chongqing from 2015 to 2017			Survey	The prices of the houses with mountain-water interactive landscapes increased by 21.38%, more than those of houses with	The Hedonic Price Model was used to assess the impact of mountain-water landscapes on housing prices.	China (Asia)	Site selection	Environment		W	E

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Table 1 (*continued*)

Researchers	Year	Study objectives	Participants/ samples	Interventions	Comparator	Study design	Outcomes	Research methods	Locations	Research orientation	Applications	Reliability/ validity	Database	Language
		landscapes on housing prices.					either mountain or water landscapes. Prices of houses near mountain-water interactive landscapes also increased by 15.01%, because of the spillover effect.							
Choe and Han [58]	2019	To examine the consistency and feasibility of the application of Feng Shui principles to modern architecture from a methodological perspective with the purpose of providing a scientific point of view.	5 traditional houses			Survey	Topographic elements had protective effects on climate. Feng Shui concepts could be applied to modern building systems.	3D digital maps were used to simulate real situations, which enabled the assessment of Feng Shui theory and ecological architecture.	South Korea (Asia)	Environmental planning and design	Environment	Validity	S	E

*Web of Science (W), Taiwan Periodical Literature (T), WANFANG DATA (WF), and SCOPUS (S).
**English (E), Chinese (C).
***Continent in parentheses.

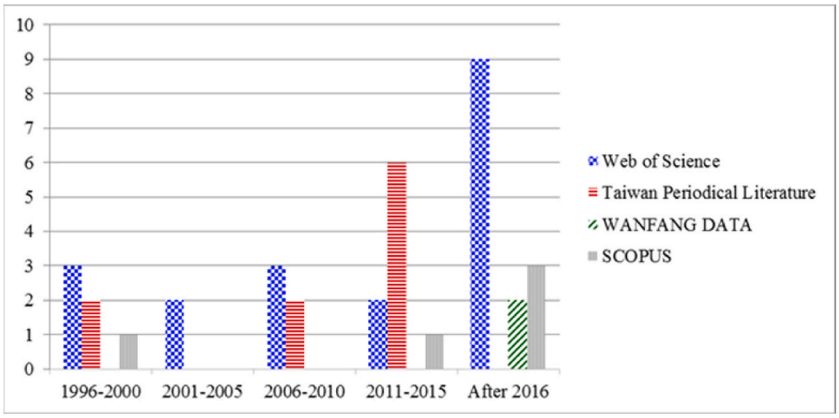

Fig. 2. Number of articles published during each period.

3.2.6. *Research orientations of the journal articles*

Among the 36 articles included in this review, 10 (27.7%) focused on residence [26,27,31,33,39,41,44,50,52,54], 10 (27.7%) focused on concepts and attitudes [29,30,32,35,37,42,45,47,53,55], seven (19.4%) focused on site selection [21,25,36,40,48,49,57],

Table 2
Number of journal articles published (five-year periods) [24].

Year of Publication	Language				Statistics	
	Chinese		English			
	Number of articles	Percentage	Number of articles	Percentage	Number of articles	Percentage
1996 to 2000	2	16.7	4	16.7	6	16.7
2001 to 2005	0	0.0	2	8.3	2	5.6
2006 to 2010	2	16.7	3	12.5	5	13.9
2011 to 2015	6	50.0	3	12.5	9	25.0
After 2016	2	16.7	12	50.0	14	38.9
Total	12	100.0	24	100	36	100.0

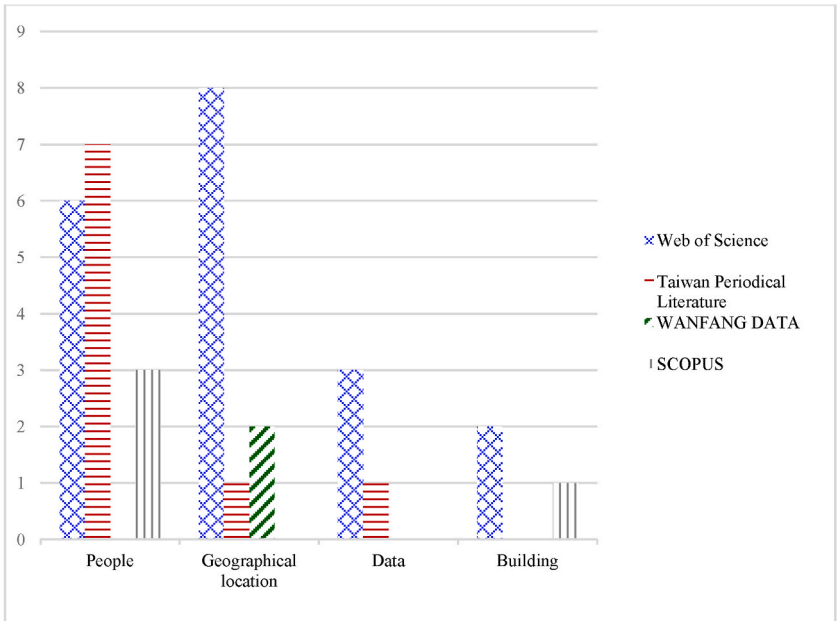

Fig. 3. Participants/samples from the journal articles.

Table 3
Study design of the journal articles [24].

Study design	Web of Science	Taiwan Periodical Literature	WANFANG DATA	SCOPUS	Number of articles
Experiment	0	1	0	0	1
Field experiment	1	0	0	0	1
Survey	18	9	2	5	34
Total	19	10	2	5	36

Table 4
Study locations.

Geographical area	Web of Science	Taiwan Periodical Literature	WANFANG DATA	SCOPUS	Number of articles
Taiwan (Asia)	3	10	0	1	14
China (Asia)	7	0	2	0	9
Hong Kong (Asia)	4	0	0	0	4
Singapore (Asia)	0	0	0	2	2
Malaysia (Asia)	0	0	0	1	1
Japan (Asia)	1	0	0	0	1
Korea (Asia)	1	0	0	1	2
Australia (Oceania)	1	0	0	0	1
United Kingdom (Europe)	1	0	0	0	1
United States (North America)	1	0	0	0	1
Other	1	0	0	0	1
Total	20	10	2	5	37

*Continent in parentheses.

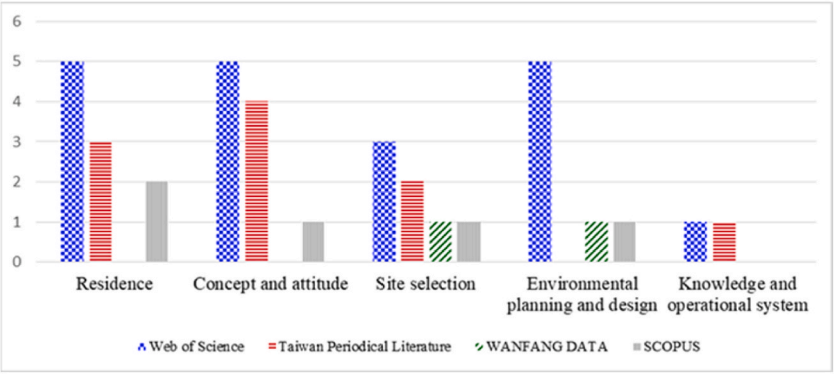

Fig. 4. Research orientation of the journal articles.

seven (19.4%) focused on environmental planning and design [28,38,43,46,51,56,58], and two (5.6%) focused on knowledge and operational system [20,34] (Fig. 4). Residence and concepts and attitudes, however, were often discussed together in the articles.

3.2.7. Professional applications of the journal articles

The applications of the 36 articles included 25 (69.4%) related to environment [20,21,26,27,29–31,33,34,36,39–42,44,48–55,57,58], four (11.1%) related to ecology [28,38,46,56], three (8.3%) related to medicine [32,45,47], two (5.6%) related to landscape architecture [25,43], one (2.8%) related to culture [35], and one (2.8%) related to education [37]. The highest number of articles was related to the environment, with 11 (44.0%) from Web of Science [26,27,31,34,36,48,50–52,55,57], followed by nine (36.0%) from Taiwan Periodical Literature [20,21,29,30,33,40–42,44], four (16.0%) from SCOPUS [39,53,54,58], and one (4.0%) from WANFANG DATA [49]. Web of Science [43] and SCOPUS [25] each had one article related to landscape architecture (Fig. 5).

3.2.8. Whether the journal articles were relevant to reliability and/or validity

Among the 36 articles in this review, six (16.7%) were related to reliability [20,26,36,39,41,52], 10 (27.8%) to validity [27,30,40,45,47–49,51,54,58], and two (5.6%) to both reliability and validity [21,25]. One article related to both reliability and validity was from Taiwan Periodical Literature [21] and the other from SCOPUS [25]. Three (50.0%) reliability-related articles were from Web of Science [26,36,52], while two (33.3%) were from Taiwan Periodical Literature [20,41]. Finally, there were five (45.5%)

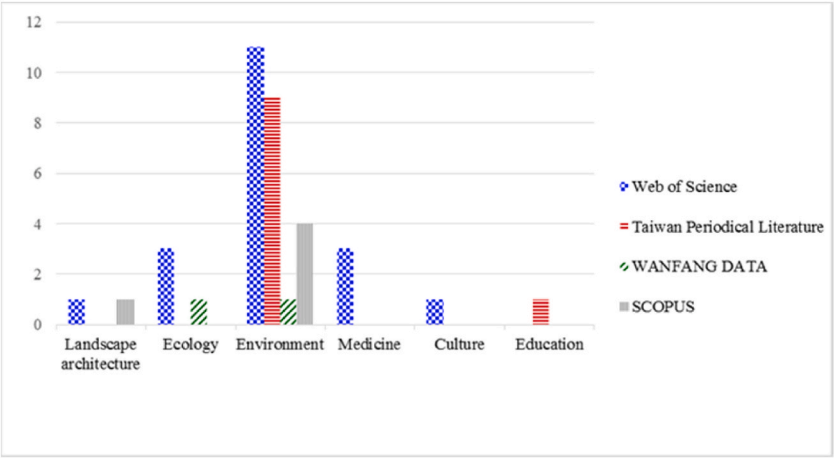

Fig. 5. Professional applications of the journal articles.

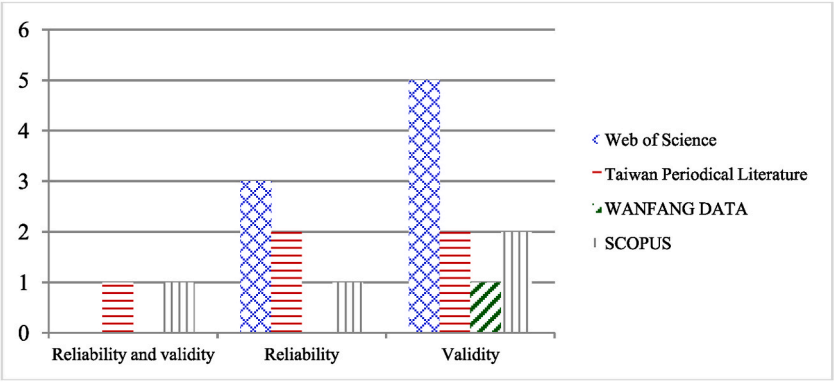

Fig. 6. Journal articles related to reliability and/or validity.

validity-related articles from Web of Science [27,45,47,48,51], two (18.2%) from Taiwan Periodical Literature [30,40], one (9.1%) from WANFANG DATA [49], and two (18.2%) from SCOPUS [54,58] (Fig. 6).

3.3. *Risk of bias within studies* *(PRISMA 2009 item 19)*

Of the 36 articles, 34 used surveys, and two used experiments. The JBI Critical Appraisal Checklist for Analytical Cross Sectional Studies [22] was therefore used to evaluate the risk of bias and research quality of the survey studies, while the JBI Checklist for Randomized Controlled Trials [23] was used to assess the risk of bias and research quality of the experimental studies. Cross sectional studies are also known as survey studies. Although the two experiments were not real randomized controlled trials because they did not use true randomization for assignment of participants, the JBI Checklist for Randomized Controlled Trials is the most appropriate tool for experiment evaluation. The scores and percentage values of each article are listed in the Appendix (Table A2, Table A3). The average rating of the 36 articles was 58.39%, meaning that they had 58.39% of the total scores of the appraisal tools. The highest rating was 75.0% (eight articles) [20,30–32,36,50,55,57], while the lowest rating was 12.5% (two articles) [33,52]. The two experimental studies had ratings below 50.0%, indicating that the quality of the studies was not good [37,47].

4. Discussion

Based on the findings of the results in Section 3, we first illuminated the current status of the empirical and quantitative studies of Feng Shui, presenting their percentage of the searched literature, the number of journal articles and their publication year, publication language, participants/samples, research orientations, professional applications, study locations, study design, reliability, and validity. We then provide a summary of the evidence for the specific outcomes of Feng Shui pertaining to people, environments, real estate data, buildings, reliability, and validity via synthesizing the findings of the 36 journal articles based on the data items of participants/samples, reliability/validity, and outcomes in Table 1. Given that the heterogeneity of these 36 articles was too great to conduct a meta-analysis, a pooled effect estimate of Feng Shui on people, environments, real estate data, buildings, reliability, and validity was

not performed. The limitations of this study and suggestions for future research are discussed.

4.1. Current status of empirical and quantitative studies of Feng Shui

Empirical and quantitative studies of Feng Shui constituted only a very small amount (36/8319 = 0.43%) of the searched literature, even though we used a broad set of eligibility criteria. A substantial amount of literature on Feng Shui consists of narrative studies. Although the amount of empirical and quantitative studies on the subject is increasing (Fig. 2, Table 2), more empirical and quantitative studies of Feng Shui are needed. Moreover, a search for Feng Shui literature either in English or Chinese alone would miss a considerable number of studies. Surprisingly, there are twice as many empirical and quantitative studies of Feng Shui published in English as in Chinese (Table 2). This is likely because traditional Chinese philosophical concepts and thinking methods are often vague in epistemology and methodology. Consequently, Feng Shui lacks precise analysis and empirical examination under a rigorous logical system [59].

Hopefully, there will be more empirical and quantitative studies of Feng Shui. This would enable systematic reviews, meta-analyses, and even umbrella reviews (reviews of systematic reviews) to generate high levels of evidence [60], on whether Feng Shui is a superstition or whether it has positive practical value. Traditionally, randomized controlled trials are generally regarded as able to provide good evidence. Therefore, when a systematic review combines several randomized controlled trials and presents an overview of the synthesized evidence, it has a higher level of evidence than a single randomized controlled trial. When a meta-analysis combines several randomized controlled trials and provides a pooled effect estimate, the level of evidence rises even further. Likewise, when an umbrella review combines several systematic reviews and/or meta-analyses and offers qualitatively and/or quantitatively synthesized evidence, its level of evidence is undoubtedly the highest [61].

The 36 articles on Feng Shui reviewed herein cover a diverse group of study samples, such as people (16 articles) [20,26,29,30,32,33,35,37,39,41,42,45,47,52–54], geographical locations (11) [28,31,36,38,40,43,46,48,49,51,56], real estate data (four) [44,50,55,57], and buildings (three) [27,34,58]. They also include the research orientations of residence (10) [26,27,31,33,39,41,44,50,52,54], site selection (seven) [21,25,36,40,48,49,57], environmental planning and design (seven) [28,38,43,46,51,56,58], knowledge and operational systems (two) [20,34], and concepts and attitudes (10) [29,30,32,35,37,42,45,47,53,55], and professional applications to the environment (25) [20,21,26,27,29–31,33,34,36,39–42,44,48–55,57,58], ecology (four) [28,38,46,56], medicine (three) [32,45,47], landscape architecture (two) [25,43], culture (one) [35], and education (one) [37]. All of these demonstrate the breadth and depth of Feng Shui. Multiple-disciplinary and/or inter-disciplinary cooperation, such as disciplines of ecology, meteorology, geography, hydrology, soil science, botany, landscape architecture, architecture, psychology, medicine, and sociology, therefore, is ideal to conduct empirical and quantitative studies of Feng Shui.

Most of the reviewed 36 articles were conducted in Asia (33) [20,21,25–44,46,48–51,53–58] with domestic participants using survey methods (34) [20,21,25–36,38–46,48–58], which limited the generalizability and causality of their findings. More experiments on Feng Shui, which can infer causality, are needed. It would be interesting to compare and contrast the influence of Feng Shui across ethnicities, cultures, geographical locations, and climates. In addition, these 36 articles were more interested in exploring validity (10) [27,30,40,45,47–49,51,54,58] than reliability (six) [20,26,36,39,41,52]. This may be because these researchers were more interested in the effect or practical value of Feng Shui. Nevertheless, given that the overall research quality of these articles was only slightly above the satisfactory level (50%), and these articles were also limited in quantity, their findings should be interpreted with caution.

4.2. Summary of evidence *(PRISMA 2009 item 24)*

What follows are the specific findings of the empirical and quantitative studies with respect to study samples and to the reliability and validity of Feng Shui. We synthesized the findings according to the study samples because they had common research subjects or unit of analysis. It was the most straightforward method to present the summary of evidence focusing on the same specific subject or unit of analysis. Furthermore, we synthesized the findings of reliability and validity of Feng Shui without the limitations of the study samples to offer a comprehensive review of whether Feng Shui is a superstition.

4.2.1. Findings regarding people

Regarding ordinary people, in Taiwan women were generally more likely to be believers in superstitions than men (N = 758) [35]. People of different age groups showed different beliefs and judgements about Feng Shui in Taiwan. Most people supported the application of Feng Shui to environmental protection in Taiwan (N = 393) [29]. Of young and middle-aged adults in Hong Kong, 63% of them had heard about Feng Shui-related physiognomy of teeth, and 24% believed in it (N = 400) [32]. In Taiwan, although science education encouraged skepticism, integrated scientific and rational thinking did not reduce superstition (N = 871) [37].

Regarding house-buyers in Taiwan, 68% considered Feng Shui important. The Sha Qi [煞氣] and facility Wai Sha [設施外煞] of a house had negative effects on their house-buying willingness (N = 100) [42]. Similarly, the most important Feng Shui factor for house-buyers in Taiwan was Wai Sha [外煞], according to the real estate brokers. The real estate brokers also stated that about 70% of house-buyers would give up buying houses with serious Feng Shui problems, and Feng Shui problems influenced about 10% of real estate prices [33]. Chinese-Malaysians from two different cities had similar points of view on Feng Shui. In addition to price and location, Feng Shui affected house-buyers' willingness (N = 160) [53]. The five most important factors influencing house purchases

were type of house, quality of residency, Feng Shui situation [形勢], ventilation and lighting, and Feng Shui orientation [方位] according to Feng Shui experts in Taiwan (N = 27) [41].

Regarding particular groups, photographs taken at five good Feng Shui sites in Taiwan were evaluated as having high-quality landscapes as indicated by the average ratings of five environmental professionals in the US using the Visual Resource Management system [25]. Further, 20 college students in the US reported positive emotions and strong preferences when viewing these photographs [25]. Of residents who lived inside a river bend with good Feng Shui in Taiwan, 37.6% were highly satisfied with their living environment, while 17.8% were lowly satisfied. Their average satisfaction rating was 5.21. Conversely, only 6.5% of those who lived outside of a river bend with bad Feng Shui were highly satisfied with their living environment, while 47.8% were lowly satisfied. Their average satisfaction rating was 4.55 (N = 235) [30]. Outpatients in the US indicated that the waiting area designed by Feng Shui experts was the most comfortable, followed by a doctor-designed waiting area, while a traditional or conventional waiting area was the least comfortable (N = 81) [45]. Nursing staff in a bed space in a critical care unit in the UK arranged according to Feng Shui principles, however, failed to experience improved emotional well-being (N = 108) [47]. Additionally, architects from different cultures all agreed that bed arrangement was the most important factor of a bedroom. Most bedroom designs were related to Feng Shui principles (N = 16) [52]. Architects from Australia and Hong Kong showed no significant differences in their preferences for ideal residential surroundings. Their interior arrangements, all of which accorded with Feng Shui principles, showed no significant difference, either (N = 122) [26]. Architects in Singapore considered that Feng Shui principles were applicable to the requirements of the Total Building Performance (N = 32) [39]. One facility manager, two Feng Shui practitioners, and one facility manager, who was also a Feng Shui practitioner in Singapore, agreed that Feng Shui principles significantly influenced three facility management activities: exterior cleaning, daily external sites/extensive cleaning, and road and pavement cleaning (N = 4) [54]. Regardless of gender, occupation, Feng Shui school, time interval, and whether aerial photographs were present or not, Feng Shui experts in Taiwan were consistent in their ratings of the environments in terms of Feng Shui quality (N = 165) [20]. The subjective judgements of Feng Shui experts in Taiwan regarding "protection from wind and gathering Qi" [藏風聚氣] and "in front of Yin and behind Yang" [負陰抱陽] and the data of the objective geographic features regarding building, dragon [龍], sand [砂], cave [穴], water [水], and orientation [向] all met the Feng Shui principles of "protection from wind and gathering Qi" (N = 70) [21].

In brief, the above four articles [33,41,42,53], with a total N of 287 people, were consistent in showing that Feng Shui was related to the decisions of house-buyers, who grew up in societies influenced by Chinese culture.

4.2.2. Findings regarding environments

With respect to Feng Shui forests, those in Hong Kong and China all preserved rich ordinary and endangered species and had greater habitat diversity than other forests (N = 44, N = 32, N = 8) [28,38,56]. With respect to outdoor wind environments, a village in Taiwan (N = 1) [48] and a community in China (N = 1) [49] all indicated that environments which met Feng Shui principles had more comfortable wind fields than non-Feng Shui settings. With respect to sunlight, it was the most important factor that determined the locations of Feng Shui graves in South Korea (N = 5549) [36]. Facing not due south but slightly southeast was the best orientation for traditional urban layouts in Beijing, while facing south was considered the most favorable orientation in Feng Shui (N = 1) [51]. Nine good and nine bad Feng Shui environments showed significant differences in the distances from Dragon cave [龍穴] to Qing Long [青龍], to Xuan Wu [玄武], and to streams, in stream width, in ratio of Qing Long Mountain volume to Bai Hu [白虎] Mountain volume, in average air pressure, relative humidity, and negative ion concentration [40]. A Feng Shui village in China was shown to be an ideal ecosystem model using the three-dimensional landscape patch indices (N = 1) [46].

In brief, of the above articles, three [28,38,56], with a total N of 84 sites were consistent in showing that Feng Shui forests had greater habitat diversity than other forests in China, in accordance with the finding that a Feng Shui village was an ideal ecosystem model [46]. Two [48,49], with a total N of 2 sites were consistent in showing that Feng Shui environments had more comfortable wind fields than non-Feng Shui settings, though both used computer simulations, and two [36,51], with a total N of 5550 sites were consistent in showing that Feng Shui was related to sunlight in Asia. The findings of the comfortable wind fields at Feng Shui locations deserve particular attention because they demonstrate empirically that Feng Shui methods can identify sites protected from the wind. In addition, Feng Shui locates sites with sufficient sunlight, conducive to farming. Both findings reveal that Feng Shui has positive practical value [13] and rational elements [14].

4.2.3. Findings regarding real estate data

Villages in Hong Kong showed a high positive correlation between Feng Shui and housing prices [31], though the author did not specify their information source. In Taiwan, bad Feng Shui factors, such as "a building directly facing the road" [路沖], proximity to viaducts, proximity to temples and altars, and dead-end streets [無尾巷], all had negative impacts on the prices of commercial real estate, such as offices, offices and residences, and stores, among which high-priced commercial real estate was affected the most (N = 10,993) [44]. In China, houses facing south had higher prices, and apartment prices in old urban areas were more sensitive to orientation than in other areas (N = 2,996, N = 63,306) [50,55]. Since mountains prevent Qi from being blown away by the wind and water can gather Qi, Feng Shui strongly emphasizes mountains and water. Mountain and water interactive landscapes increased house prices by 21.38% in China, higher than the price of houses with either mountain or river landscapes. There was also a spillover effect that led to a 15.01% increase in the price of houses near mountain-water landscapes (N = 14,789) [57]. All five of the above articles with a total N of 92,099 conclusively showed that Feng Shui was related to housing prices in societies influenced by Chinese culture

[31,44,50,55,57].

4.2.4. Findings regarding buildings

Traditional quadrangular buildings in China have been found to have good indoor air quality and to easily maintain a good indoor climate, thus helping to save energy spent on air conditioning [27]. The Efficient Fuzzy Weighted Average Model provided more efficient, reliable, and informative decisions than the Fuzzy Weighted Average Model in the application of Luan Tou school [巒頭派] principles to office layouts [34]. Topographic elements that followed Feng Shui principles were found to have a protective effect on climate in South Korea using computer simulations (N = 5) [58], consistent with the evidence that Feng Shui environments had more comfortable wind fields [48,49].

4.2.5. Evidence regarding reliability and validity

Among the 36 articles included in this review, only one directly examined the reliability of Feng Shui practitioners. It found that Feng Shui experts' internal consistency reliability was good, with a Cronbach's α between 0.76 and 0.99 (N = 95), which was conducted in Taiwan using questionnaires [20]. Five other articles compared and contrasted the principles and/or concepts of Feng Shui with other professional fields, finding that good Feng Shui environments were consistent with the "prospect-refuge theory" and the "phenomenological model" of landscape aesthetics and were evaluated to have high-quality landscapes (n = 5, n = 20), which was conducted in the US using questionnaires [25]. The principles of Feng Shui accorded with the opinions of architects (N = 76, N = 32, N = 16), which were studied in Australia and Hong Kong, Singapore, and China, respectively, using surveys [26,39,52], and facility managers (N = 4), which was studied in Singapore using surveys [54]. Three articles conducted using surveys in Taiwan, South Korea, and Taiwan, respectively [21,36,41], showed that places found by applying theories of Feng Shui indeed met the principles of Feng Shui (N = 18, N = 5,549, N = 27). All nine of the above articles with a total N of 5540 sites [21,36,41] and a total N of 244 people [20,25,26,39,52,54] at different locations conclusively showed that Feng Shui had reliable outcomes (their essential study characteristics can be found in Table 1). Thus, Feng Shui may not be a mere superstition.

Reliability, however, does not guarantee validity. Four of the 36 articles directly examined the effects of Feng Shui on people. They found that good Feng Shui environments increased people's preferences and positive emotions (n = 20)(conducted in US using questionnaires [25]), and led to greater living satisfaction (N = 235)(conducted in Taiwan using questionnaires [30]), and more comfort (N = 81)(conducted in US using questionnaires [45]), but failed to improve caregivers' emotional well-being (N = 108)(conducted in UK using field experiments [47]). These four articles showed conflicting results for the validity of Feng Shui in terms of human responses. Moreover, seven articles examined whether Feng Shui was associated with good living environments. They showed that buildings (in China and South Korea, respectively [27,58]) and environments (studies in Taiwan, Taiwan, China, and China, respectively [21,48,49,51]) that met the principles of Feng Shui had good air quality, more adequate sunlight, and more appropriate wind fields than non-Feng Shui settings and that good Feng Shui environments differed significantly in geographic features and meteorological conditions from bad Feng Shui environments (Taiwan [40]). These seven articles showed consistent results for the validity of Feng Shui in terms of environmental characteristics [21,27,40,48,49,51,58].

In sum, given that the divergent findings on the validity of Feng Shui in terms of environmental characteristics and human responses, Feng Shui cannot be regarded as a science. Nevertheless, the evidence synthesized herein shows that Feng Shui is reliable and has positive practical value [13] and rational elements [14] for locating suitable habitats for humans. It should be noticed that the original goal of Feng Shui was to find a piece of land suitable for human habitation [3,9]. In this regard, Feng Shui is not a superstition because this review identified the validity and practical value of Feng Shui in creating good living environments. Feng Shui later on became more sophisticated because it incorporated many sets of symbolic theoretical systems, such as numerology. This evolution increased the mystery of Feng Shui and may have steered Feng Shui farther away from science [3,9]. Since Feng Shui is not a superstition, nor a science, Needham's [13] description of Feng Shui as "quasi-science" appears appropriate.

4.3. Limitations *(PRISMA 2009 item 25)*

Because of limited human power and resources, we searched only the Chinese and English literature. Other common languages, such as Hindi or Spanish, were not included, which may lead to language bias. Moreover, since this review was concerned with journal articles, gray literature, such as books, conference papers, master's theses, doctoral dissertations, and technical reports, was not included. In addition, the databases of Zhiwang [中国知网] and Airiti [華藝] were not included. Publication bias [8], therefore, may affect our findings. Since we only searched two databases in Chinese and English, respectively, the comprehensiveness of this systematic review is less than ideal, but is acceptable [11]. Among the 36 reviewed articles, only two used experimental methods [37,47] that could infer causality [7], and only one of those used field experiments [47] with better ecological validity than controlled laboratory experiments [16]. Neither was a randomized controlled trial, however, and both exhibited poor research quality (Table A3). The other 34 articles all adopted survey methods [20,21,25–36,38–46,48–58], meaning that no causal relationship could be inferred [7]. In addition, the number of human participants in some studies was too small, less than 30 [25,41,52,54]. Most of the studies with human participants did not provide their basic sociodemographic backgrounds, such as gender, age, ethnicity, and occupation. Some articles focusing on the environment [25,46,48,49,51] and architecture [27,58] used insufficient samples as well. It is also important

to have control groups and to present explicit comparison results. Moreover, although the overall research quality of these articles was slightly above the satisfactory level (50%), the interpretation of their results should be with caution. Finally, the heterogeneity of these 36 articles was too great to conduct a meta-analysis.

4.4. Suggestions

The 36 empirical and quantitative Feng Shui articles constituted only 0.43% of the total of 8319 articles searched. More empirical and quantitative studies on Feng Shui are therefore needed, particularly experiments which can be used to infer causality [7]. Given that Feng Shui is complicated, however, it is very difficult to cover factors of the Luan Tou school and Li Qi school [理氣派] in the experiments, particularly Li Qi factors such as Five Elements [五行], Ba Gua [八掛], Eight Characters [八字], Nine Flying Stars [九星], and Yearly Fortune [流年], which makes it even more difficult to conduct experiments. In addition, if an experiment uses a simulated setting, such as photographs, computer modeling, physical models, or laboratories, the simulated setting may be criticized as lacking actual Feng Shui characteristics, such as Qi, Yin, and Yang [陰陽], and magnetic fields. Field experiments conducted in real-world settings may therefore be more appropriate because of their greater ecological validity [16]. If the most rigorous randomized control trial is not possible, a *de facto* field experiment with control groups, with either within-subject or between-subject comparisons, may be considered. The within-subject design has greater statistical power than the between-subject design, and requires a smaller sample size [62], however.

Moreover, given that the research quality of the reviewed 36 articles was less than ideal, to enhance the quality of future studies, it is recommended that researchers follow the Consolidated Standards of Reporting Trials (CONSORT) [63] for experimental studies, while non-randomized experimental studies follow the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) [64]. Strengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE) [65] is recommended for observational studies. If the study is focused on people, it should report the sociodemographic data of the participants and recruit more non-Asian ethnic groups. In addition to quantitative research, empirical qualitative research on Feng Shui should follow the Standards for Reporting Qualitative Research (SRQR) [66], or the Consolidated Criteria for Reporting Qualitative Research (COREQ) [67].

Finally, it is recommended that both quantitative and qualitative Feng Shui empirical research be conducted by gradually studying the basic or simple factors, such as Qi, dragons, sand, cave, water, and the orientation of the Luan Tou school, which is the original model of Feng Shui [68]. The Luan Tou school focuses on physical, substantial phenomena, such as the topography, streams, soil, vegetation, and climate, whose rational and practical value is easier to understand and examine than the Li Qi school. Based on existing studies, scholars could then further explore more complex Feng Shui factors, such as the Five Elements, Ba Gua, Eight Characters, Nine Flying Star, and Yearly Fortune of the Li Qi school. For now, it is difficult to understand the rational and practical value of the Li Qi school. Similarly, it is recommended to study the immediate or short-term effects of Feng Shui first, before moving on to repetitive/accumulative or long-term effects, which requires examining a dose-response or exposure-outcome relationship. The direct influence of Feng Shui both on people and on environmental factors such as air quality, sunlight, wind environment, negative ions, and magnetic fields, can be measured. As a result, the mechanisms and pathways between these indirect effects of the environment on people can be investigated. The question of whether Feng Shui can show effects across cultures, ethnicities, and geographic environments is also worth exploring. Furthermore, perspectives of beliefs, spirituality, religions, and philosophies may provide reflections of Feng Shui in addition to the aspects of practical value, rational basis, and physical and tangible phenomenon.

5. Conclusions (PRISMA 2009 item 26)

This study is the first to provide a synthesis of the empirical and quantitative findings on the specific outcomes of Feng Shui, along with its reliability and validity. Because of its limitations, such as the small number of studies reviewed, the less than ideal research quality of the reviewed articles, and their low generalizability and causality, the evidence discussed in this study should be interpreted with caution. The strongest evidence was that Feng Shui was related to housing prices in societies influenced by Chinese culture. Other synthesized evidence suggested that: (1) Feng Shui was related to the decisions of house-buyers growing up in societies influenced by Chinese culture; (2) Feng Shui forests had greater habitat diversity than other forests in China; (3) Feng Shui environments in Asia had more comfortable wind fields than non-Feng Shui settings; (4) in Asia, Feng Shui was associated with sunlight; (5) Feng Shui had good reliability; and (6) Feng Shui was valid with respect to environmental characteristics but its influence on humans is inconclusive. The associations of Feng Shui and habitat diversity, ecosystem model, sunlight, wind field, and environmental features demonstrate that Feng Shui influences and shapes human residence [69] and has positive practical value [13] and rational elements [14] for sustainable and comfortable habitation. In this regard, Feng Shui is, therefore, not a superstition, particularly with respect to the Luan Tou school. Whether Feng Shui is capable of securing good fortune and enabling people to avoid ill fortune, particularly with respect to the Li Qi school, however, remains inconclusive. Given this, Feng Shui is not a science. We look forward to more empirical studies of Feng Shui with good research quality in the future, particularly *de facto* field experiments recruiting non-Asian participants to shed further light on the quasi-science of Feng Shui.

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Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article. </p>

Additional information

No additional information is available for this paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table A1
PRISMA 2009 checklist [11].

Section/Topic	Number	Checklist Item	Reported	Note
Title				
Title	1	Determine whether the study is a systematic review, meta-analysis, or both.	Yes	
Abstract				
Structured summary	2	Offer a structured summary including: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; and systematic review registration number.	Yes	
Introduction				
Rationale	3	Report the rationale for the review in the context of what is already known.	Yes Section 1.2.	
Objectives	4	Offer an explicit statement of questions being addressed with respect to participants, interventions, comparisons, outcomes, and study design.	Yes Section 1.3.	
Methods				
Protocol and registration	5	Report whether a review protocol exists, where it can be accessed, and, if available, report registration number.		
Eligibility criteria	6	Describe study characteristics and report characteristics used as criteria for eligibility, giving rationale.	Yes Section 2.1.	
Information sources	7	Report all information sources in the search and date last searched.	Yes Section 2.2.	
Search	8	Report full electronic search strategy for at least one database, reporting any limits used, so that it can be repeated.	Yes Section 2.3.	
Study selection	9	Report the process for selecting studies.	Yes Section 2.4.	
Data collection process	10	Report method of data extraction from reports and any processes for obtaining and confirming data from investigators.	Yes Section 2.5.	

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Table A1 (*continued*)

Section/Topic	Number	Checklist Item	Reported	Note
Data items	11	Report all variables for which data were sought.	Yes Section 2.6.	
Risk of bias in individual studies	12	Report methods used for assessing risk of bias of individual studies.	Yes Section 2.7.	
Summary measures	13	Report the principal summary measures.		MA
Synthesis of results	14	Report the methods of handling data and combining results of studies.		MA
Risk of bias across studies	15	Report any assessment of risk of bias that may affect the cumulative evidence.		MA
Additional analyses	16	Report methods of additional analyses.		MA
Results				
Study selection	17	Report number of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Yes Section 3.1.	
Study characteristics	18	For each study, report characteristics for which data were extracted and offer the citations.	Yes Section 3.2.	
Risk of bias within studies	19	Report data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Yes Section 3.3.	
Results of individual studies	20	For all outcomes considered (benefits or harms), report, for each study.		MA
Synthesis of results	21	Report results of each meta-analysis done.		MA
Risk of bias across studies	22	Report results of any assessment of risk of bias across studies (see Item 15).		MA
Additional analysis	23	Provide results of additional analyses, if done (see Item 16).		MA
Discussion				
Summary of evidence	24	Outline the main findings including the strength of evidence for each main outcome.	Yes Section 4.2.	
Limitations	25	Discuss limitations.	Yes Section 4.3.	
Conclusions	26	Offer a general interpretation of the results in the context of other evidence, and implications for future research.	Yes Section 5.	
Funding				
Funding	27	Report sources of funding for the systematic review and other support.	Yes	

* Meta-analysis (MA).

Table A2
Quality appraisal of the journal articles using the survey method [22].

Authors/Year	Chang, Lee, Hung, Tsai, and Perng, 2009 [34]				Huang and Teng, 2009 [35]				Um, 2009 [36]				Hu, Li, Liao, and Fan, 2011 [38]				Pheng, Xiaopeng, and Ting, 2012 [39]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1. Were the criteria for inclusion in the sample clearly defined?	✓				✓				✓				✓				✓			
2. Were the study subjects and the setting described in detail?	✓				✓				✓				✓				✓			
3. Was the exposure measured in a valid and reliable way?			✓				✓				✓				✓				✓	
4. Were objective, standard criteria used for measurement of the condition?	✓				✓				✓				✓				✓			
5. Were confounding factors identified?			✓				✓				✓				✓				✓	
6. Were strategies to deal with confounding factors stated?			✓				✓		✓						✓				✓	
7. Were the outcomes measured in a valid and reliable way?	✓				✓				✓			✓	✓				✓			
8. Was appropriate statistical analysis used?				✓	✓				✓			✓	✓				✓			
Overall appraisal	4				5				6				5				5			
Percentage	50.0				62.5				75.0				62.5				62.5			
Authors/Year	Han and Lo, 2012 [40]				Hsu, Ho, and Lo, 2012 [41]				Huang, Liu, and Ku, 2012 [42]				Chen, Yuei, and Takakazu, 2014 [43]				Lin and Huang, 2014 [44]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1. Were the criteria for inclusion in the sample clearly defined?	✓				✓				✓				✓				✓			
2. Were the study subjects and the setting described in detail?	✓				✓				✓				✓				✓			
3. Was the exposure measured in a valid and reliable way?			✓				✓				✓				✓				✓	
4. Were objective, standard criteria used for measurement of the condition?	✓				✓				✓				✓				✓			
5. Were confounding factors identified?			✓				✓				✓				✓				✓	
6. Were strategies to deal with confounding factors stated?			✓				✓				✓				✓				✓	
7. Were the outcomes measured in a valid and reliable way?	✓				✓				✓				✓				✓			
8. Was appropriate statistical analysis used?	✓				✓				✓					✓			✓			
Overall appraisal	5				5				5				4				5			
Percentage	62.5				62.5				62.5				50.0				62.5			
Authors/Year	Han, 2015 [21]				Bazley, Vink, Montgomery, and Hedge, 2016 [45]				Yao, Yan, and Wu, 2016 [46]				Chu, Hsu, and Hsieh, 2017 [48]				Wang and Zhang, 2018 [49]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1. Were the criteria for inclusion in the sample clearly defined?	✓				✓				✓				✓				✓			
2. Were the study subjects and the setting described in detail?	✓				✓				✓				✓				✓			

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Table A2 (*continued*)

Authors/Year	Han, 2015 [21]				Bazley, Vink, Montgomery, and Hedge, 2016 [45]				Yao, Yan, and Wu, 2016 [46]				Chu, Hsu, and Hsieh, 2017 [48]				Wang and Zhang, 2018 [49]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
3. Was the exposure measured in a valid and reliable way?			✓				✓				✓				✓				✓	
4. Were objective, standard criteria used for measurement of the condition?	✓				✓				✓				✓				✓			
5. Were confounding factors identified?			✓				✓				✓				✓				✓	
6. Were strategies to deal with confounding factors stated?			✓				✓				✓				✓				✓	
7. Were the outcomes measured in a valid and reliable way?	✓				✓				✓				✓				✓			
8. Was appropriate statistical analysis used?	✓					✓						✓				✓				✓
Overall appraisal	5				4				4				4				4			
Percentage	62.5				50.0				50.0				50.0				50.0			

Authors/Year	Lu, 2018 [50]				Almodovar-Melendo and Cabeza-Lainez, 2018 [51]				Wang, Hong, and Abdul-Rahman, 2018 [52]				Sia, Yew, and Siew, 2018 [53]				Pheng, Gao, and Ang, 2018 [54]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1. Were the criteria for inclusion in the sample clearly defined?	✓				✓				✓				✓				✓			
2. Were the study subjects and the setting described in detail?	✓				✓					✓			✓				✓			
3. Was the exposure measured in a valid and reliable way?			✓				✓				✓				✓				✓	
4. Were objective, standard criteria used for measurement of the condition?	✓				✓					✓			✓				✓			
5. Were confounding factors identified?			✓				✓				✓				✓				✓	
6. Were strategies to deal with confounding factors stated?	✓						✓				✓				✓				✓	
7. Were the outcomes measured in a valid and reliable way?	✓				✓						✓		✓				✓			
8. Was appropriate statistical analysis used?	✓							✓				✓	✓				✓			
Overall appraisal	6				4				1				5				5			
Percentage	75.0				50.0				12.5				62.5				62.5			

Authors/Year	Song, Wilhelmsson, and Zheng, 2019 [55]				Wang, Liu, Dai, Cao, Wang, and Wang, 2019 [56]				Liu, Wang, Gu, Liu, and Zhou, 2018 [57]				Choe and Han, 2019 [58]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1.Were the criteria for inclusion in the sample clearly defined?	✓				✓				✓				✓			
2.Were the study subjects and the setting described in detail?	✓				✓				✓				✓			
3.Was the exposure measured in a valid and reliable way?			✓				✓				✓				✓	
4.Were objective, standard criteria used for measurement of the condition?	✓				✓				✓				✓			
5.Were confounding factors identified?			✓				✓				✓				✓	
6.Were strategies to deal with confounding factors stated?	✓						✓		✓						✓	
7.Were the outcomes measured in a valid and reliable way?	✓				✓				✓				✓			
8.Was appropriate statistical analysis used?	✓				✓				✓				✓			
Overall appraisal	6				5				6				5			
Percentage	75.0				62.5				75.0				62.5			

Table A3
Quality appraisal of the journal articles using the experimental method [23].

Authors/Year	Wang, Lin, and Chang, 2011 [37]				Charles, Glover, Bauchmüller, and Wood, 2017 [47]			
Evaluation items	**Yes**	**No**	**Unclear**	**NA**	**Yes**	**No**	**Unclear**	**NA**
1. Was true randomization used for assignment of participants to treatment groups?				✓		✓		
2. Was allocation to treatment groups concealed?				✓	✓			
3. Were treatment groups similar at the baseline?			✓				✓	
4. Were participants blind to treatment assignment?			✓		✓			
5. Were those delivering treatment blind to treatment assignment?			✓				✓	
6. Were outcomes assessors blind to treatment assignment?			✓				✓	
7. Were treatment groups treated identically other than the intervention of interest?			✓		✓			
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?		✓					✓	
9. Were participants analyzed in the groups to which they were randomized?				✓		✓		
10. Were outcomes measured in the same way for treatment groups?	✓				✓			
11. Were outcomes measured in a reliable way?	✓				✓			
12. Was appropriate statistical analysis used?	✓				✓			
13.Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	✓						✓	
Overall appraisal	4				5			
Percentage	30.77				46.1			

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