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Global Scientific Trends On Nutrition Apps to Support Healthy Lifestyle in Digital Age

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ABSTRACTS

Technological developments have brought about significant changes in the way people manage their health and fitness, especially through nutrition apps. Bibliometric analysis is used in the article to help discover current trends in the use of nutrition apps that support a healthy lifestyle. Key focuses of this trend include personalization, easy access to nutritional information, and integration with other health devices. In addition, this article also explores the positive impact of using nutrition apps on users' health awareness and behavior, as well as the challenges faced, such as data privacy issues and the need for scientific validation of the recommendations provided. The Scopus database was used to search for article data. Search results on the Scopus database found 107 documents. The development of publication of articles regarding nutritional applications to support a healthy lifestyle can be said to be quite increasing every year, although in 2023, 2019 and 2017 there has been a decline. There are a total of 175 countries that have contributed to publications regarding the use of nutrition applications to support a healthy lifestyle. Through this analysis, it is hoped that it can provide insight into the important role of nutritional applications in supporting a healthy lifestyle in the digital era.

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1. INTRODUCTION

In today's digital era, nutrition apps have become an increasingly popular tool to support a healthy lifestyle. Technological developments and increasing public awareness of the importance of health encourage the growth of this application. According to a study by Mumcu (Mumcu, 2021), the number of downloads of health and fitness apps worldwide will reach more than 1.2 billion in 2022. This figure shows the great interest of society in utilizing technology to maintain and improve their health.

Nutrition applications offer various features that can help users manage their diet and monitor nutritional intake. These features include food logging, nutritional analysis, personalized meal plans, and water reminders. A study by West et al. (West, *et al., 2017*) found that the use of nutrition apps can increase adherence to a healthy diet and aid in weight loss. This study shows that technology can be an effective tool in supporting health behaviour change.

Additionally, nutrition apps often come with extensive food databases and accurate nutritional information. This allows users to make better decisions regarding their food choices. According to research by Tonkin et al. (Tonkin, *et al., 2017*), apps that feature a comprehensive food database are more effective in helping users achieve their health goals. The accuracy and ease of access to this information is one of the main advantages of nutrition apps compared to traditional methods such as food diaries.

The trend in using nutrition apps is also driven by the ease of access and convenience they offer. This application can be accessed anytime and anywhere via smartphone, making it easier for users to track and manage their nutritional intake in real-time. A survey by the Pew Research Center in 2021 showed that 85% of adults in the United States own a smartphone, which means the potential for nutrition app users is huge (Paradis, *et al., 2021*). This convenience is an important factor in the adoption of health technology by the wider community.

However, while the popularity of nutrition apps continues to rise, there are still challenges that need to be overcome. One of the main challenges is ensuring the security of user data. Research by Al Ameen et al. (Al Ameen, *et al., 2012*) revealed that concerns about data privacy are one of the obstacles for users in using health applications. Therefore, application developers need to ensure that user data is well protected and follows applicable privacy regulations.

In the future, nutritional application trends are predicted to continue to grow with the integration of advanced technologies such as artificial intelligence and data analytics. This technology can provide more accurate recommendations and higher personalization based on user data. The study by Chew et al. (Chew, *et al., 2021*) shows that applications that use artificial intelligence can increase effectiveness. With the rapid development of technology, nutrition applications have great potential to continue to support healthy lifestyles and improve society's overall quality of life.

Based on this, this research was carried out to look for the latest trends in the use of nutritional applications that support a healthy lifestyle, so it is hoped

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that through this article, readers can understand the latest trends in nutritional applications and how this technology can help them achieve their desired health goals

2. METHOD

The method used in this research is literature study with the help of bibliometric analysis. There are 8 stages in conducting this research as shown in Figure 1.

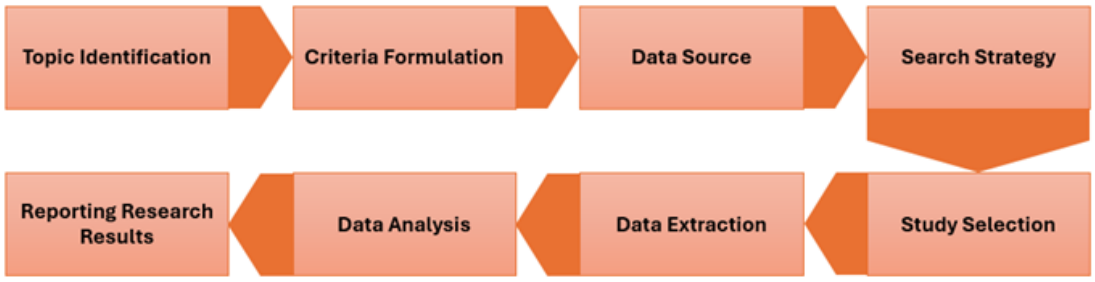

Fig. 1. Research Stages.

2.1. Topic Identification

Determining the research topic is carried out at this stage. The research topic that will be taken is trends in nutritional applications to support a healthy lifestyle.

2.2. Criteria Formulation

Criteria formulation is the stage of determining several criteria from the article data used. Determining criteria at this stage can help make it easier to search for article data. The criteria that must be met for this research to proceed according to plan are:

- Articles published in the last 10 years.
- Articles in English or Indonesian.
- Articles that include studies on nutritional applications and their impact on a healthy lifestyle

2.3. Data Source

The data source used in this research is article data indexed by Scopus. Therefore, article data was taken directly from the scopus.com website with the keyword's "nutrition" AND "application" AND "healthy" AND "lifestyle" AND "Healthy lifestyle".

2.4. Search Strategy

The article data search strategy used is to search the specified database using formulated keywords and collect all relevant articles based on title and abstract.

2.5. Study Selection

There were two selection stages carried out in this research. The first stage is selection based on title, abstract and keywords to remove irrelevant articles. The second stage is to read the full text of the selected articles to ensure the relevance and quality of the study.

2.6. Data Extraction

The activity carried out at this stage is to collect important information from each selected article.

2.7. Data Analysis

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Analysis is used using bibliometric methods. VOSviewer is used to help see trends in several terms related to this research topic (Al Husaeni & Nandiyanto, 2022).

2.8. Reporting Research Results

The final stage is to write down all the results obtained, present the main trends in nutritional applications and their impact on healthy living, and provide recommendations for future application development and further research.

3. RESULTS AND DISCUSSION

3.1. Gizi Application

Nutrition apps have become a popular and useful tool in helping individuals live a healthy lifestyle. With the various features offered, this application allows users to monitor and manage their nutritional intake more efficiently. There are several common features that nutrition apps have and how they can help users achieve their health goals:

- Nutrition tracker. The main feature of the nutrition app is its ability to track the user's food intake. Users can easily log the food they consume, and the app will automatically calculate the number of calories, carbohydrates, protein, fat, and other nutrients they consume. Some applications can even scan barcodes on food labels to import nutritional information quickly and accurately (Claessens, *et al., 2009*).
- Diet guide and recipes. Many nutrition apps provide diet guidance based on user preferences and goals. Users can choose from various types of diets, such as low-carbohydrate diets, high-protein diets, or vegetarian diets. Apps also often offer a collection of healthy and delicious recipes according to users' nutritional preferences (Banaschewski, *et al., 2009*).
- Physical activity tracker. Some nutrition apps also include a physical activity tracking feature, which allows users to monitor the number of calories they burn through exercise and daily activities. Integration with physical activity tracking devices such as Fitbit or Apple Watch allows users to get a more complete picture of their health and energy balance (Chung & Rhie, 2021).
- Nutrition Education. Most nutrition apps also provide educational content about nutrition, allowing users to better understand the nutritional value of foods and their impact on health. This educational content can be in the form of articles, videos, or nutritional tips tailored to user needs (Chen, *et al., 2018*).

There are several nutritional applications that have been developed as shown in Figure 2.

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Fig. 2. Nutrition applications.

3.2. Healthy Lifestyle

A healthy lifestyle is a lifestyle that includes various habits and practices aimed at improving a person's physical, mental, and emotional well-being (Mamurov, *et al., 2020*). This includes aspects such as a balanced diet, regular exercise, adequate sleep, stress management, and avoidance of harmful habits such as smoking and excessive alcohol consumption. Adopting a healthy lifestyle has been shown to reduce the risk of various chronic diseases such as heart disease, diabetes, and cancer, as well as improving overall quality of life (Li, *et al., 2020*).

One of the main components of a healthy lifestyle is a balanced diet and adequate nutrition (Amirli, *et al., 2024*). Consuming foods rich in fiber, vitamins and minerals is very important to support optimal body function and prevent the development of disease. Research shows that a balanced diet dominated by fruits, vegetables, whole grains, and healthy plant or animal protein can reduce the risk of obesity, type 2 diabetes, and heart disease.

In addition, regular physical activity is also an important component of a healthy lifestyle (Macovei, *et al., 2014*). Regular exercise not only helps maintain a healthy weight, but also improves muscle strength, bone density, and heart health. The physical activity guidelines recommended by the World Health Organization (WHO) are at least 150 minutes of moderate to vigorous intensity aerobic activity each week, supplemented with strength training at least twice a week (Yang, 2019).

Adopting a healthy lifestyle is not something instant, but a process that requires awareness, commitment, and discipline. However, its long-term benefits to health and well-being make it a worthwhile investment for a long, quality life. By paying attention to the various important components of a healthy lifestyle, a person can achieve optimal health potential and quality of life.

3.3. Benefits of Using Nutrition Apps

The use of nutrition apps has provided a variety of benefits for individuals looking to manage their health and diet. Here are some of the main benefits that can be gained from using nutrition apps:

Accurate monitoring of food intake. Nutrition apps allow users to accurately record the types and amounts of food they consume each day. With detailed records, users can monitor their intake of calories, carbohydrates, protein, fat, fiber, and other nutrients. This helps users to stay within calorie and nutrient limits

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appropriate to their health or weight loss goals (Pendergast, *et al., 2017*).

- Progress monitoring and motivation. With the progress monitoring feature, users can see their progress over time. This helps increase motivation and maintain commitment to a healthy diet. Some nutrition apps even provide virtual rewards or achievements as additional incentives to motivate users to achieve their health goals (Carter, *et al., 2013*).
- Personalized nutrition education. Many nutrition apps provide personalized nutrition information and advice according to user preferences and needs. Through these features, users can learn more about the nutritional composition of the food they consume and gain a better understanding of their nutritional needs (Krebs & Duncan, 2015).
- Support and counseling. Some nutrition apps offer direct support and counseling from nutritionists or health professionals via chat features or online consultations. It gives users access to accurate information and personalized guidance to help them achieve their health goals (Al-Busafi, *et al., 2018*).

3.4. Challenge Using Nutrition Apps

Although nutrition apps offer many benefits, there are several barriers that can hinder effective use. Here are some of the main obstacles that users often face:

- Limited data reliability. One of the main obstacles to using nutrition apps is limited data reliability. Nutrition information on apps is often based on general databases that may not correspond to the specific foods or brands consumed by users. This can lead to inaccuracies in recording food and nutrient intake (DiFilippo, *et al., 2015*).
- User compliance. User compliance is a serious issue in the use of nutrition apps. Many users tend to lose interest or motivation in regularly recording their food intake. Additionally, some users may feel burdened or tired by the time-consuming recording process (Laing, *et al., 2014*).
- Difficulty interpreting data. Although nutrition apps provide a lot of data, users may face difficulties in interpreting the information. For example, users may not fully understand the implications of certain calorie or nutrient amounts in the context of their diet. This may reduce the effectiveness of app use to achieve their health goals (Lewis, *et al., 2011*).
- Data privacy and security. Concerns about data privacy and security are also significant barriers to the use of nutrition apps. Users often question how their personal data is used by applications and whether the information is safe from unauthorized access or misuse (Huckvale, *et al., 2015*).

Although there are barriers to the use of nutritional applications, technology development and research continue to address these challenges. By understanding and overcoming these barriers, nutrition apps have great potential to improve users' overall health and lifestyle. However, it is important for users to remain critical and careful in selecting and using nutrition applications that suit their needs and preferences.

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3.5. Research Trends in Nutrition Applications for a Healthy Lifestyle (2014-2024)

Search results on the Scopus database regarding nutrition publications for supporting a healthy lifestyle found 107 documents from 2014 to 2024. The number of publications regarding nutrition publications for supporting a healthy lifestyle in Scopus has a large annual growth rate with details as in Figure 3. Figure 3 shows the details the number of publications per year is 2014 2 documents, 2015 5 documents, 2016 7 documents, 2017 5 documents, 2018 12 documents, 2019 10 documents, 2020 12 documents, 2021 19 documents, 2022 20 documents, 2023 7 documents, and 2024 8 documents.

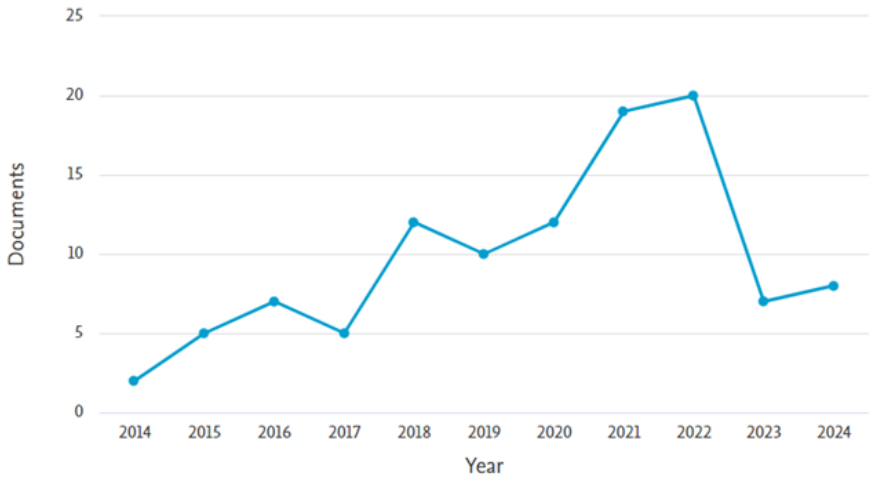

Fig. 3. Annual scientific production.

Based on the data shown in Figure 3, the development of article publications regarding nutritional applications to support a healthy lifestyle can be said to be increasing every year. Although, from the highest total publications in 2022 there was a decrease in the number of publications from 2023. The increase in research regarding the use of nutritional applications to support a healthy lifestyle, especially in 2022, could be influenced by several factors (Flanagan, *et al., 2021*; Elavsky, *et al., 2017*; Krebs & Duncan, 2015), including:

- Health awareness: People are increasingly aware of the importance of maintaining health and a balanced diet to prevent disease and improve quality of life.
- COVID-19 Pandemic: The COVID-19 pandemic increased awareness of the importance of the immune system and overall health, prompting people to seek digital solutions to support a healthy lifestyle.
- Technological developments: Technological advances are making nutrition apps easier for users to access and use, with increasingly sophisticated features and greater personalization.
- Support from nutritionists: Nutritionists and health professionals are starting to recommend the use of nutrition apps as an additional tool in diet management and monitoring nutritional intake.
- High interest in healthy lifestyles: The rise of healthy lifestyle trends,

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including certain diets such as veganism, paleo, or keto, is driving people to seek relevant information and support through nutrition apps.

In this study, we analyzed the identification of developments in the use of nutrition applications to support a healthy lifestyle based on average citations per year. Publications regarding the use of nutritional applications to support a healthy lifestyle in Scopus have an average citation per document of 16.16, while a detailed report on the number of citations per year is shown in Table 1. In Table 1, we only display the 10 articles with the most citations over 10 years final. Based on Table 1, the highest number of citations occurred in 2016 with a total of 266 citations and the average number of document citations per year was 86.80 citations.

Table 1. Average citations per years.

Title	Year	Cited by	Author
The efficacy of nudge theory strategies in influencing adult dietary behaviour: A systematic review and meta-analysis	2016	266	Arno A.; Thomas S.
Monitoring eating habits using a piezoelectric sensor-based necklace	2015	138	Kalantarian H.; Alshurafa N.; Le T.; Sarrafzadeh M.
Current Trends in Ancient Grains-Based Foodstuffs: Insights into Nutritional Aspects and Technological Applications	2018	107	Boukid F.; Folloni S.; Sforza S.; Vittadini E.; Prandi B.
Caution, "normal" BMI: health risks associated with potentially masked individual underweight—EPMA Position Paper 2021	2021	72	Golubnitschaja O.; Liskova A.; Koklesova L.; Samec M.; Biringer K.; Büsselberg D.; Podbielska H.; Kunin A.A.; Evsevyeva M.E.; Shapira N.; Paul F.; Erb C.; Dietrich D.E.; Felbel D.; Karabatsiakis A.; Bubnov R.; Polivka J.; Polivka J., Jr.; Birkenbihl C.; Fröhlich H.; Hofmann-Apitius M.; Kubatka P.
Understanding the use of smartphone apps for health information among pregnant	2019	58	Wang N.; Deng Z.; Wen L.M.; Ding Y.; He G.

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Title	Year	Cited by	Author
Chinese women: Mixed methods study			
Feasibility of Smartphone-Based Education Modules and Ecological Momentary Assessment/Intervention in Pre-bariatric Surgery Patients	2015	53	Mundi M.S.; Lorentz P.A.; Grothe K.; Kellogg T.A.; Collazo-Clavell M.L.
Describing the process of adopting nutrition and fitness apps: Behavior stage model approach	2018	46	König L.M.; Sproesser G.; Schupp H.T.; Renner B.
Evaluation of a smartphone nutrition and physical activity application to provide lifestyle advice to pregnant women: The SNAPP randomized trial	2018	44	Dodd J.M.; Louise J.; Cramp C.; Grivell R.M.; Moran L.J.; Deussen A.R.
Pregnancy, exercise and nutrition research study with smart phone app support (Pears): Study protocol of a randomized controlled trial	2016	42	Kennelly M.A.; Ainscough K.; Lindsay K.; Gibney E.; Mc Carthy M.; McAuliffe F.M.
Validation of a questionnaire to measure overall mediterranean lifestyle habits for research application: The MEDiterranean LIFEstyle index (MEDLIFE); [Validación de un cuestionario para medir los hábitos de estilo de vida mediterráneos para su aplicación en investigación: índice de estilo de vida mediterráneo (MEDLIFE)]	2015	42	Sotos-Prieto M.; Santos-Beneit G.; Bodega P.; Pocock S.; Mattei J.; Peñalvo J.L.

The development of research regarding the use of nutritional applications to support a healthy lifestyle can be influenced by several factors. One of them is the increasingly widespread adoption of technology in society, which allows the development of more sophisticated and personalized nutritional applications. In addition, support from nutrition experts and health professionals in recommending the use of nutrition applications also influenced the

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development of this research. Increasing awareness of the importance of health and a healthy lifestyle, especially during the COVID-19 pandemic, is also an important factor in encouraging research on nutritional applications (Flanagan, *et al., 2021*).

This research also explains the countries that contributed to publications regarding the use of nutritional applications to support a healthy lifestyle. Based on the research results, it was found that 175 countries have contributed to publications regarding the use of nutritional applications to support a healthy lifestyle. More detailed information on these countries can be seen in Table 2.

Table 2. Countries that have contributed publish articles regarding nutritional applications to support a healthy lifestyle.

Country	Total of Publication	Country	Total of Publication
United States	22	Canada	2
Spain	11	Yemen	2
Germany	10	Taiwan	1
China	9	South Korea	1
Australia	9	South Africa	1
Netherlands	8	Slovakia	1
United Kingdom	6	Singapore	1
Portugal	6	Serbia	1
Poland	6	Saudi Arabia	1
Italy	6	Rwanda	1
Indonesia	5	Russian Federation	1
India	5	Philippines	1
Turkey	4	Peru	1
Switzerland	4	Palestine	1
Austria	4	Oman	1
Norway	3	North Macedonia	1
Mexico	3	Nigeria	1

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Country	Total of Publication	Country	Total of Publication
Ireland	3	New Zealand	1
Greece	3	Morocco	1
Belgium	3	Malaysia	1
United Arab Emirates	2	Kazakhstan	1
Ukraine	2	Jordan	1
Sweden	2	Japan	1
Qatar	2	Israel	1
Luxembourg	2	France	1
Iran	2	Denmark	1
Czech Republic	2	Algeria	1
Colombia	2		

Figure 4 shows collaborative research publications regarding the use of nutrition applications to support a healthy lifestyle. The countries that have contributed the highest number of publications are the United States with 22 publications, Spain with 11 publications, Germany with 10 publications, China with 9 publications, Australia with 9 publications, the Netherlands with 8 publications, the United Kingdom with 6 publications, Portugal with 6 publications, Poland with 6 publications, and Italy with 6 publications.

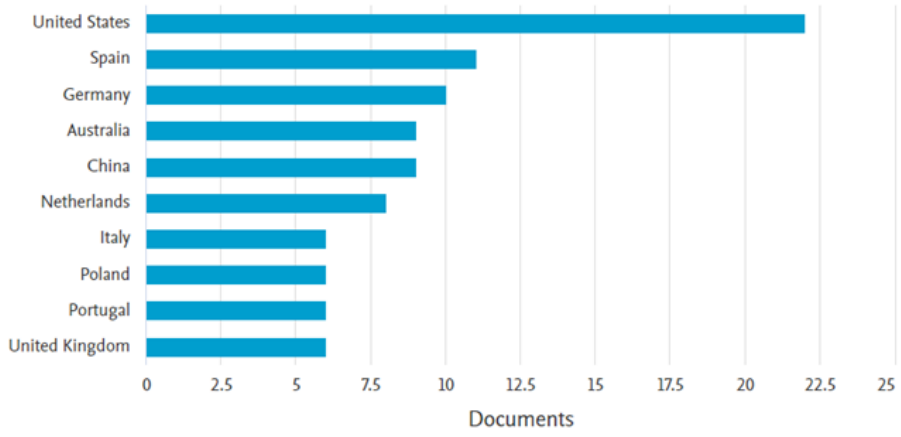

Fig. 4. Collaboration in publication of nutrition application for support healthy lifestyle country by Scopus.

In addition, we conducted research on publication trends through subject area analysis in research publication documents regarding the use of nutrition applications to support a healthy lifestyle. Figure 5 shows the percentage of

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subjects that have the highest number of appearances. Based on Figure 5, there are 19 subjects covering journals that have published articles regarding nutritional applications that support a healthy lifestyle. These subjects are Medicine (67 documents), Nursing (25 documents), Agricultural and Biological Sciences (20 documents), Social Sciences (12 documents), Biochemistry, Genetics and Molecular Biology (11 documents), Engineering (8 documents), Health Professions (8 documents), Computer Science (7 documents), Environmental Science (7 documents), Pharmacology, Toxicology and Pharmaceutics (6 documents), Chemical Engineering (5 documents), Chemistry (5 documents), Business, Management and Accounting (3 documents), Multidisciplinary (2 documents), Neuroscience (2 documents), Physics and Astronomy (2 documents), Arts and Humanities (1 document), Materials Science (1 document), and Psychology (1 document).

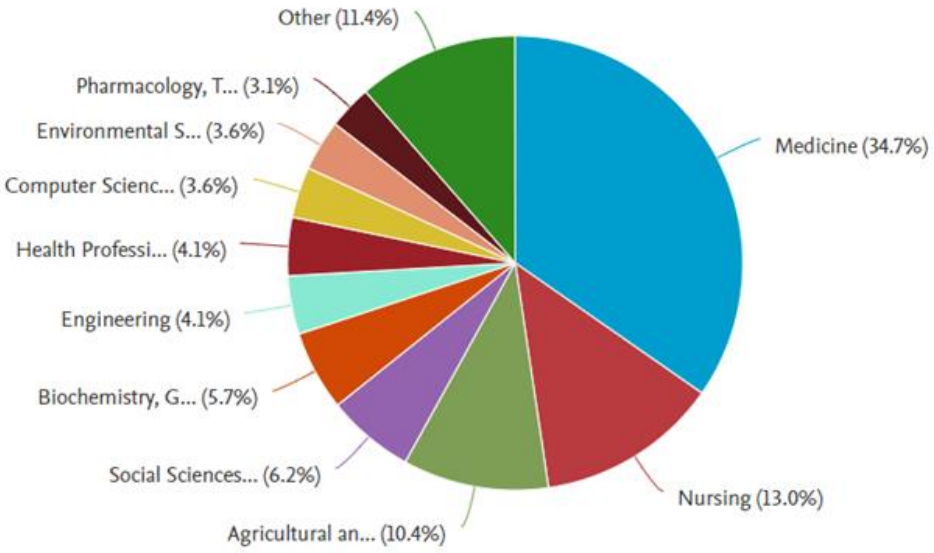

Fig. 5. Document by subject area.

3.6. Visualization of Terms from The Title and Abstract of Articles Regarding Nutrition Apps to Support a Healthy Lifestyle

Figure 6 shows a co-occurrence network visualization of research on the use of nutrition apps to support a healthy lifestyle. Co-occurrence network visualization is a data visualization technique used to display the relationship between various elements based on the frequency of their occurrence together in a dataset (Yang, *et al., 2012*). This technique is often used in text analysis, information science, bioinformatics, and other fields that require an understanding of relationship patterns between different elements. In this research, each term is divided into 3 clusters, namely:

- Cluster 1 (marked as red): application, behavior, diet, food, healthy lifestyle, knowledge, nutrition, person, questionnaire.
- Cluster 2 (marked as green): age, app, effect, life, obesity, physical activity, quality, smartphone app.

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- Cluster 3 (marked as blue): effectiveness, health, information, lifestyle, mobile application, recommendation, system, and technology.

Based on Figure 6, the terms "application", "nutrition", and "healthy lifestyle" which are terms used as keywords when searching for data on the scopus.com website are in cluster 1 which is marked in red. The term "application" has a total link strength is 407 with 70 occurrences, the term "nutrition" has a total link strength of 373 with 54 occurrences, and the term "healthy lifestyle" has a total link strength of 363 with 55 occurrences.

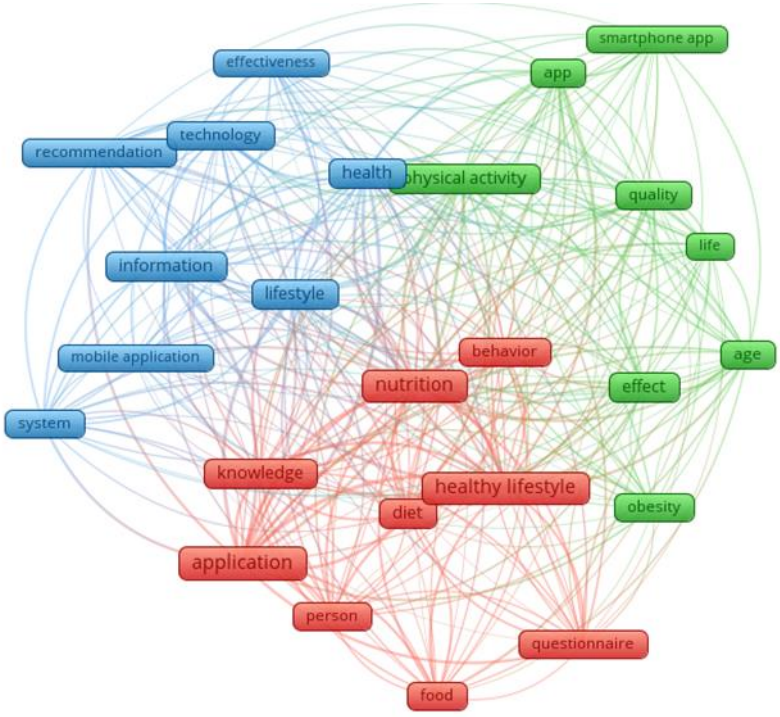

Fig. 5. Co-occurrence network visualization.

Finally, to find out publication trends regarding nutritional applications that support a healthy lifestyle, we analyzed another form of visualization, namely density visualization. Density visualization is a type of visualization used to describe the spatial or temporal distribution of continuous data, such as geographic data, temperature, population density, or the intensity of a phenomenon (Demšar & Virrantaus, 2010). This visualization highlights where data values tend to cluster or scatter, thus helping in understanding possible patterns and trends (Behrisch, *et al., 2018*).

Figure 7 shows the terms with the highest number of occurrences over time. Based on Figure 7, it is known that from 2014 to 2024 the terms frequently used in research regarding nutritional applications to support a healthy lifestyle are application, nutrition, healthy lifestyle, health, lifestyle, physical activity, effect, information, knowledge, and app. Of these ten terms, health has become one of the terms frequently used recently, namely since 2020. Apart from health, the terms frequently used recently by researchers in research related to nutritional applications and healthy lifestyles are mobile application,

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effectiveness, quality, and obesity (see Figure 8).

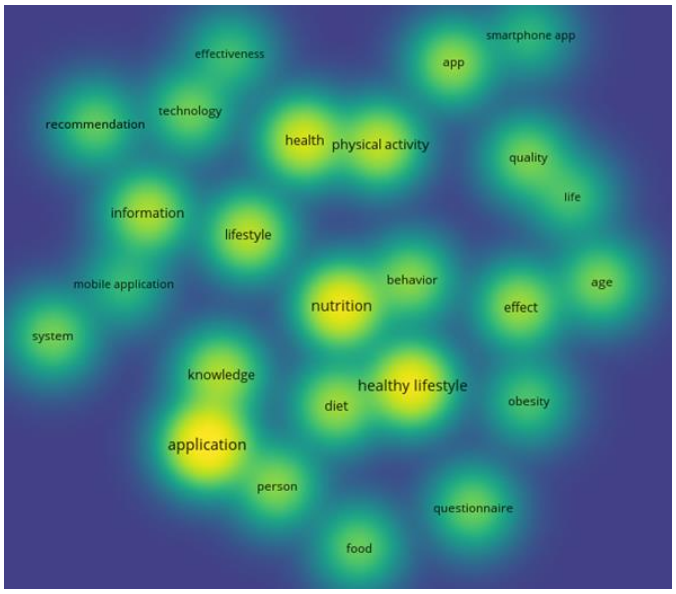

Fig. 6. Density Visualization.

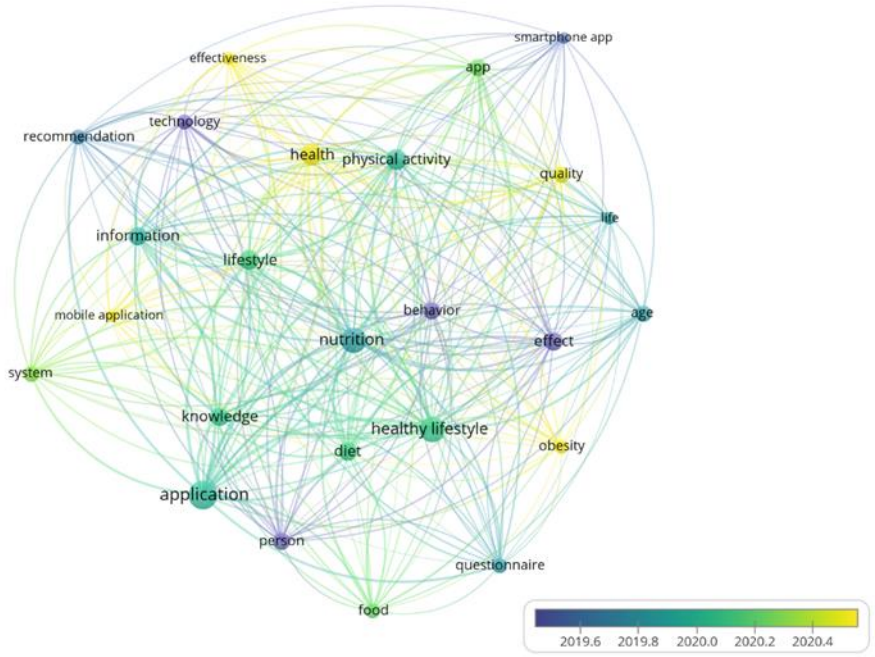

Fig. 7. Overlay visualization.

4. CONCLUSION

This research describes current trends in the development of nutritional applications aimed at supporting healthy lifestyles. Through a review of the various nutrition apps available, it can be concluded that there has been a significant increase in the number and diversity of features offered. These applications are designed to provide comprehensive support in efforts to

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maintain a balanced diet, monitor nutritional intake, and facilitate an active lifestyle. Apart from that, search results on the Scopus database regarding nutrition applications for supporting healthy lifestyles found 107 documents from 2014 to 2024. The number of publications regarding nutrition applications for supporting healthy lifestyles in Scopus has a fairly large annual growth rate. The development of publication of articles regarding nutritional applications to support a healthy lifestyle can be said to be quite increasing, although in certain years it has decreased, such as in 2017, 2019 and 2023. The development of research regarding the use of nutritional applications to support a healthy lifestyle can be influenced by health awareness, COVID-19 pandemic, technological developments: Technological advances are making nutrition apps easier for users to access and use, with increasingly advanced features and better personalization, support from nutritionists, and increased interest in healthy lifestyles. Based on topic trend analysis in the research theme nutrition application for supporting a healthy lifestyle, it was found that there are 10 terms that are often used in research with this theme, namely application, nutrition, healthy lifestyle, health, lifestyle, physical activity, effect, information, knowledge, and app. This analysis shows that these aspects are a major focus in research on the use of nutrition apps to promote healthy lifestyles, reflecting the importance of technology integration in supporting public health.

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