Berkala Ilmu Kesehatan Kulit dan Kelamin

Original Article **Periodical of Dermatology and Venereology**

Research Trend of Studies Regarding the Change and Treatment of the Skin on Pregnant Women in the Last Decade: A Systematic Review and Bibliometric Analysis

Agnes Nauli[1], Dina Arwina Dalimunthe[2] iD

[1]*Resident of Dermatology, Venereology and Aesthetic, Faculty of Medicine, Universitas Sumatera Utara, Prof. dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Medan - Indonesia*

[2]*Department of Dermatology, Venereology and Aesthetic, Faculty of Medicine, Universitas Sumatera Utara, Prof. dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Medan - Indonesia*

ABSTRACT

Background: The number of publications related to the change and treatment of the skin in pregnant women in the last decade has significantly grown. To date, however, a study offering comprehensive information related to the change and treatment of the skin in pregnant women has not been conducted or found in an electronic journal or proceeding. The purpose of this study is to present a bibliographic and bibliometric review of the numerous documents studying the skin of pregnant women. **Methods:** A systematic review involving bibliometric analysis with quantitative method was performed to carry out this study, which 198 eligible documents from the Scopus database published in the period of 2013–2022 were used as research materials. **Result:** Results revealed that the publication and development of studies related to the change and treatment of the skin in pregnant women slightly soared from 2013 until 2022. Meanwhile, the citation development of the studies regarding the change and treatment of the skin in pregnant women tended to moderately decrease between 2013 and 2022. Additionally, influential documents, authors, countries, affiliations, and sources contributed to the development of studies related to the change and treatment of the skin in pregnant women. **Discussion:** In particular, this study informs us that the publication and development of studies related to the change and treatment of the skin in pregnant women slightly soared from 2013 until 2022. Most pregnant women undergo a skin change. This study implies that women must treat a skin change when they are pregnant.

Keywords: Bibliometric Analysis, Pregnant Women, Scopus, Systematic Review, Visualization.

Correspondence: Dina Arwina Dalimunthe, Department of Dermatology, Venereology and Aesthetic, Faculty of Medicine, Universitas Sumatera Utara, Prof. dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Medan, dina.arwina@usu.ac.id, Phone : +6282163732580.

BACKGROUND

Pregnancy is a period associated with various changes, such as endocrine, metabolic, immunological, and vascular, that are intensive in a woman's body. Changes in pregnancy have a significant effect on women.[1] Hormone levels increase intravascular volume, and comp

ression from the enlarging uterus underlies complex physiological adaptations that are important for fetal development. One of the hormonal changes such as estrogen, progesterone, prolactin, β-HCG, metabolism of proteins, lipids, and carbohydrates, as well as changes in adaptive immunity, cause skin problems in women.[2]

Skin problems that often occur in pregnant and lactating women include pigmentation of hair, nails, glands, connective tissue, and blood vessels. The most common skin lesion is hyperpigmentation, which affects up to 90% of pregnant women and even more in

darker skin types.[2-4] Rashes and skin changes are very common during pregnancy. Due to the specific mental and emotional state of the expectant mother, these changes may give rise to concerns that may be related to appearance, possible recurrence in future pregnancies, potential effects on the fetus, or a combination of these. Several skin diseases are specifically associated with pregnancy.[5]

There are various complex physiological changes in the skin of pregnant women, and it is important to be able to differentiate normal changes from pathological changes to avoid unnecessary testing and stress for the patient.[6] Many of these changes diminish or resolve postpartum. Examples of skin changes that occur during pregnancy such as hyperpigmentation, melasma, striae distensae (striae gravidarum), spider angiomata, palmar erythema, and granuloma gravidarum.[4,6] To recognize these skin changes, a review study is needed that discusses how skin changes in pregnant and lactating women. Bibliometric analysis is a suitable method quantitative to provide an overview of research trends in skin changes in pregnant and lactating women.

Several literature studies related to pregnant and lactating women, for example, the literature review: *complementary therapy to reduce nausea and vomiting during pregnancy,*[7] effect of aromatherapy on nausea and vomiting in pregnant women (systematic review),[8] and a diagnostic pitfall in an atypical febrile presentation in a patient with a pregnancy-specific dermatosis—case report and literature review.[9] Literature research related to changes in pregnant women only, such as *physiologic changes of pregnanc*y: A review of the literature stated that most clinicians recognize the changes that are usually described in the literature, such as 2ulfil2gmentation, melasma, striae gravidarum, and telogen effluvium.[4] However, paramedics may not be aware of changes that tend to be rarely discussed. This comprehensive review provides a broad overview of the physiological changes that occur during pregnancy, as described in the literature over the past 10 years. This research will look specifically at how the skin changes in pregnant and lactating women using the bibliometric quantitative method, where the source comes from articles indexed by Scopus for the last 10 years, which is of course different from the research conducted by Motosko et al.,[4] which examines changes in pregnant women with the literature review method only.

METHODS

To present and inform a bibliographic and bibliometric review wuth quantitative of a lot of relevant literature related to the change and treatment of the skin in pregnant women published in the last decade, a systematic literature review using bibliometric analysis was performed. Donthu et al.[10] stated that bibliometric analysis helps identify knowledge gaps and find research novelty in a certain scientific field. A few articles in the literature proposed that there were five steps in conducting bibliometric analysis: (1) specifying the search keyword, (2) exploring initial search results, (3) refining the documents, (4) compiling the initially statistical data, and (5) analyzing the data.[11,12] In detail, each step in carrying out the bibliometric analysis in this study was explained in the following subsections.

The Scopus database was used for the documents that studied the change and treatment of the skin in pregnant women. Some literature revealed that the Scopus database has a lot of electronically well-qualified scientific papers from numerous scientific keywords.[13–15] To find prospective documents that were suitable to the topic of the change and treatment of the skin in pregnant women, a certain keyword was established, a which was "skin", "pregnancy" and "women". The search process for documents in the Scopus database using these keywords was conducted on February 27th, 2023, particularly on 6.25 PM at Western Indonesian Time.

The initial search process using the keyword "skin AND pregnancy AND women" found 847 documents consisting of articles, book chapters, conference papers, reviews, editorials, books, notes, short surveys, and letters. The documents were published in the period of 1866–2023, during in which most of the documents had been published by the publishers and some documents still had the status of being in press. Furthermore, the documents were written in a few languages, such as English, Chinese, Japanese, Portuguese, French, and Russian. Moreover, the documents were found from various sources, such as journals, books, conference proceedings, and book series.

To acquire the documents which was suitable to the topic of the change and treatment of the skin on pregnant women, they had to be refined by considering the established inclusion criteria. There were several inclusion criteria for this systematic literature study. Firstly, the document was published in the period of 2013 – 2022. Secondly, the document was only written in English. Thirdly, the document was only obtained

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from the journal. Fourthly, the type of document was only an article. Fifthly, the publication stage status of the document was in final. The documents that did not the inclusion criteria were excluded from this study. A few of literatures stated that there were four stages to systemic: (1) identification, (2) screening, (3) eligibility, and (4) inclusion.[16-18] The systematic process of document refinement presented in Figure 1.

The eligible documents were downloaded from the Scopus database in some formats, such as Comma Separated Values (CSV) and Research Information System (RIS). Muhammad et al.[12] argued that the

formats contain several essential pieces of information such as bibliographical information, abstracts and keywords, and bibliometric information. Moreover, the data presentation in RIS format utilizing the software of Perish or Publish (PoP) could provide the raw statistics data such as the number of document citations, author names, document titles, publication years, document sources, publishers, and document types.[11] Additionally, the appearance of the PoP software presented the descriptive analysis summary, such as the total of publications (TP), the total of citations (TC), the number of citations per year (NCY),
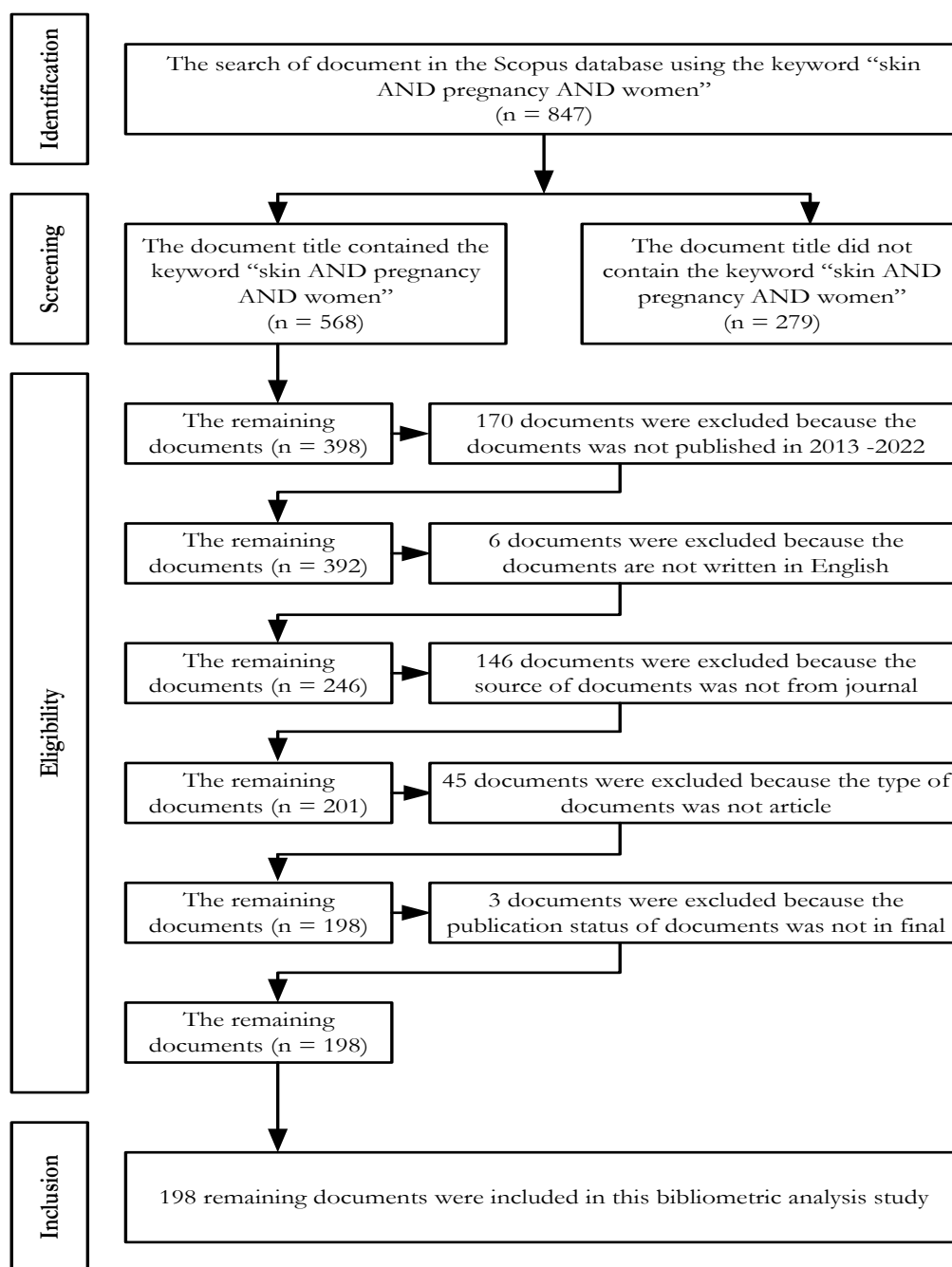

Figure 1. The refinement process of documents.

the number of citations per publication (NCP), the number of authors per publication (NAP), the h-index, g-index, and the period of publication and citation years.[12] Meanwhile, the data presentation in CSV format utilizing the software of VOSviewer could display the most numerous publications and citations viewed from the units of document, author, country, source, and institution. Moreover, the appearance of VOSviewer software presented the keyword occurrence, total strength link, some visualizations, and clustering.[11]

There were some analyses used to analyse the data in this study, such as performance analysis, science mapping, and network analysis.[10] Moreover, Donthu et al.[10] itemized that science mapping consists of citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis, while network analysis consists of network metrics, clustering, and visualization.[8] To present the development of publication and citation of the studies of the change and treatment of the skin in pregnant women in the last decade, performance analysis was used, which was supported by PoP software in analysing the data. In addition, the citation analysis was performed to present the most influential documents, countries, authors, institutions, and sources related to the researches on the change and treatment of the skin in pregnant women. Moreover, the co-word analysis

was used to map the forms of the change and treatment of the skin in pregnant women by visualizing the most frequently appearing keywords related to the researches on the change and treatment of the skin in pregnant women and this analysis was enriched by visualization analysis and hierarchical clustering analysis.[9] Then, to visualize the social interactions among authors, author's countries, and author's institutions regarding the researches on the change and treatment of the skin in pregnant women, the co-authorship analysis was performed, in which this analysis was enriched by the network visualization analysis. Some analyses, uch as citation analysis, co-word analysis, and co-authorship analysis, were supported by VOSviewer software.[18]

RESULT

The results of the following data analysis outputs present the trend of studies related to the change and treatment of the skin in pregnant women, consisting of performance analysis, citation analysis, co-word analysis, and co-authorship analysis.

Performance analysis was performed to present the development of publication and citation of studies regarding the change and treatment of the skin in pregnant women in the period of 2013 – 2022. The publication and citation reports of coastal livelihood system studies are presented in Figure 2.
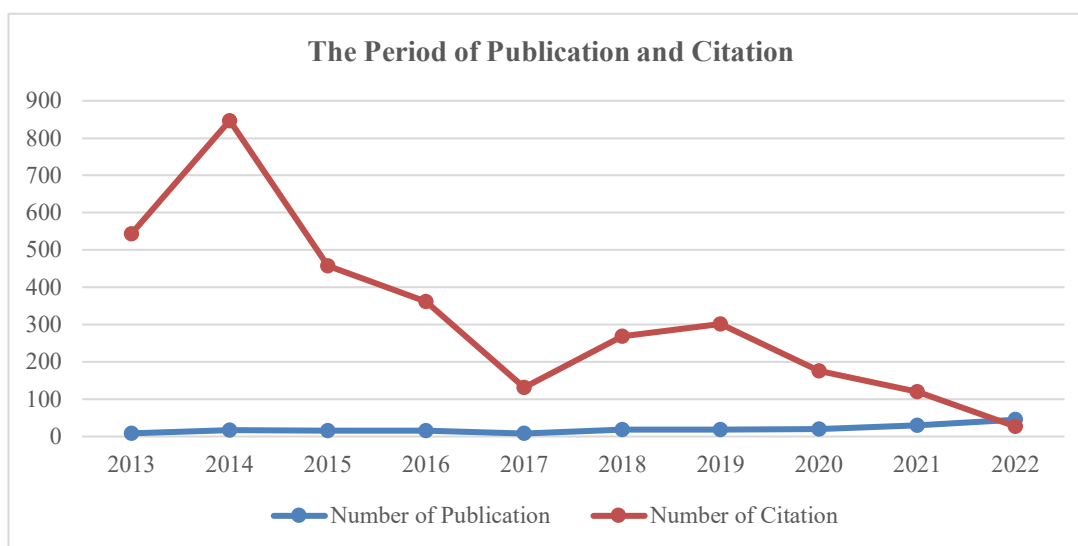

Figure 2. Publication and citation report of studies regarding the change and treatment of the skin on pregnant women.

Figure 2 shows that of the 198 eligible documents involved in this study, nine were published in 2013, followed by seventeen in 2014, sixteen in 2015 and 2016, eight in 2017, eighteen in 2018, nineteen in 2019, twenty in 2020, thirty in 2021, and forty-five in 2022. This report shows that the publication and development

of studies related to the change and treatment of the skin in pregnant women slightly soared from 2013 until 2022. Some literature also reported that the publication of studies related to complement therapy to reduce nausea and vomiting during pregnancy sharply increased in the period 2007–2017.[7,8] Meanwhile, of

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the 3,249 citations on those documents, there were 544 citations in documents in 2013, followed by 847 citations in 2014, 457 citations in 2015, 362 citations, 301 citations in 2019, 176 citations in 2020, 120 citations in 2021, and 27 citations in 2022. This report shows that the citation development of studies regarding the change and treatment of the skin in pregnant women tends to moderately decrease between 2013 and 2022. Motosko et al.[4] also revealed that the development of citations of studies related to the psychologic changes of pregnant women tended to fall from 2000 to 2016. Citation analysis was performed to present the most influential documents, countries, authors, institutions, and sources related to the researches in the change and treatment of the skin on pregnant women.

Table 1. The top five most cited documents on the skin of pregnant women

No	Title	Author	Source	Citation	Year
1	"Skin changes during pregnancy. Is that an important issue for pregnant women?"	Spalding et al	*Ginekologia Polska*	331	2014
2	"Effects of pregnancy on skin properties: A biomechanical approach"	Orencio & Fujii	*Skin Research and Technology*	157	2013
3	"Recurrent acral angioosteoma cutis in a pregnant patient"	Islam et al	*JAAD Case Reports*	146	2014
4	"Study on the skin status of mid-pregnancy women based on lipidomics"	Nunn	*Journal of Cosmetic Dermatology*	94	2013
5	"Fetal nuchal skin-fold thickness during the 2nd trimester of pregnancy"	Sudha et al	*Journal of Obstetrics and Gynaecology Research*	93	2015

Firstly, the top five most influential documents from studies regarding the change and treatment of the skin in pregnant women are shown in Table 1.

Table 1 shows that the document entitled "Skin changes during pregnancy. Is that an important issue for pregnant women?" was the most influential document studying the skin of pregnant women. The document written by Spalding et al. as published by Ginekologia Polska in 2014, and to date, it has been cited as many as 331 times. This shows that the number of citations per year on the document was stated to be 36.78, which it means that the document is cited an average of nearly 37 times every year from 2014 into 2022. Some documents with numerous citations studied complementary therapy to reduce nausea and vomiting during pregnancy,[7] the effect of aromatherapy on nausea and vomiting in pregnant women,[8] and the psychologic changes in pregnant women.[4] This shows that these documents have made the most contribution to the changes in pregnant women.

Secondly, the top five most influential authors who wrote the documents related to the studies of the skin of pregnant women are shown in Table 2. Table 2 shows that Islam, M. M., was the most productive author having published five documents related to the studies of the skin of pregnant women. The authors is affiliated with the University of Leeds, United Kingdom.

Table 2. The top five most cited authors of studies regarding the skin of pregnant women

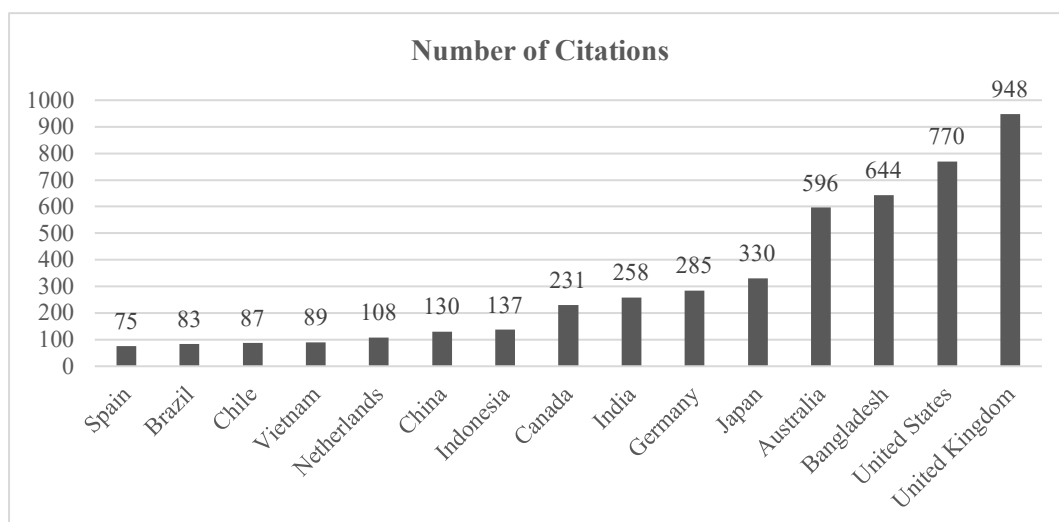| Author	Total Citation	Organization
Lacambra, C	333	University of Cambridge
Beck, M. W	331	University of California
Hale, L. Z	331	Harvard University
Meliane, I	331	Tokyo University
Ruffo, S	331	Auckland University

Figure 3. The top 15 most influential countries regarding the studies of of the skin of pregnant women.

In the period of 2013 – 2022, the document authorized by Lacambra, C., had been cited as many as 333 times by other relevant documents. This shows that the number of citations per year on the document written by Lacambra, C., was stated to be 33.3 which means that the document authorized by Lacambra, C., is cited an average of nearly 34 times every year between 2013 and 2022. Thirdly, the top fifteen most influential countries regarding studies of the skin of pregnant women are presented in Figure 3.

Figure 3 shows that the United Kingdom was the most influential country on the studies related to the change and treatment of the skin in pregnant women, in which the documents published by the country had been cited as many as 948 times by other relevant documents. However, the United Stated was the most influential country in the studies regarding complementary therapy to reduce nausea and vomiting during the pregnancy.[7]

Fourthly, the top five most influential sources on studies of the change and treatment of the skin in pregnant women are shown in Table 3. Table 3 shows that Tropical Medicine and International Health was the most influential source in the studies related to the change and treatment of the skin in pregnant women. The documents published by the source of Tropical Medicine and International Health had been cited as many as 653 times in other relevant documents.

Moreover, Motosko et al.[4] also reported that Tropical Medicine and International Health was the most influential source in the studies related to the psychologic changes of pregnant women. Fifthly, the top ten most influential institutions regarding studies of the change and treatment of the skin in pregnant women are presented in Figure 4. Figure 4 shows that Global Marine Team, located Kingdom was the most influential institution in the studies of the change and treatment of the skin in pregnant women. The documents published by Global Marine Team had been cited as many as 331 times in other relevant documents.

Table 3. The top five most influential sources on the skin of pregnant women

Source	Number of Citations	Journal Quartile Ranking
Tropical Medicine and International Health	653	Q1
Acta Medica Iranica	171	Q1
Journal of Emergency Medicine	159	Q1
Obstetric Medicine	158	Q1
Minerva Ginecologica	140	Q1

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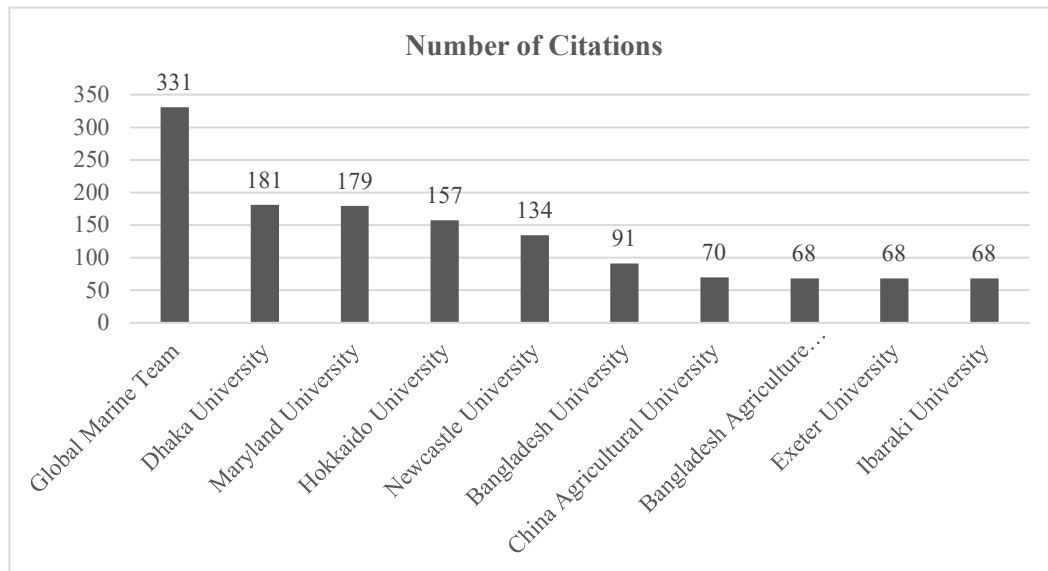on Pregnant Women in the Last Decade: A Systematic Review and Bibliometric Analysis

Figure 4. The top 10 most influential institutions in the studies of skin of pregnant women.

A Co-authorship analysis was performed to visualize the social interactions among authors, and the author's countries regarding the researches on the change and treatment of the skin in pregnant women. Firstly, the visualization of social interactions among authors is presented in Figure 5, in which there were 35 interconnected authors who emerged by selecting the minimum number of documents of an author as many as one document and the minimum number of citations of an author as many as no citation.
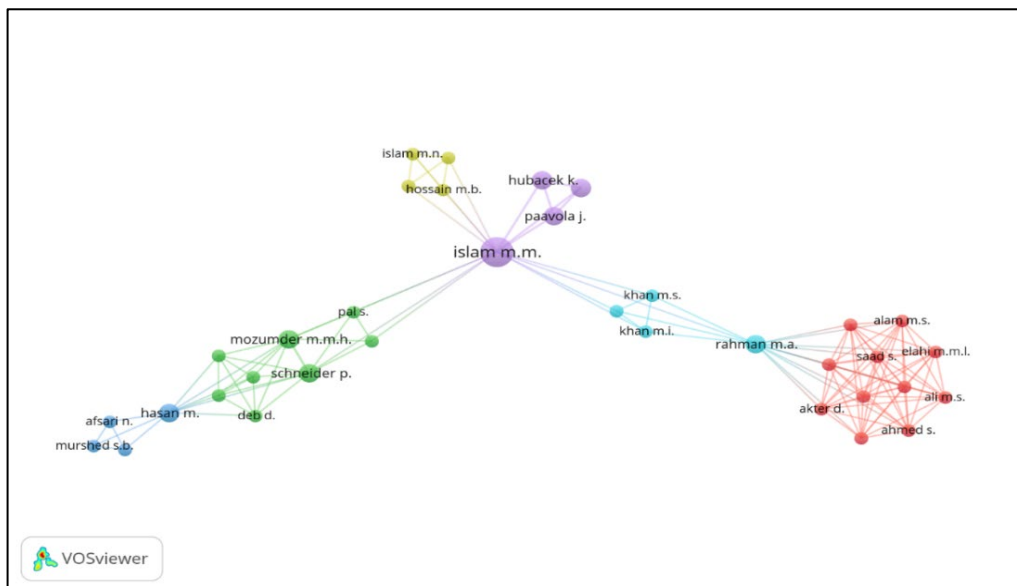

Figure 5. The social interactions among authors on the studies of the skin of pregnant women.

Figure 5 shows that 35 interconnected authors were grouped into six clusters such as red, green, purple, yellow, blue, and blue sky. In particular, the red cluster consisted of Ahmed, D., Akter, D., Alam, M. S., Ali, M. S., Elahi, M. M. L., Ishtiak, T., Jakariya, M., Khan, A. M. S., Saad, S., Sayem, S. M., and Tamim, H. M. Additionally, the green cluster consisted of Ahmed, T., Deb, D., Hossain, M. M., Mim, S. S., Mozumder, M. M. H., Pal, S., Schneider, P., and Uddin, M. M. Furthermore, the blue cluster consisted of Afsari, N., Hasan, M., Murshed, S. B., and Uddin, S. M. N. Moreover, the yellow cluster consisted of Hossain, M. B., Islam, M. N., Islam, M. T., and Islam, R. In addition, the purple cluster consisted of Hubacek, K., Islam, M. M., Paavola, J., and Sallu, S. Then, the blue-sky cluster consisted of Khan, M. I., Khan, M. S., Mondal, G., and Rahman, M. A.

Secondly, the visualization of social interactions among authors' countries is presented in Figure 6, in which there were 26 interconnected

authors' countries, which emerged by selecting the minimum number of documents of a country as many

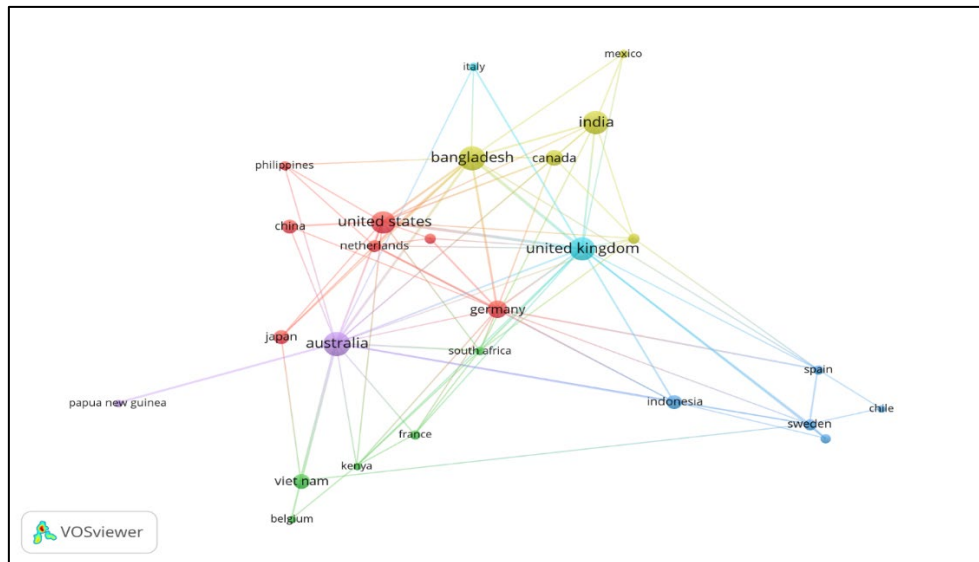as three documents and the minimum number of citations of a country as many as no citation.

Figure 6. The social interactions among authors' countries on the studies of the skin of pregnant women.

Some countries in the green cluster, such as Italy, the United States, China, and the United Kingdom are commonly connected. Motosko et al.[4] also revealed that some countries in Europe, America, and Asia are commonly linked to each other in studies related to the psychologic changes of pregnant women. Additionally, several countries in the red cluster, such as India, Spain, and the Russian Federation are also commonly connected. A literature review also reported that some countries in Europe and Asia commonly liked each other in carrying out studies regarding the complementary therapy to reduce nausea and vomiting during the pregnancy.[7] Moreover, several countries in Europe and Asia are also commonly linked to each

other in performing the studies related to the effect of aromatherapy on nausea and vomiting in pregnant women.[8] Overall, some countries in each cluster are commonly linked to each other in conducting the studies regarding the change and treatment of the skin in pregnant women.

A Co-word analysis was performed to map the change and treatment of the skin in pregnant women by visualizing the most frequently appearing keywords related to the studies of the skin in pregnant women. By selecting the minimum number of occurrences of a keyword, as many as 129 occurrences emerged, resulting in, 45 interconnected keywords. (see Figure 7).
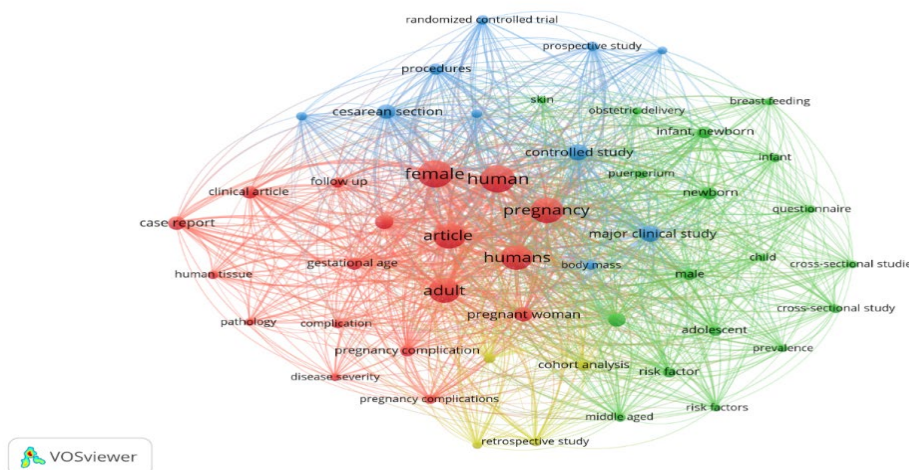

Figure 7. The network visualization of the emerging keywords on the skin of pregnant women.

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Figure 7 presents that 45 emergently interconnected keywords related to the studies of the change and treatment of the skin on pregnant women were grouped to eleven clusters such as red, green, yellow, and blue. Moreover, the hierarchical clustering analysis was performed to show the frequency of each keyword on the change and treatment of the skin on pregnant women (See Table 4).

Table 4. The hierarchical clustering analysis of keywords on the skin of pregnant women

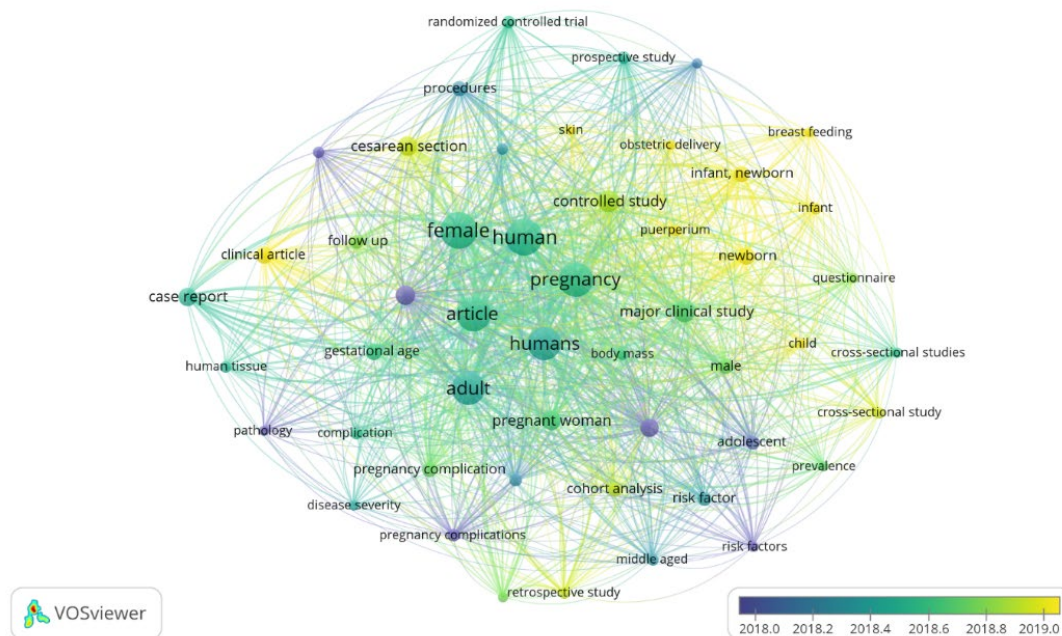| Cluster	Keyword	Frequency	Total Link Strength
Red	Adult	8	24
	Article	6	8
	Case Report	5	7
	Clinical Article	3	3
	Complication	3	9
	Disease Severity	2	25
	Female	2	7
	Follow Up	2	5
	Gestational Age	2	4
	Human Tissue	2	4
	Pathology	2	2
	Pregnancy	2	2
	Pregnancy Complication	2	2
	Pregnant Women	2	2
	Priority Journal	2	2
Green	Adolescent	10	27
	Breast Feeding	5	9
	Child	4	13
	Cross-Sectional Study	3	8
	Infant	3	3
	New Born	2	8
	Male	2	7
	Middle Aged	2	6
	Obstetric Delivery	2	6
	Prevalence	2	5
	Puerperium	2	5
	Questionnaire	2	3
	Risk Factor	2	3
	Skin	2	2
	Young Adult	2	2
Blue	Body Mass	11	22
	Caesarean Section	6	13
	Controlled Study	3	11
	Major Clinical Study	3	8
	Outcome Assessment	2	5
	Procedures	2	4
	Perspective Study	2	4
	Treatment Outcome	2	4
Yellow	Cohort Analysis	7	16
	Pregnancy Outcome	3	6
	Retrospective Study	2	8

Figure 8. The overlay visualization of the emerging keywords on the skin of pregnant women

In addition, this analysis was also used to present the current trends of the studies related to the change and treatment of the skin in pregnant women by distributing the frequently emerging keywords in the period of 2013 – 2022 (see Figure 8).

Figure 8 presents that there were some keywords related to the change and treatment of the skin in pregnant women that emerged in the current period, such as "skin", "clinical article", "infant", "breast feeding", "child", "puerperium", "new born", "cross-sectional study", and "obstetric delivery". This shows that these keywords represent the recent research trends of the studies regarding the change and treatment of the skin in pregnant women.

DISCUSSION

Generally, this study provides a bibliometric and bibliographic review of the large scientific documents related to the change and treatment of the skin in pregnant women. In particular, this study informs us that the publication and development of studies related to the change and treatment of the skin in pregnant women slightly soared from 2013 until 2022. Meanwhile, the citation development in studies regarding the change and treatment of the skin in pregnant women tends to moderately decrease between 2013 and 2022. Furthermore, the document entitled "Skin changes during pregnancy. Is that an important issue for pregnant women?" is the most influential document studying the skin of pregnant women, which was published in Ginekologia Polska in 2014 is written

by Spalding et al. and has been cited as many as 331 times by other relevant documents.

Lacambra, C., an author affiliated in Cambridge University, the United Kingdom is the most influential author, and the documents authorized by Lacambra, C., have been cited as many as 333 times in the period of 2013 – 2022. Additionally, the United Kingdom is the most influential country on studies related to the change and treatment of the skin in pregnant women, and the documents published by the country have been cited as many as 948 times. Then, Tropical Medicine and International Health is the most influential source on the studies related to the change and treatment of the skin in pregnant women, in which the documents published by the source of Tropical Medicine and International Health have been cited as many as 653 times. In addition, Global Marine Team, located in the United Kingdom is the most influential institution in studies of the change and treatment of the skin in pregnant women, the documents published by Global Marine Team have been cited as many as 331 times.

Apart from being the most productive author who has published five documents, Islam, M. M., is also the leading author who generates the networking research regarding the change and treatment of the skin on pregnant women. In addition, Rahman, M. A., an author affiliated with North South University, Bangladesh, and Hasan, M., an author affiliated with Bangladesh University of Engineering and Technology, are also the leading authors building the networking studies related to the change and treatment of the skin in pregnant women. Furthermore, the social interactions among the authors' countries show that

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United Kingdom, the United States, Australia, India, and Bangladesh are the leading maker sof the research network studying the change and treatment of the skin in pregnant women. Moreover, Tasmania University, located in Australia, becomes a central institution connecting many institutions in the world to conduct studies related to the change and treatment of the skin in pregnant women.

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