

Research Article

Bibliometric Analysis of the Utilisation of FINDRISC in Patients with Diabetes: 2005-2021

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Abstract

Research on risk factors for diabetes (DM) is growing. Identification of these risk factors aims to prevent DM as early as possible. This study intends to identify the utilization of the Finnish diabetes risk score (FINDRISC) and its development using bibliometric analysis. The keywords "FINDRISC AND Diabetes" were used to search for articles published in 2005-2021 in PubMed. A total of 249 articles were analyzed based on the number of publications per year, journals that publish the papers, number of publications by author and year of publication, number of publications by affiliation and year of publication, number of publications by country of origin of authors and year of publication, number of keywords, number of citations, types of articles, specific topics, and theme mapping. The data visualization was obtained from the Scopus database and the VOSviewer and Biblioshiny applications. Despite the increase in publications, the number of publications on FINDRISC in DM patients is still very few per year, with 92.8% being the primary study. Based on clusters of the country of origin, publications are still dominated by researchers from countries in the European region, and the researchers intensely relate to each other through citations. Research themes related to FINDRISC are not limited to DM risk factors. This study is the first study of a bibliometric analysis of the utilization of FINDRISC in DM patients. The analysis results can be used to evaluate existing research gaps and identify future research opportunities.

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INTRODUCTION

The International Diabetes Federation estimates that there has been an increase in the number of people with diabetes by 21% between 2013 and 2019^{1,2}. The number of people with diabetes is estimated to be 463 million in 2019 and will increase to 700 million by 2045. It is estimated that 50.1% of people with diabetes are still undetected³. In addition, people with prediabetes as a high-risk group for developing diabetes usually go undetected clinically⁴. Improper and late intervention in this group will cause prediabetes to develop progressively into type 2 diabetes mellitus within 2-3 years, which in 70% of patients will remain throughout their lives⁵. Diabetes mellitus will burden patients, families, and the health care system⁶.

A systematic review and meta-analysis have discovered that lifestyle change interventions such as exercise, weight loss, and dietary management can prevent prediabetes and even slow the progression of type 2 diabetes⁷. Identification of individuals with prediabetes in the population is essential. However, prediabetes is difficult to trace because it is asymptomatic. Therefore, an instrument is needed to identify individuals with a high risk of developing type 2 diabetes so that lifestyle change interventions can be more targeted⁸.

The Finnish diabetes risk score (FINDRISC) is an instrument in the form of a questionnaire aimed at identifying individuals with a high risk of developing diabetes⁹. The question items in this instrument are a set of the main risk factors for type 2 diabetes. Initially, this instrument was developed to detect the risk of diabetes in the next ten years in the Caucasian population. However, this instrument has been translated, adapted, and validated over time so it can be applied to other populations, such as Asian populations¹⁰⁻¹². Several other studies have also compared the performance of the original version of FINDRISC with the simplified version of FINDRISC^{13,14}.

A study showed that FINDRISC could screen individuals at high risk of developing type 2 diabetes and that lifestyle intervention for these individuals effectively treats their obesity, one of the risk factors for type 2 diabetes¹⁵. In addition to its ability to identify individuals at high risk of developing diabetes, several studies have also evaluated the ability of FINDRISC to detect individuals with undiagnosed type 2 diabetes, the presence of impaired glucose tolerance, and the risk of developing metabolic syndrome¹⁶⁻¹⁸. Individuals with higher FINDRISC are also associated with a decreased quality of life¹⁹. No studies precisely quantify the development of research trends toward the FINDRISC instrument. Bibliometric analysis can be used for this purpose and has been widely used in many disciplines to observe research trends on a particular topic, population, or region. It can also be used to identify the potential for future research development. Therefore, this study aimed to identify the utilization of the FINDRISC using bibliometric analysis.

MATERIALS AND METHODS

Bibliometric analysis was performed by conducting a literature search on PubMed and Scopus with the keywords: "FINDRISC" AND "Diabetes". A total of 249 articles were obtained and analyzed based on the number of publications per year, journals that publish the articles, number of publications by author and year of publication, number of publications based on affiliation and year of publication, number of publications by country of origin and year of publication, number of keywords per year, number of citations per year, types of articles, specific topics, and theme mapping. The data visualization was obtained from the Scopus database with the VOSviewer and Biblioshiny applications.

Data analysis and visualization

The data in the Scopus database are visualized automatically. In contrast, we used VOSviewer and Biblioshiny to show data from the PubMed database. Only four of the 11 figures in this article are obtained from Scopus, notably **Figures 1, 2, 8, and 9**. We used VOSviewer/Biblioshiny to visualize the rest of the data from PubMed.

RESULTS AND DISCUSSION

From the literature search on PubMed and Scopus, the same 249 articles were obtained, with the annual distribution shown in **Figure 1**. Despite the increase in the number of publications, the number of publications on the topic of FINDRISC in patients with diabetes mellitus is still very few per year, where every year, only less than 35 articles are published. The highest number of published articles, 34 articles, was in 2020.

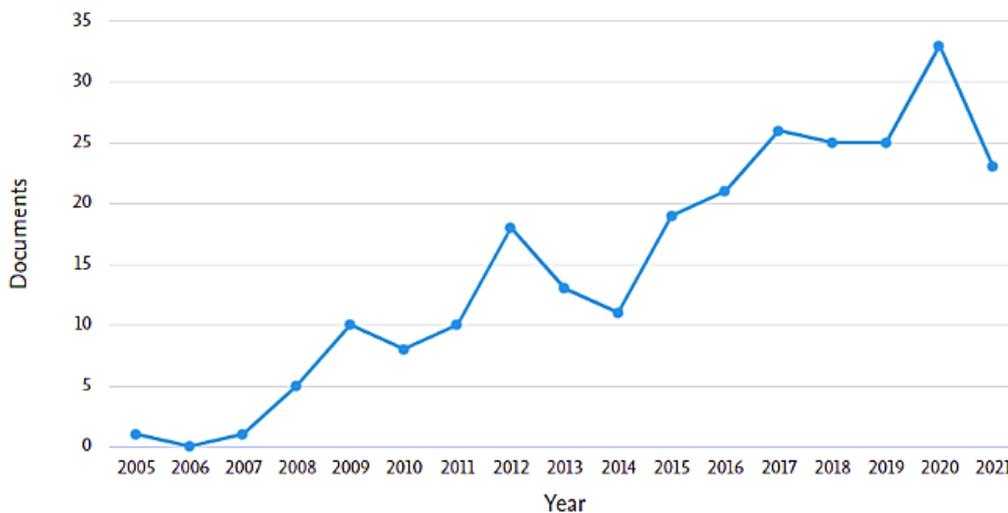


Figure 1. Number of articles on the topics of FINDRISC and diabetes for the period 2005-2021.

A bibliometric analysis of the number of publications related to the utilization of FINDRISC in patients with diabetes revealed an increasing trend since 2005. The overview of publication productivity based on country clusters showed that those researchers from European countries still dominate publications. This situation is likely because the FINDRISC instrument was first developed in a population at high risk of developing diabetes in Finland^{20,21}. In 2003, a new Diabetes Risk Screening program was started in Finland, with the development of an instrument called the Diabetes Risk Score instrument. Furthermore, the first publication discussing this topic was in 2005²². This finding is in line with the Word Cloud analysis (**Figure 10**), which shows that the word "Finland" is the word with the highest frequency of occurrence.

Figure 2 shows the journals that published articles related to FINDRISC and diabetes from 2005-2021. PLoS One was the journal that published the most articles on this topic in 2016. In 2021, Diabetes Research and Clinical Practice and Primary Care Diabetes published three articles on FINDRISC and diabetes. Research topics regarding FINDRISC and diabetes still have the potential to be explored, as evidenced by PLoS One publishing many articles related to FINDRISC and diabetes.

Figure 3 displays the authors of articles related to FINDRISC and diabetes based on the year of publication and the number of publications. There are eight clusters of authors of articles that are also related to each other. The number of relationships between authors is 344. The authors with yellow circles are included in the latest publication cluster, although the number of published articles is still limited. Tuomilehto was the author with the most publications around 2012-2016, followed by Lindstrom at the same time range.

Figure 4 displays the number of articles by institutional affiliation of the author and year of publication. There are 10 relations between institutions to which the authors are affiliated, and these institutions are divided into three clusters based on the year of publication. Research in 2018 was conducted mainly by the Diabetes Research Group, Dasman Diabetes Institute, and the Department of Chronic Disease. The institution that conducted the most extended years of research was the National Institute for Health.

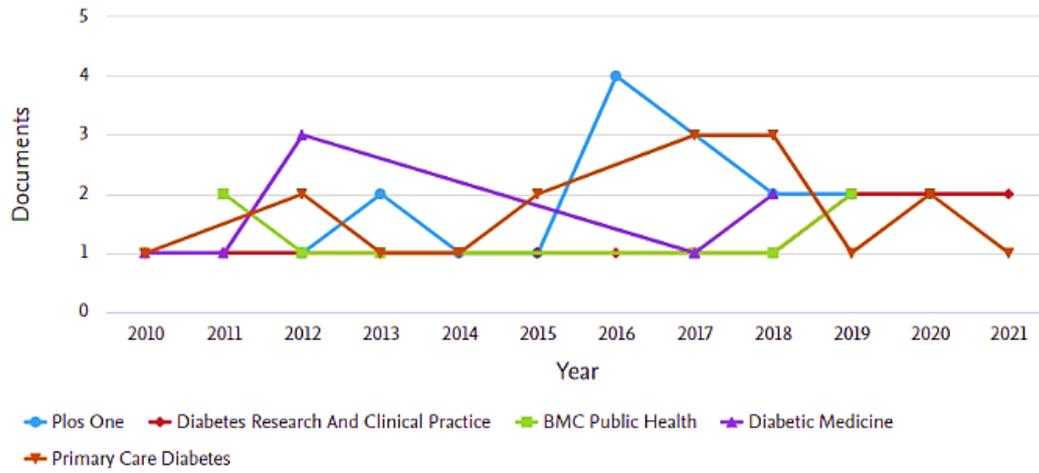


Figure 2. Number of published articles related to FINDRISC and diabetes by journal.

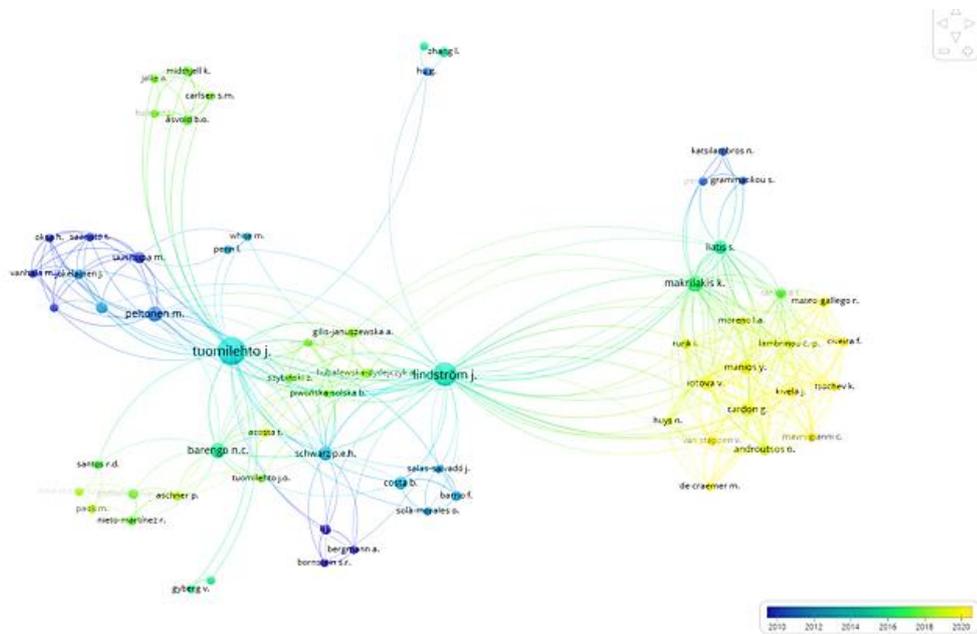


Figure 3. Number of publications on the topics of FINDRISC and diabetes for the period 2005-2021 by author and year of publication.

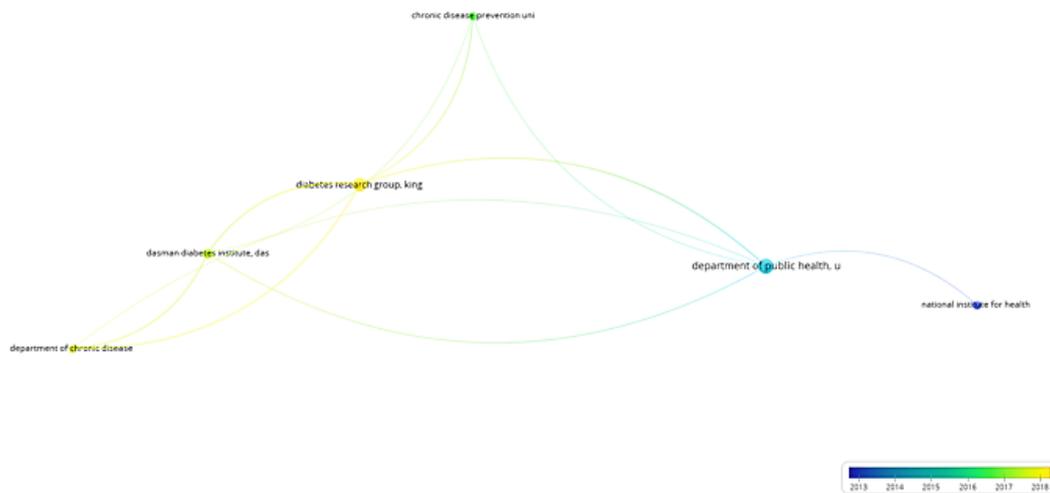


Figure 4. Number of articles with FINDRISC and diabetes topics in publications for the period 2005-2021 by author affiliation and year of publication.

Figure 5 shows the number of articles by country of origin of the author and year of publication. There are five clusters of countries involved based on the year of publication, with 111 relationships with each other. Recent publications have been by authors from Saudi Arabia, Brazil, Venezuela, Greece, Belgium, and Colombia, although the number of publications is still relatively small. Most publications were by authors from Finland in 2015. This is understandable because FINDRISC originates from Finland.

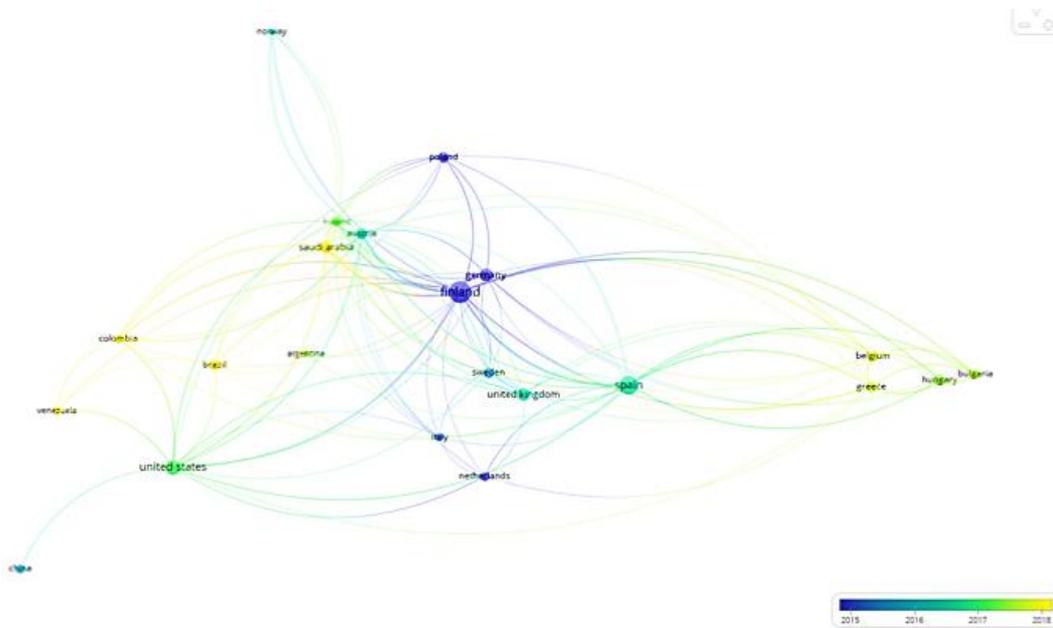


Figure 5. Mapping of publications with FINDRISC and Diabetes topics for the period 2005-2021 by country of origin of author and year of publication.

Figure 6 shows the keywords used by the authors. There are five clusters of these keywords based on the year of publication with 199 relationships with each other. The keyword "diabetes" appeared in 2017 and is almost the same as "type 2 diabetes," which appeared in 2015.

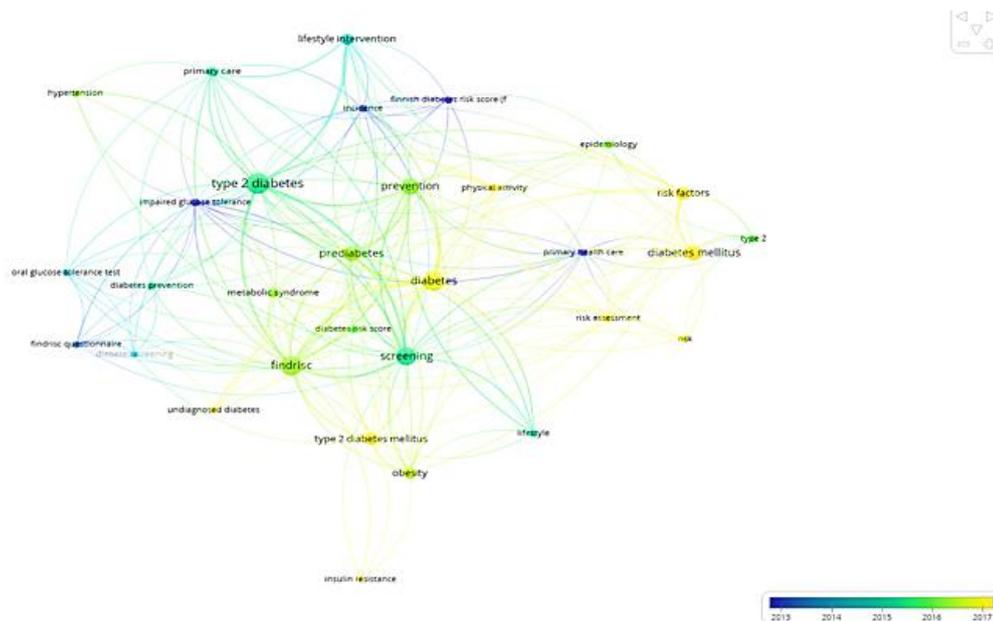


Figure 6. Mapping of keywords related to FINDRISC and Diabetes topics in publications for the period 2005-2021 based on keyword type and year of publication.

Since 2015, articles have been published by researchers from countries in the Americas and Asia. Even though the number of articles is still relatively small, the researchers who research the topic of FINDRISC seem to be intensely related and interact with each other through citations. The lack of publications regarding the utilization of FINDRISC in Asian populations provides an opportunity to conduct a comparative analysis of the validity of the FINDRISC screening instrument in Asian populations. The different characteristics of populations with diabetes mellitus in Europe and Asia are very important to understand by clinicians and policymakers for the prevention of risk factors and management of diabetes. Compared to the European population, the incidence of diabetes in the Asian population is dominated by young people with insulin resistance due to excessive accumulation of body fat and abdominal obesity²³.

Figure 7 exhibits a mapping of citations by author and year of publication. There are six clusters based on the year of publication with 115 relationships between authors. The article by Tuomilehto was most cited in 2014, while the most cited articles published in 2020 were those by Cardon and Iotova. **Figure 8** shows the types of published articles, most of which are research articles (92.8%). While **Figure 9** displays the subject areas of the research, most of which are medicine (58.4%).

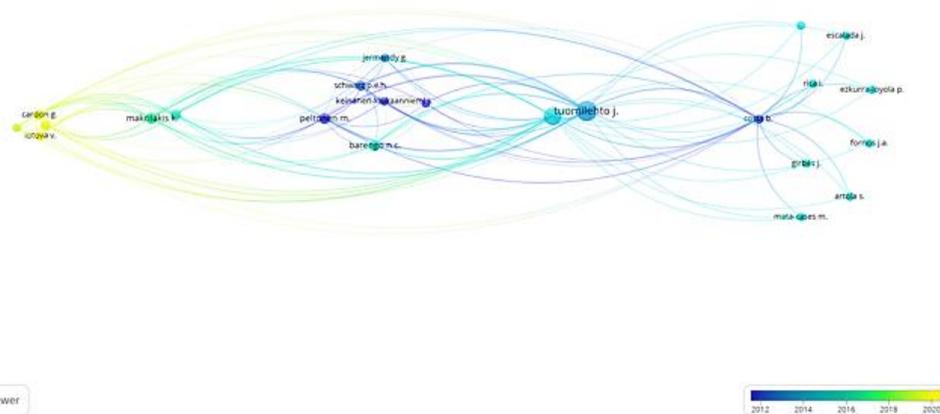


Figure 7. Mapping of citations related to FINDRISC and Diabetes topics in publications for the period 2005-2021 by author and year of publication.

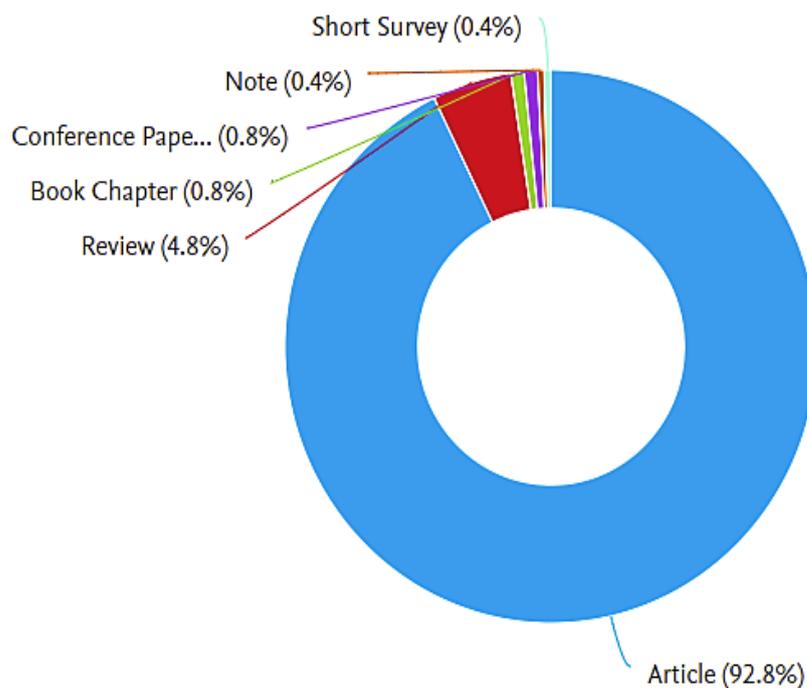


Figure 8. Types of articles on the topics of FINDRISC and Diabetes in publications for the period 2005-2021.

Documents by subject area

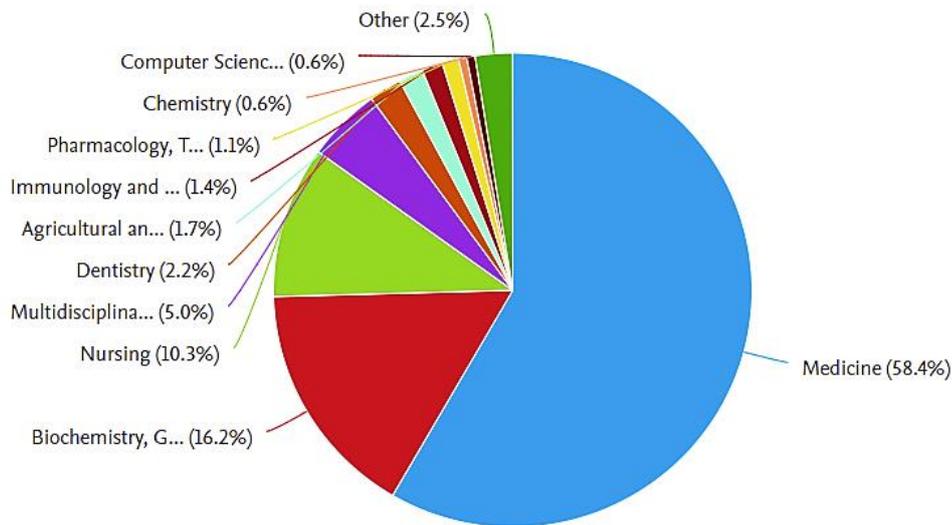


Figure 9. Subject areas of research with the topics of FINDRISC and Diabetes in publications for the period 2005-2021.

The overview of the types of published articles reveals that most of the documents in this bibliometric analysis are original papers or research articles. The number of review articles was found to be less than 5%. It indicates an opportunity to conduct a systematic literature review, scoping review, or meta-analysis method to examine the validity and performance of FINDRISC as an instrument for screening various populations at risk of developing diabetes or having prediabetes. In addition, the existing publications that test the validity of FINDRISC in the new population mainly used a cross-sectional design, and there are still few publications that used prospective data²⁴.

Figure 10 shows the most frequently occurring words in publications about FINDRISC and diabetes. "Finland" is the most mentioned word in the publications. Figure 11 is a mapping of themes based on articles found in publications for 2005-2021. The theme clusters can be seen from the color difference. The cluster in gray is the cluster of most discussed themes in research on FINDRISC and diabetes, which include: consensus, diet restriction, clinical effectiveness, Spain, questionnaire, glucose blood level, and others.



Figure 10. Word Cloud in research related to FINDRISC and Diabetes in publications for the period 2005-2021.

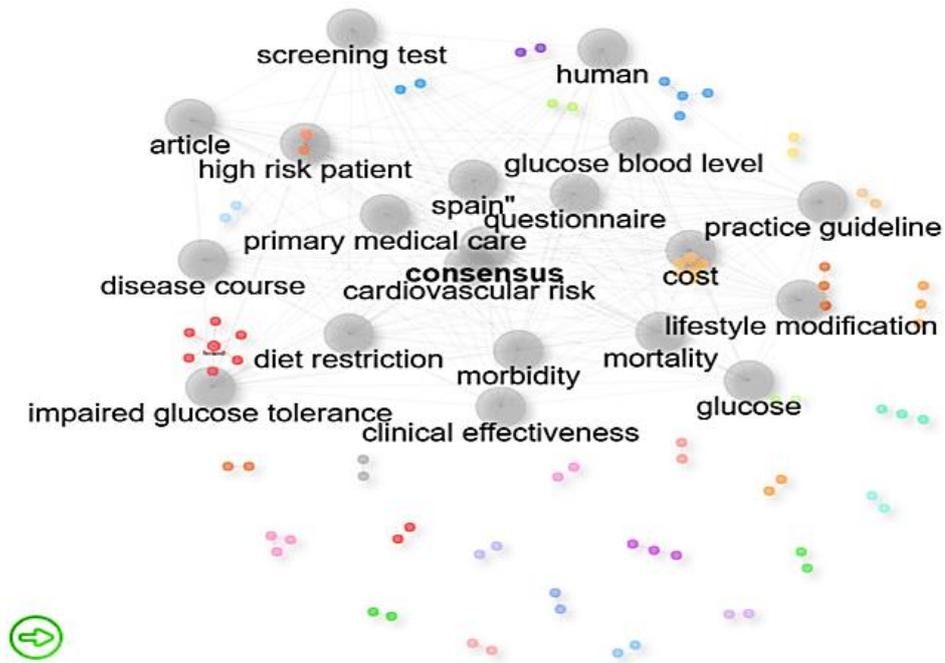


Figure 11. Mapping of themes of research with the topics of FINDRISC and Diabetes in publications for the period 2005-2021.

It seems that the research themes related to FINDRISC are not only limited to immediate diabetes risk factors such as diet restriction, glucose blood level, cardiovascular risk, and lifestyle modification but also intersect with broader themes such as disease course, mortality, morbidity, and costs. Several themes that were also discussed, such as screening tests, high-risk patients, and clinical effectiveness, indicate that the FINDRISC instrument has the potential to be studied further at the clinical level and community level, and it is possible for this instrument to be used to screen for other metabolic disorders such as metabolic syndrome. In addition, the attempt to include FINDRISC in the practice guidelines for primary medical care has become a growing theme²⁵. A cost-effectiveness analysis is necessary for the evaluation²⁶.

On the other hand, although nearly 60% of the subject areas of research on FINDRISC and diabetes are medicine, research from other subject areas such as biochemistry, nursing, dentistry, agriculture, pharmacology, and others provides opportunities for collaborative research on this topic in the future. Various reports on the results of studies related to FINDRISC are still popular and exciting to publish. This is indicated by articles on this topic continuously published by reputable and prestigious journals such as PLoS One, BMC Public Health, and Primary Care Diabetes.

One limitation of this study is that the only databases used were PubMed and Scopus. Scopus will repeat the number of articles based on contributing authors from different countries in one article, so some articles may be counted multiple times if the contributing authors are from several countries²⁷. Nevertheless, this is sufficient to serve as a basis for evaluating the utilization of FINDRISC in diabetes screening and identifying research gaps and future research opportunities. Opportunities to conduct research using Indonesia's FINDRISC instrument are still ample. This instrument can be one of the government's considerations, especially in measures for the early detection of diabetes, for example, in the integrated post guidance for non-communicable diseases (*Pos Binaan Terpadu; Posbindu*) and the Healthy Campus program initiated by the Ministry of Health of the Republic of Indonesia.

CONCLUSION

Despite the increase in publications, the number of publications on FINDRISC in patients with diabetes mellitus per year is still relatively small, with 92.8% of publications being primary studies. The publications are still dominated by those of researchers from countries in the European region, and these researchers intensely relate to each other and interact with each other through citations. Research themes related to FINDRISC are not limited to diabetes risk factors.

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AUTHORS' CONTRIBUTION

DAP was the first to propose this research concept. Then, **DAP** and **MRR** collect and analyze data. In addition to being the corresponding author, **BA** also ensures that the final draft of the manuscript complies with the guidelines of the intended journal. **ZZ** contributes to data visualization. **SR** support in budgeting. All authors provided feedback from the initial draft to the final manuscript and approved the overall process.

DATA AVAILABILITY

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 6th ed. Brussels (Belgium): International Diabetes Federation; 2013.
2. International Diabetes Federation. IDF Diabetes Atlas. 9th ed. Brussels (Belgium): International Diabetes Federation; 2019.
3. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract.* 2019;157:107843. doi:10.1016/j.diabres.2019.107843
4. Andes LJ, Cheng YJ, Rolka DB, Gregg E, Imperatore G. Prevalence of prediabetes among adolescents and young adults in the United States, 2005-2016. *JAMA Pediatr.* 2020;174(2):e194498. doi:10.1001/jamapediatrics.2019.4498
5. Hostalek U. Global epidemiology of prediabetes - present and future perspectives. *Clin Diabetes Endocrinol.* 2019;5:5. doi:10.1186/s40842-019-0080-0
6. Valensi P, Schwarz EH, Hall M, Felton AM, Maldonato A, Mathieu C. Pre-diabetes essential action: a European perspective. *Diabetes Metab.* 2005;31(6):606-20. doi:10.1016/S1262-3636(07)70239-2
7. Uusitupa M, Khan T, Vigiouliou E, Kahleova H. Prevention of Type 2 Diabetes by Lifestyle Changes : a systematic review and meta-analysis. *Nutrients.* 2019;11(11):2611. doi:10.3390/nu11112611
8. Arslanian S, Bacha F, Grey M, Marcus MD, White NH, Zeitler P. Evaluation and Management of Youth-Onset Type 2 Diabetes: A Position Statement by the American Diabetes Association. *Diabetes Care.* 2018;41(12):2648-68. doi:10.2337/dci18-0052
9. Lindström J, Tuomilehto J. The diabetes risk score: a practical tool to predict type 2 diabetes risk. *Diabetes Care.* 2003;26(3):725-31. doi:10.2337/diacare.26.3.725

10. Lim HM, Chia YC, Koay ZL. Performance of the Finnish Diabetes Risk Score (FINDRISC) and Modified Asian FINDRISC (ModAsian FINDRISC) for screening of undiagnosed type 2 diabetes mellitus and dysglycaemia in primary care. *Prim Care Diabetes*. 2020;14(5):494-500. doi:10.1016/j.pcd.2020.02.008
11. Zhang M, Zhang H, Wang C, Ren Y, Wang B, Zhang L, et al. Development and validation of a risk-score model for type 2 diabetes: a cohort study of a rural adult Chinese population. *PLoS One*. 2016;11(4):e0152054. doi:10.1371/journal.pone.0152054
12. Dugee O, Janchiv O, Jousilahti P, Sakhiya A, Palam E, Nourti JP, et al. Adapting existing diabetes risk scores for an Asian population: A risk score for detecting undiagnosed diabetes in the Mongolian population. *BMC Public Health*. 2015;15:938. doi:10.1186/s12889-015-2298-9
13. Bernabe-Ortiz A, Perel P, Miranda JJ, Smeeth L. Diagnostic accuracy of the Finnish Diabetes Risk Score (FINDRISC) for undiagnosed T2DM in Peruvian population. *Prim Care Diabetes*. 2018;12(6):517-25. doi:10.1016/j.pcd.2018.07.015
14. Bergmann A, Li J, Wang L, Schulze J, Bornstein SR, Schwarz PEH. A simplified Finnish Diabetes Risk Score to predict type 2 diabetes risk and disease evolution in a German population. *Horm Metab Res*. 2007;39(9):677-82. doi:10.1055/s-2007-985353
15. Saaristo T, Moilanen L, Korpi-Hyövälti E, Vanhala M, Saltevo J, Niskanen L, et al. Lifestyle intervention for prevention of type 2 diabetes in primary health care. *Diabetes Care*. 2010;33(10):2146-51. doi:10.2337/dc10-0410
16. Mavrogianni C, Lambrinou CP, Androutsos O, Lindström J, Kivela J, Cardon G, et al. Evaluation of the Finnish Diabetes Risk Score as a screening tool for undiagnosed type 2 diabetes and dysglycaemia among early middle-aged adults in a large-scale European cohort: The Feel4Diabetes study. *Diabetes Res Clin Pract*. 2019;150:99-110. doi:10.1016/j.diabres.2019.02.017
17. Salinero-Fort MA, Burgos-Lunar C, Lahoz C, Mostaza JM, Abánades-Herranz JC, Laguna-Cuesta F, et al. Performance of the Finnish Diabetes Risk Score and a simplified Finnish Diabetes Risk Score in a community-based, cross-sectional programme for screening of undiagnosed type 2 diabetes mellitus and dysglycaemia in Madrid, Spain: the SPREDIA-2 study. *PLoS One*. 2016;11(7):e0158489. doi:10.1371/journal.pone.0158489
18. Janghorbani M, Adineh H, Amini M. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) as a screening tool for the metabolic syndrome. *Rev Diabet Stud*. 2013;10(4):283-92. doi:10.1900/RDS.2013.10.283
19. Väättäin S, Cederberg H, Roine R, Keinänen-Kiukaanniemi S, Saramies J, Uusitalo H, et al. Does future diabetes risk impair current quality of life? a cross-sectional study of health-related quality of life in relation to the Finnish diabetes risk score (FINDRISC). *PLoS One*. 2016;11(2):e0147898. doi:10.1371/journal.pone.0147898
20. Nieto-Martínez R, González-Rivas JP, Aschner P, Barengo NC, Mechanick JL. Transculturalizing diabetes Prevention in Latin America. *Ann Glob Heal*. 2017;83(3-4):432-43. doi:10.1016/j.aogh.2017.07.001
21. Toumillehto J, Lindström J, Eriksson JG, Valle TT, Uusitupa M. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med*. 2013;344(18):1343-50. doi:10.1056/nejm200105033441801
22. Rokhman MR, Arifin B, Zulkarnain, Satibi, Perwitasari DA, Boersma C, et al. Translation and performance of the Finnish Diabetes Risk Score for detecting undiagnosed diabetes and dysglycaemia in the Indonesian population. *PLoS One*. 2022;17(7):e0269853. doi:10.1371/journal.pone.0269853
23. Ma RCW, Chan JCN. Type 2 diabetes in East Asians: similarities and differences with populations in Europe and the United States. *Ann N Y Acad Sci*. 2013;1281(1):64-91. doi:10.1111/nyas.12098
24. Jølle A, Midthjell K, Holmen J, Carlsen SM, Tuomilehto J, Bjørngaard JH, et al. Validity of the FINDRISC as a prediction tool for diabetes in a contemporary Norwegian population: a 10-year follow-up of the HUNT study. *BMJ Open Diabetes Res Care*. 2019;7(1):e000769. doi:10.1136/bmjdr-2019-000769

25. Fauzi NFM, Wafa SW, Ibrahim AM, Raj NB, Nurulhuda MH. Translation and Validation of American Diabetes Association Diabetes Risk Test: The Malay Version. *Malays J Med Sci.* 2022;29(1):113-25. doi:[10.21315/mjms2022.29.1.11](https://doi.org/10.21315/mjms2022.29.1.11)
26. Noyes K, Holloway RG. Evidence from cost-effectiveness research. *NeuroRx.* 2004;1(3):348-55. doi:[10.1602/neurorx.1.3.348](https://doi.org/10.1602/neurorx.1.3.348)
27. Putera PB, Suryanto, Ningrum S, Widianingsih I. A bibliometric analysis of articles on innovation systems in Scopus journals written by authors from Indonesia, Singapore, and Malaysia. *Sci Ed.* 2020;7(2):177-83. doi:[10.6087/kcse.214](https://doi.org/10.6087/kcse.214)