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RESEARCH ARTICLE

Research impact in randomized controlled trials of diabetes: an altmetric approach

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Abstract

Purpose This study aimed to assess the impact of research in randomized controlled trials (RCTs) of diabetes and explore the various subject areas related to diabetes that receive attention on social media platforms. Altmetric measures were utilized to collect and extract relevant data, providing valuable insights into the social reach and influence of clinical research beyond traditional citation-based metrics.

Methods The research focused on RCTs of diabetes involving at least one Iranian author, indexed in Scopus. Altmetric.com was employed to extract altmetric data, and the collected articles were categorized into 14 subject areas for individual analysis using STATA.

Results The analysis revealed that a majority of the diabetes studies examined nutrition, complications, treatment, genetics, basic mechanisms, and comorbidities of the disease. Conversely, subject areas such as diagnosis, education, gestational diabetes, psychology, physical activity, prevention, dentistry, and economics had fewer studies associated with them. Among social media platforms, Twitter, Facebook, Google+, and Reddit emerged as the most frequently mentioned platforms. Furthermore, Mendeley readership was identified as the preferred platform for engagement across several subject areas.

Conclusions The substantial number of social media mentions indicates a significant level of public interest and concern regarding diabetes. Social media platforms serve as effective tools for disseminating research findings from clinical trials. Altmetric data proves valuable to researchers and funding agencies seeking to comprehend the impact of their work, enabling them to allocate resources more effectively.

Keywords Altmetrics · RCT · Diabetes · Social media · Research impact

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Introduction

As scientific resources become increasingly available on the internet, there is a growing interest in evaluating their citation impact on scientific connections. This has led to the emergence of a broad field of research known as webometrics. One of the key functions of webometrics is to assess web-based citations obtained from Google Scholar and compare them to more conventional citations from the Institute for Scientific Information (ISI). However, with the rise of social media on the web, there is now a shift in focus towards analyzing citations on social media, which is known as alternative metrics (altmetrics) [1].

In the past, the evaluation of research impact was mainly based on the Science Citation Index issued by ISI. Later on, other indices such as the Hirsch index and Crown indicator (CI) were introduced, and other institutions such as Google Scholar and Scopus started analyzing citations. Currently, altmetrics has been introduced as a new way of evaluating research impact. Altmetrics examines the impact of scientific work on social networks such as Facebook, Twitter, Wikipedia, and blogs [2]. As scientific communities seek new and standardized metrics to evaluate the impact of researchers, Altmetrics has gained significant attention due to its innovative approach, although its strengths and weaknesses are still debated among researchers. Moreover, as scientific fields continue to advance, policymakers and research funding agencies are searching for ways to measure the outcome and impact of research in different countries. Therefore, altmetrics could be a suitable index for this purpose [3]. Altmetric are metrics used to measure the attention and impact of scholarly publications on social media and other online platforms [4]. While some studies have found a positive correlation between study quality and altmetric coverage, others have reported mixed or inconclusive results; the relationship between study type and altmetric coverage may depend on various factors, such as the topic of the study, the type of audience, and the dissemination strategies used by the authors [5].

Despite the uncertainty regarding the relationship between study type and altmetric coverage, studies that evaluate the impact of rigorous research on the public through social media can still provide valuable insights into the dissemination and communication of scientific information. Such studies may help researchers, publishers, and other stakeholders understand how to effectively communicate research findings to diverse audiences through various media channels [6].

The field of altmetric and social media research has experienced significant growth in the past 10 years, with most of the research being conducted during this time frame. The majority of this research has focused on exploring the relationship between altmetrics indexes and the number of citations in various scientific disciplines [7, 8]. In many studies, the number of citations only represents a limited fraction of the impact that scientific resources have, and the rest remains invisible. Analyzing the data from altmetrics can reveal this invisible impact [9]. There have been numerous studies on the association and correlation of bibliographic indexes and altmetrics, and they have concluded that there is a positive but weak correlation between altmetric indexes and citation count [10].

To demonstrate a country's scientific potential and performance in different subject areas, the allocation of national resources is often prioritized towards research development in healthcare systems and various fields related to diseases, including diabetes. Diabetes is a significant public health concern, with its prevalence increasing globally. Therefore, research efforts in this field are crucial for improving the prevention, diagnosis, treatment, and overall management of diabetes. By investing in diabetes research, countries can show their commitment to addressing this critical health issue and contribute to the global effort to combat diabetes [11].

Diabetes is currently one of the most prevalent and significant diseases in the world, affecting millions of people globally. It is estimated that by 2045, around 700 million people worldwide will be living with diabetes. This is a worrying trend as diabetes can lead to several health complications, including cardiovascular diseases, kidney failure, blindness, and neuropathy; therefore, it is essential to invest in research efforts to better understand the causes, prevention, and treatment of diabetes to reduce its impact on individuals and society as a whole [12]. Examining research conducted in the field of diabetes worldwide, including in Iran, can help identify existing research gaps and contribute to the advancement of future research while minimizing duplication of research efforts.

Randomized controlled trials (RCTs) are considered the gold standard in evidence-based medicine because they provide the strongest evidence of cause-and-effect relationships between interventions and outcomes;RCTs are experimental studies where participants are randomly assigned to receive either the intervention being tested or a control group [13]. The level of evidence for RCTs is typically high, as they are designed to minimize bias and confounding factors that could affect the study outcomes; RCTs are usually classified as level 1 evidence (the highest level) in the hierarchy of evidence [14].

These studies are important in evidence-based medicine because they provide the most reliable evidence for evaluating the effectiveness and safety of medical interventions;

Randomized controlled trials are used to inform clinical practice guidelines, which are evidence-based recommendations for healthcare providers and also used to inform regulatory decisions, such as the approval of new drugs and medical devices by regulatory agencies [15].

Therefore, Altmetrics is a relatively new field that measures the impact of research beyond traditional citation metrics, such as the number of times an article has been cited in other publications. It tracks online attention to research outputs, including social media posts, blogs, news articles, and other online sources. Altmetrics can be used to evaluate the public engagement with research, as well as its societal impact [16–18]. It can be used to track the online attention to RCTs of diabetes, such as the number of tweets, Facebook posts, and other social media mentions. This can provide insights into the public engagement with RCTs of diabetes and help researchers understand how their work is being received by the wider community.It can help researchers and healthcare professionals engage with a wider audience, including patients, caregivers, and the general public, by sharing RCT findings on social media and responding to questions and comments.

The main aim of this study is to investigate the significance and impact of randomized controlled clinical trials on diabetes research in Iran, particularly in terms of their presence on social media. we used Altmetric tools to evaluate the social media coverage of these trials. The study is motivated by the importance of these trials in advancing our knowledge of diabetes and its management. The findings could provide valuable insights into the social impact of clinical research, including mentions in news and social media outlets. Furthermore, this research aims to identify the current research landscape and inform the allocation of resources for future research efforts in the field of diabetes in Iran. Despite the limitations, the study seeks to create a representation of the state of diabetes research in Iran for researchers and policymakers, to encourage greater engagement with scientific networks and to highlight the potential impact of research results on the public.

Methods

To gather data for this study, we employed descriptive methods and Altmetrics measures. We specifically focused on English randomized controlled trials of diabetes that had at least one Iranian author listed in Scopus database from 2010 to 2022 and saved them in a CSV file,while excluding review articles and conference papers. The study comprised two phases: bibliographic and Altmetric analysis. During the bibliographic phase, we initially matched diabetes-related keywords using the Mesh Pubmed thesaurus and EMTREE of EMBASE database. We then matched the meanings of the keywords of clinical trials based on the Cochrane database and used this information to construct our search strategy. This approach allowed us to identify relevant studies related to diabetes and clinical trials, which we could further analyze and collect data for our study.we searched for relevant articles using several search strategy models.

Based on the title and objective of the research ("Research Impact in randomized controlled trials of Diabetes: An Altmetric Approach"), here is a search strategy steps to formulate a search model:

1. Research question or objective: What is the impact of randomized controlled trials (RCTs) related to diabetes, as measured by Altmetrics indices?
2. Inclusion and exclusion criteria: Inclusion criteria include RCTs related to diabetes, published in English, and with Altmetric indices available. Exclusion criteria include studies that are not RCTs or are not related to diabetes,conference papers and review articles.
3. Keywords and synonyms for diabetes: Diabetes Mellitus, Type 2, Type II, Type 2 Diabetes, Adult-Onset, Maturity-Onset, Non-Insulin-Dependent, T2D, T2DM, Ketosis-Resistant, Slow-Onset, MODY, NIDDM
4. Keywords and synonyms for RCT: Randomized Controlled Trials as Topic, Controlled Clinical Trial, Randomized Controlled Trial, Controlled Clinical Trial, Clinical Trials as Topic, experimental, quasi-experimental study, interventional study, Single-Blind Method, RCT, Prospective study
5. Search database: Scopus
6. Search filters: Studies must be published in English and include DOI.
7. Search strategy: we used the following search terms used across scopus database:
8. TITLE-ABS-KEY((("Diabetes Mellitus, Type 2" OR (Diabet* AND (type2 OR "type 2" OR "Type II" OR "Type 2 Diabetes" OR Adult-Onset OR Maturity-Onset OR Non-Insulin-Dependent OR " Noninsulin Dependent" OR Slow-Onset OR Stable OR Ketosis-Resistant)) OR NIDDM OR MODY OR T2DM OR T2D))) AND TITLE-ABS-KEY((("Randomized Controlled Trials as Topic" OR "Controlled Clinical Trial" OR "Controlled Clinical Trials as Topic" OR "Randomized Controlled Trial" OR "Controlled Clinical Trial" OR RCT OR placebo OR "Clinical Trials as Topic" OR "experimental study" OR "quasi-experimental study" OR "Quasi Experimental Studies" OR (Studies AND Quasi-Experimental) OR "Non-Randomized Controlled Trials as Topic" OR (Clinical Trial*AND Non-Randomized) OR Non-Randomized Clinical Trial OR Nonrandomized Controlled Trials as Topic OR "interventional study" OR "Double-Blind Method" OR "double blind procedure" OR "Single-Blind Method" OR "single blind

procedure" OR "triple blind" OR crossover OR cross over OR "crossover procedure" OR assign OR match OR matched OR allocation OR allocated OR "prospective study" OR placebo OR "Placebo Effect" OR drug therapy OR cluster OR effects OR (clinical trials AND randomized) OR randomized OR randomly OR RCT OR RANDOM* OR TRIAL* OR groups)))

After identifying the pertinent studies, we conducted a comprehensive examination of the articles using thematic analysis. To ensure accuracy and consistency, we collaborated with a group comprising three specialized physicians in endocrinology and metabolism, as well as the research team. Together, we devised a pharmaceutical categorization for diabetes subjects, which is presented in the table provided below. By taking into account expert opinions, the drug class and methodology employed in each article, as well as the evaluation conducted by our research team, we finalized a selection of 14 subject classifications from the complete texts of the studies. This selection was made based on the objectives, title, methodology, and findings of each study (Table 1).

During the Altmetrics phase, we extracted the DOI of each study and conducted Altmetric analysis using altmetrics.com. By collecting and analyzing data through descriptive methods and Altmetrics measures, we aimed to gain valuable insights into randomized controlled trials of diabetes with Iranian authors.

The altmetric indicators of these studies were obtained from Altmetric Institute (https://www.altmetric.com/)

We followed the steps below to analyze the data using altmetric.com

1. We collected the DOIs of 2179 randomized controlled trials (RCTs) related to diabetes, out of a total of 7844 collected articles in the field of clinical trials for diabetes. We gathered citation data for these articles from Scopus and analyzed 1820 of them that had DOIs, Altmetrics indices, and at least one Iranian author indexed in Scopus. These 1820 articles were also categorized into 14 thematic classifications related to diabetes.
2. We inputted the DOIs into Altmetric.com to retrieve their AAS (Altmetric Attention Score). The AAS is a quantitative measure of the online attention received by a research output, such as an article or dataset. Altmetric.com calculates the AAS using a proprietary algorithm that considers various factors, such as the volume, source, and nature of the attention received across online sources like social media, news outlets, blogs, and policy documents. The AAS is represented by a score between 0 and 100, with a higher score indicating greater levels of attention. Altmetric.com provides this metric to help researchers and institutions assess the impact and reach of their research.
3. We examined the individual AAS for each RCT.
4. We analyzed the data for patterns or trends.We also observed that RCTs published in certain journals or with specific keywords in their titles tended to receive more online attention.
5. We considered the sources of attention and the geographic locations of the attention. We found that social

Table 1 Drug classification in diabetes

Drug class	Examples
Metformin	
Sulfonylureas	DiaBeta, Glynase, or Micronase (glyburide or glibenclamide) Amaryl (glimepiride) Diabinese (chlorpropamide) Glucotrol (glipizide) Tolinase (tolazamide) Tolbutamide
Thiazolidinediones	Actos. Alogliptin/pioglitazone. Avandia. Oseni. Pioglitazone. Rosiglitazone
DPP-4 inhibitors	sitagliptin, saxagliptin, linagliptin, and alogliptin
Incretins	exenatide (Byetta, Bydureon), liraglutide (Victoza)
SGLT2 inhibitors	canagliflozin, dapagliflozin, and empagliflozin
Alpha-glucosidase inhibitors	acarbose (Precose) and miglitol (Glyset)
Insulin	

media platforms like Twitter and Facebook generated the most attention for RCTs related to diabetes, and that attention was concentrated in certain countries or regions.

6. We used the data to draw conclusions and make informed decisions. We utilized the AAS to identify the most impactful RCTs related to diabetes with Iranian authors.
7. The data collected was saved in Excel format using the CSV file format for future analysis. Only randomized controlled trials (RCTs) of diabetes documents with DOI (Digital Object Identifier) were included in the collected data. Subsequently, the variables were transferred to the STATA statistical software for further analysis, taking into account the subject classifications previously established.

Results

A study conducted an analysis of randomized controlled trials on diabetes classified into 14 subject areas, using altmetrics data.

Basic mechanism of diabetes

In the first category, which focused on the basic mechanism of diabetes, 117 items with available DOIs were retrieved from Altmetric.com. The analysis showed that the total outputs tracked were 42, with 138 total mentions and 40 outputs receiving attention. Social media platforms like Twitter and Facebook accounted for 95% of the mentions, while news and other sources like Wikipedia and patents contributed to 4% and 1%, respectively. The study also found that Twitter was the most popular platform for researchers to interact, with 128 tweets by 111 unique tweeters in 20 countries. The geographical map revealed that Iran had one unique tweeter who contributed to 2.3% of the total mentions with three tweets.A map was also provided to illustrate the distribution of tweets across different countries (Fig. 1).

According to Fig. 2, Mendeley was the most popular platform for interaction among users in the analyzed outputs. The demographics of these users, including location and discipline, can be found in the summary tab of the details page. The article with the highest altmetrics score in this category was "Effect of sequence variants on variance in glucose levels predicts type 2 diabetes risk and accounts for heritability" published in Nature Genetics in 2017 with a score of 24.Based on Altmetric.com,top institutional affiliations were Shahid Beheshti University of Medical Sciences, Pasteur Institute of Iran, and National University Hospital of Iceland, with 7(57%), 4(40%), and 1(36%) outputs with a total of 50 mentions respectively.

Figure 3 shows the top institutional affiliations based on Altmetric.com data analyzed in the study. The top three affiliations were Shahid Beheshti University of Medical Sciences, Pasteur Institute of Iran, and National University Hospital of Iceland, with 7 (57%), 4 (40%), and 1 (36%)

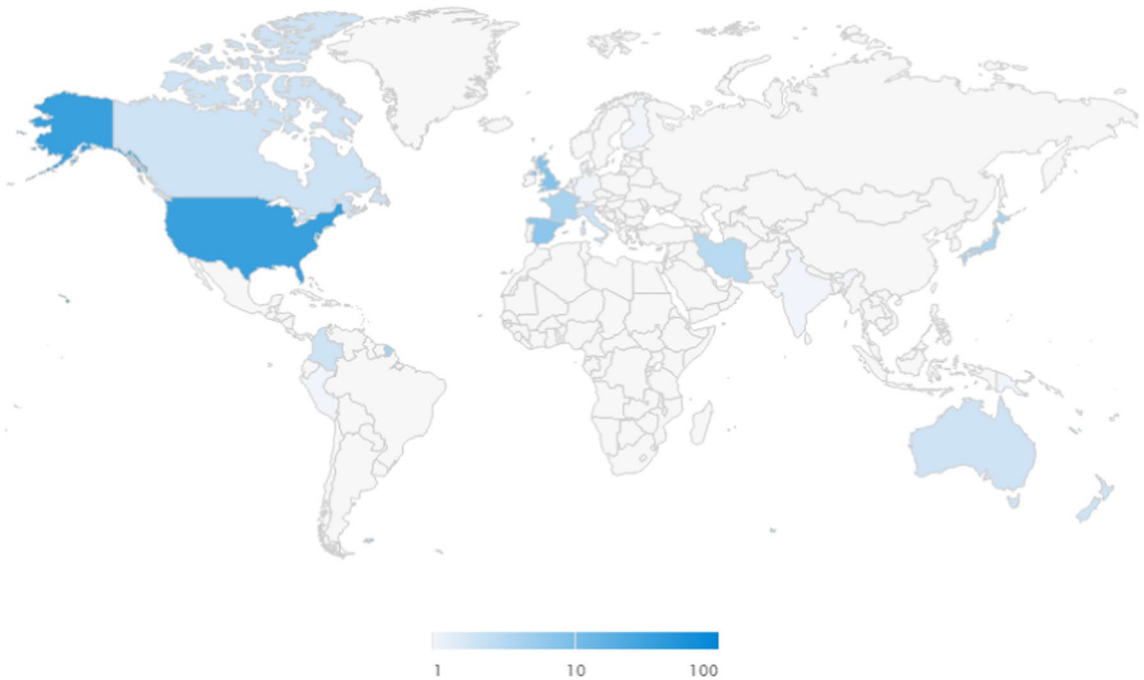

Fig. 1 Geographical distribution of tweets from altmetrics.com in the category of the basic mechanism of diabetes

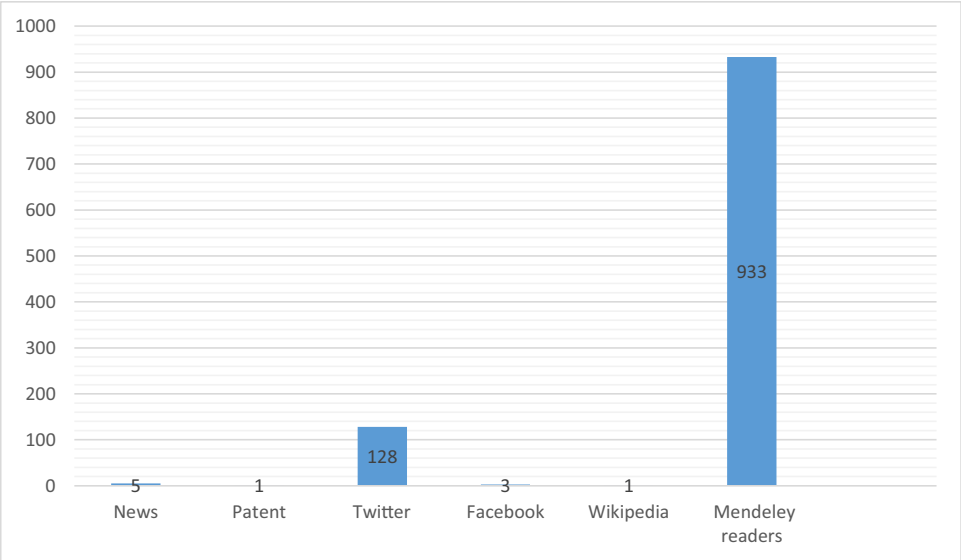

Fig. 2 Altmetrics Attention Score in the category of the basic mechanism of diabetes

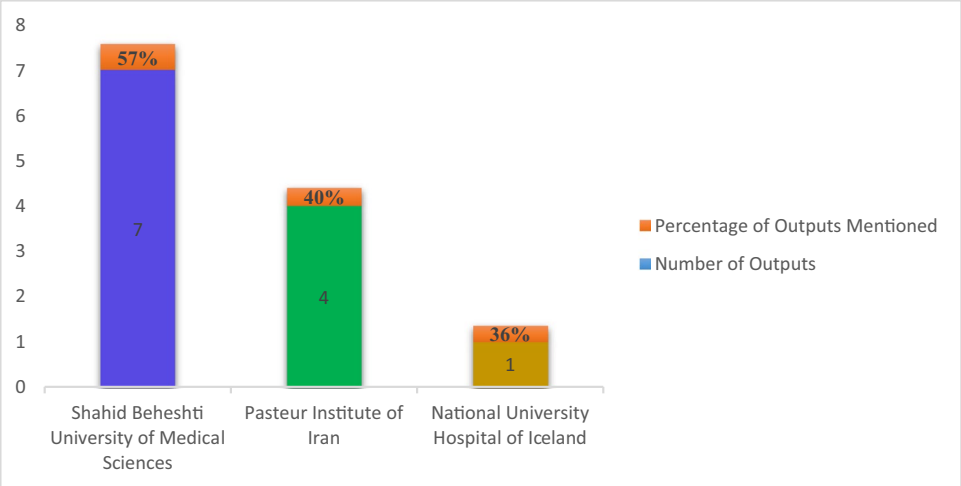

Fig. 3 Top institutional affiliations based on outputs and mentions in basic mechanism of diabetes

outputs, respectively. These affiliations were mentioned in a total of 50 mentions, according to the Altmetric.com data.

Figure 4 shows the percentage of mentions on social media platforms for three different subject areas: Medical and Health Sciences, Clinical Sciences, and Biological Sciences, based on Altmetric.com data analyzed in the study. According to the data, Medical and Health Sciences had the highest percentage of mentions on social media platforms at 77%, followed by Clinical Sciences at 67%. Biological Sciences had the third highest score at 13%.

The figure also highlights that subject categorization in Altmetric.com is done by machine learning techniques, which rely on the articles and not the journals for classification. This means that each article within a journal might receive different keywords, resulting in a more specialized and precise keyword selection process.

When analyzing journals, the data revealed 21 journals with varying degrees of interaction on social media, with The Nature Genetics being the most frequently mentioned journal (Fig. 5).

Comorbidities of diabetes

The study collected research data on comorbidities of diabetes with an available DOI (n = 107 items) from Altmetric.com. The analysis showed that out of the total outputs tracked [19], 38 received attention, with a total of 191 mentions. Social media platforms like Twitter, Facebook, and Google+ accounted for 97% of the mentions, while news and blogs contributed to 2%, and other sources like videos accounted for 1%.

Among the outputs, There have been 173 tweets about this content by 145 unique tweeters in 26 countries.

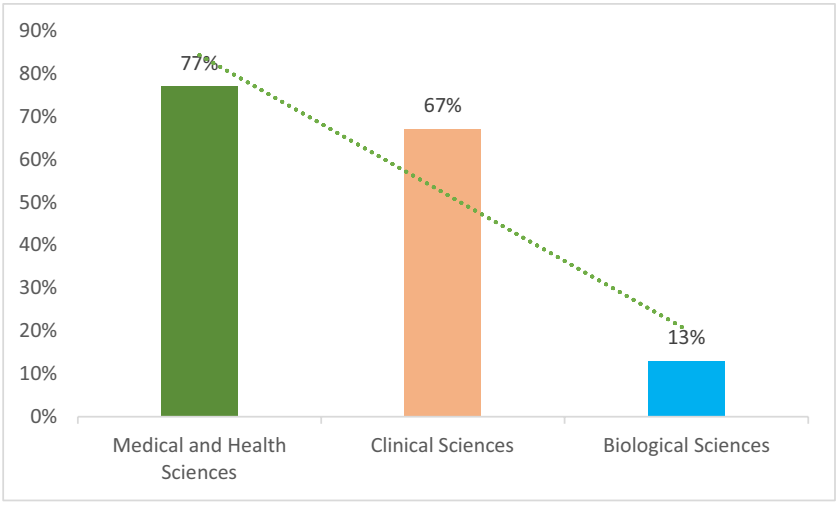

Fig. 4 Subject-Based Variation Mentions on social media platforms

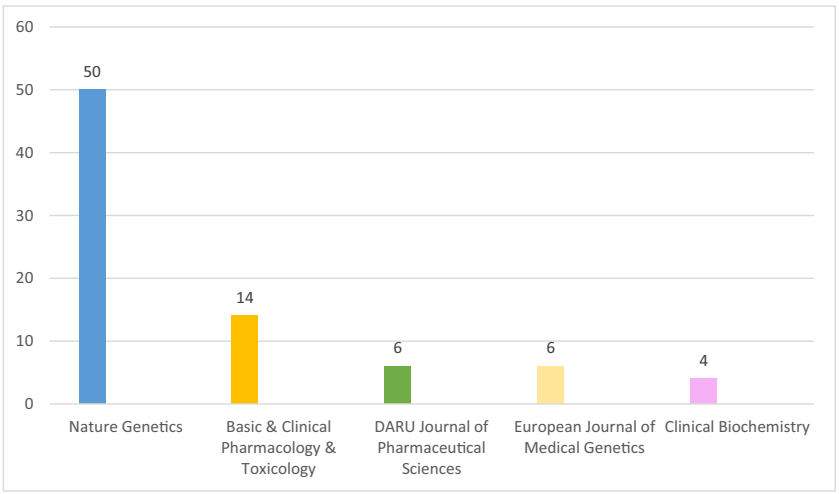

Fig. 5 Journals with more frequency on social media in the category of the basic mechanism of diabetes

According to Fig. 4 Iran has 1 (0.06%) mentions by 1unique tweeters (Fig. 6).

The article with the highest altmetrics score in the comorbidities of diabetes category was "The association of type II diabetes with gut microbiota composition" published in Microbial Pathogenesis in 2017 with a score of 65. Microbial Pathogenesis, with 89 mentions in 1 output, was the most frequently mentioned journal in this category.

This Table 2 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study.When analyzing institutional affiliations, Iran University of Medical Sciences had the highest number of outputs with 5 (50%) and a total of 69 mentions. Tehran University of Medical Sciences had 10 outputs (19%) with a total of 37 mentions, while Western University had one output (7%) with 15 mentions.

Complications of diabetes

The study used Altmetric.com to gather research data on complications of diabetes with an available DOI (n=383 items). The analysis showed that out of the total outputs tracked (122), 104 received attention, with a total of 795 mentions. Social media platforms such as Twitter, Facebook, Google+, and Reddit accounted for 96% of the mentions, while news and blogs contributed to 4%. Other sources, including videos, Q&A posts, and academic sources such as research highlights, accounted for 1% of the mentions.

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 682 tweets from 594 unique tweeters across 36 countries (Fig. 7).

The article with the highest altmetrics score in the complications of diabetes category was "Hookah smoking is strongly associated with diabetes mellitus, metabolic syndrome, and obesity: a population-based study" published in

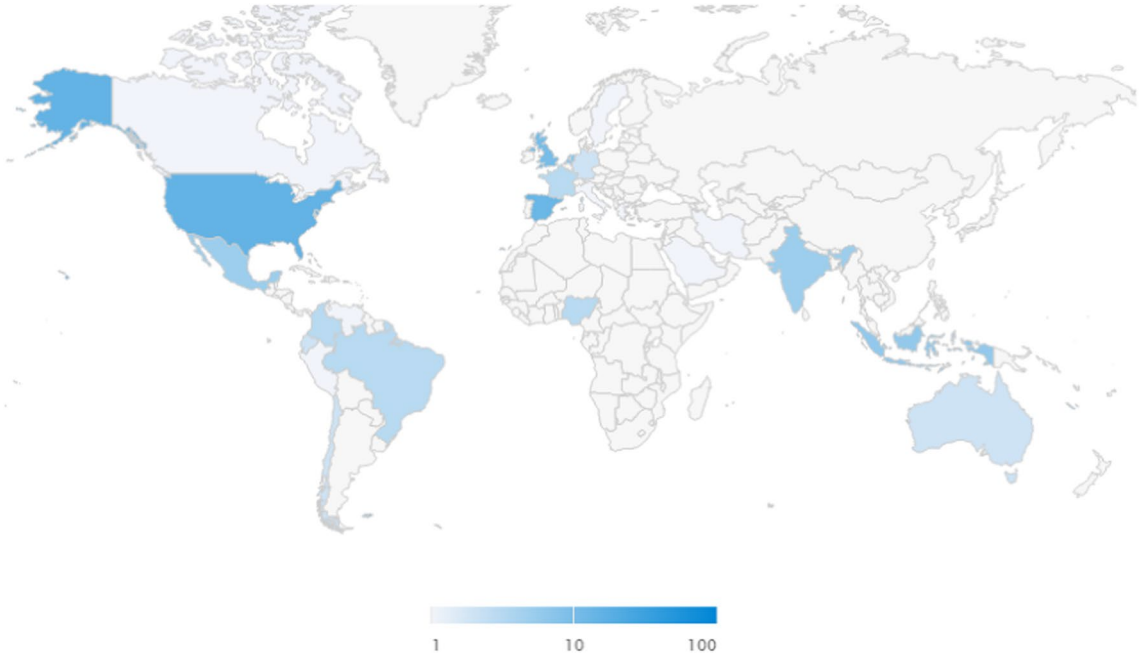

Fig. 6 Geographical distribution of tweets from altmetrics.com in the category of diabetes comorbidities

Table 2 Top institutional affiliations based on outputs and mentions in comorbidities

Institutional affiliation	Number of outputs	Percentage of outputs mentioned	Total mentions
Iran University of Medical Sciences	5	50%	69
Tehran University of Medical Sciences	10	19%	37
Western University	1	7%	15

Diabetology & Metabolic Syndrome in 2018 with a score of 286 [20].

Table 3 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study.Among institutional affiliations, Mashhad University of Medical Sciences had the highest number of outputs with 7 (56%) and a total of 449 mentions. Tehran University of Medical Sciences had 38 outputs (22%) with a total of 181 mentions, while Shahid Beheshti University of Medical Sciences had 17 outputs (12%) with 99 mentions. The table emphasizes the role of institutional affiliations in the dissemination and impact of research. It also highlights the importance of tracking altmetrics to gain insights into the broader reach and influence of research beyond traditional academic metrics.

According to Altmetric.com, the frequency of subjects discussed on social media platforms varied depending on the type of platform. Medical and Health Sciences had the highest percentage of mentions on social media platforms at 95%, followed by Public Health and Health Services at 65%. Clinical Sciences had the third-highest score at 25%.

When analyzing journals, Altmetric.com identified 88 journals with varying degrees of interaction on social media. The following are 5 journals with the highest total mentions. Diabetology & Metabolic Syndrome is a top journal in this category (Fig. 8).

Diagnosis of diabetes

The study used Altmetric.com to gather research data on the diagnosis of diabetes with an available DOI (n=77 items). The analysis showed that out of the total outputs tracked [21], 19 received attention, with a total of 37 mentions. Twitter accounted for 100% of the mentions with 33 tweets, while Facebook contributed to 4 mentions.

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 33 tweets from 32 unique tweeters across 9 countries. No information was provided regarding the demographics of the tweeters (Fig. 9).

The article with the highest altmetrics score in the diagnosis of diabetes category was "Looking at

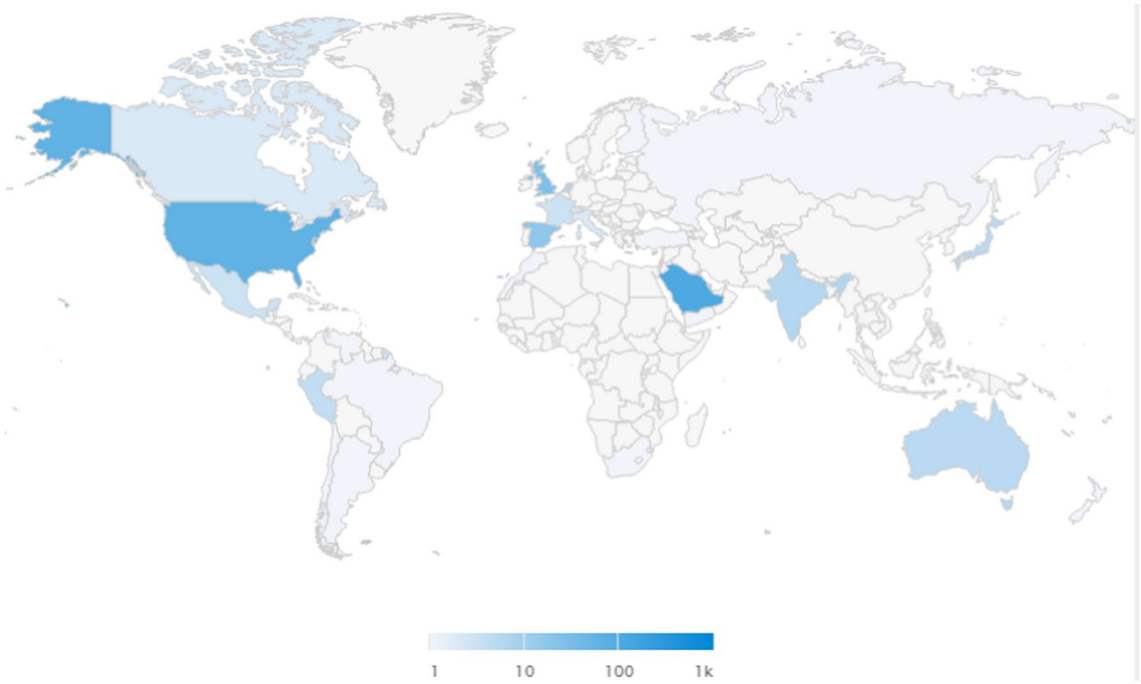

Fig. 7 Geographical distribution of tweets from altmetrics.com in the category of diabetes complications

Table 3 Top Institutional Affiliations and Mentions in the Study of Diabetes Complications

Institutional affiliation	Number of outputs	Percentage of outputs mentioned	Total mentions
Mashhad University of Medical Sciences	7	56%	449
Tehran University of Medical Sciences	38	22%	181
Shahid Beheshti University of Medical Sciences	17	12%	99

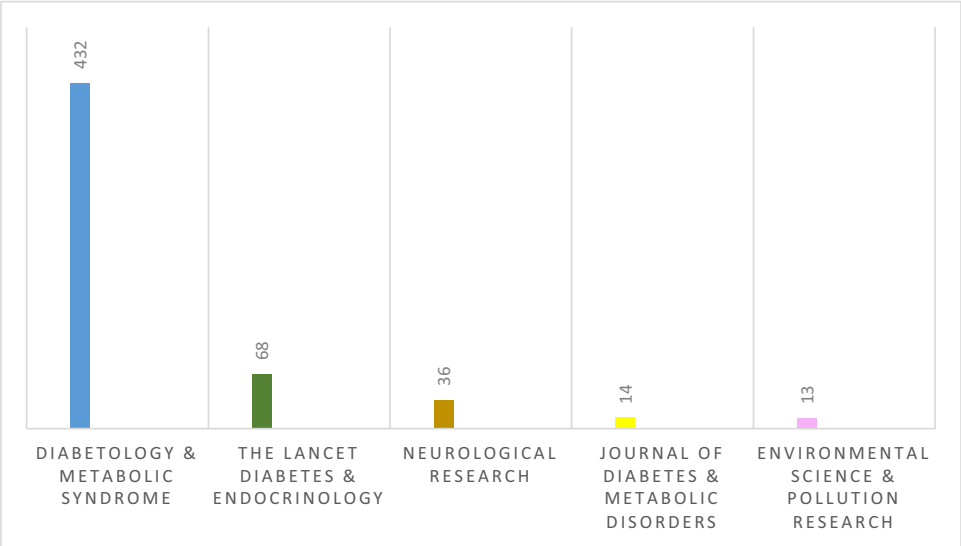

Fig. 8 Journals with the highest frequency appearing on social media in the category of diabetes complications

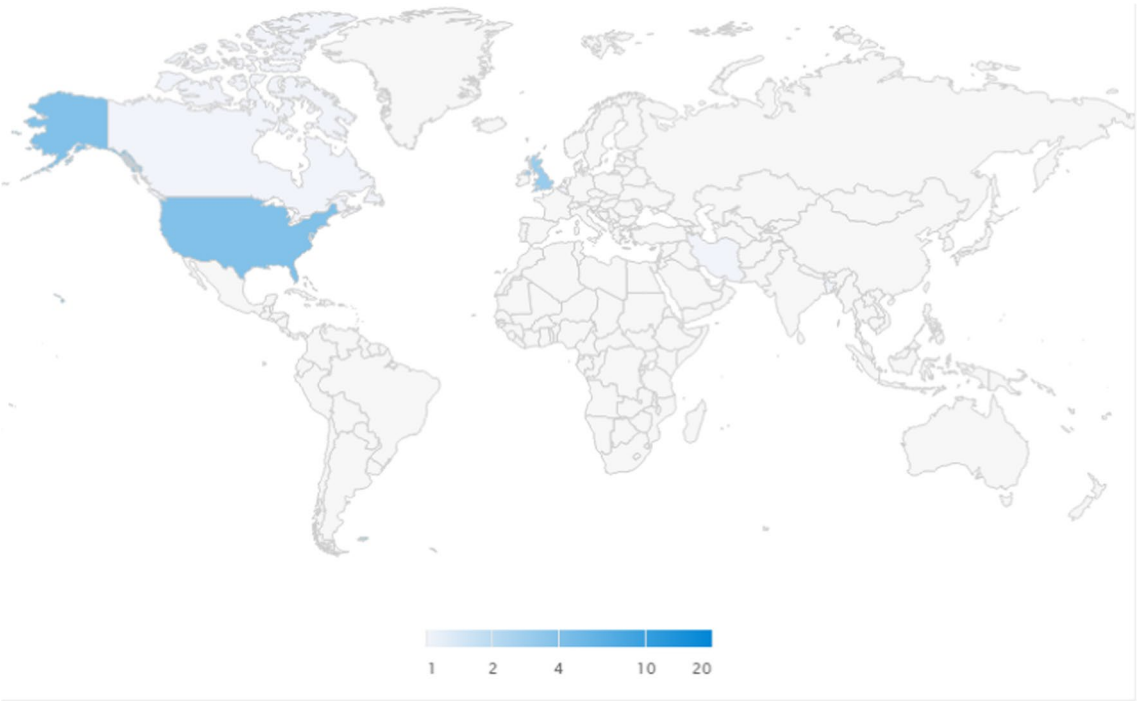

Fig. 9 Tweets demographic from altmetric.com in the category of diagnosis

Table 4 Top institutional affiliations in the field of diagnosis of diabetes

Institutional affiliation	Number of outputs	Percentage of outputs mentioned	Total mentions
National Institute of Genetic Engineering and Biotechnology	1	16%	6
Tehran University of Medical Sciences	5	13%	5
University of Winnipeg	1	13%	5

Marine-Derived Bioactive Molecules as Upcoming Anti-Diabetic Agents: A Special Emphasis on PTP1B Inhibitors" published in Molecules in 2018 with a score of 3 [22].

Table 4 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. Among institutional affiliations, the National Institute of Genetic Engineering and Biotechnology had 1 output (16%) with a total of 6 mentions, Tehran University of Medical Sciences had 5 outputs (13%) with a total of 5 mentions, and the University of Winnipeg had 1 output (13%) with 5 mentions.It underscores the significance of institutional affiliations in research and their potential impact on the visibility and effectiveness of research outcomes. Additionally, it highlights the value of altmetrics in monitoring the online attention and impact of research, which can provide valuable insights into the wider reach and influence of academic research beyond conventional academic metrics.

According to Altmetric.com, the frequency of subjects discussed on social media platforms varied depending on the type of platform. Medical and Health Sciences had the highest percentage of mentions on social media platforms at 48%, followed by Clinical Sciences at 35%. Engineering had the third-highest score at 18%.

When analyzing journals, Altmetric.com identified 13 journals with varying degrees of interaction on social media (Fig. 10).

Education in diabetes

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 47 tweets from 34 unique tweeters across 9 countries. No information was provided regarding the demographics of the tweeters (Fig. 11).

The Altmetrics Attention Scores in other platforms such as academic sources, policies, patents, and others were zero (Fig. 11).

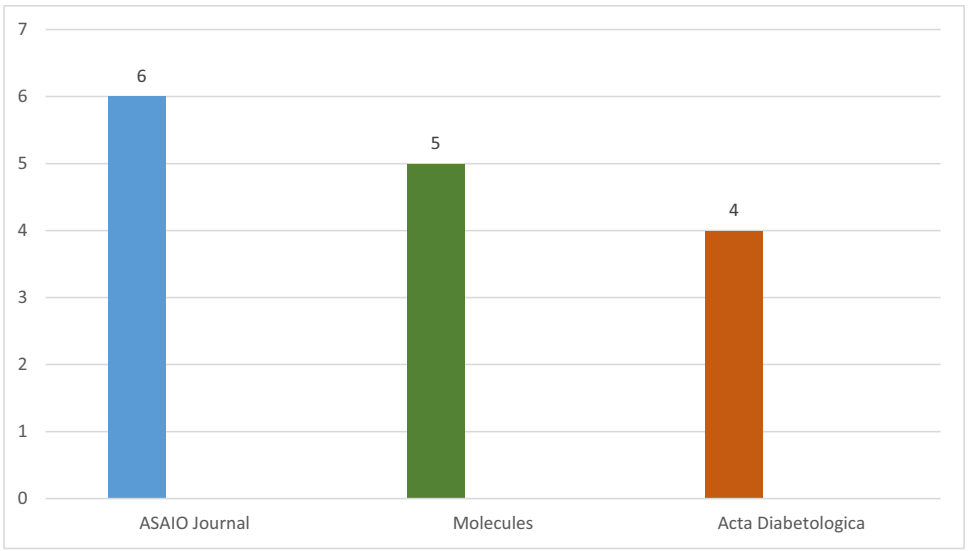

Fig. 10 Journals with the highest frequency on social media in the category of diagnosis

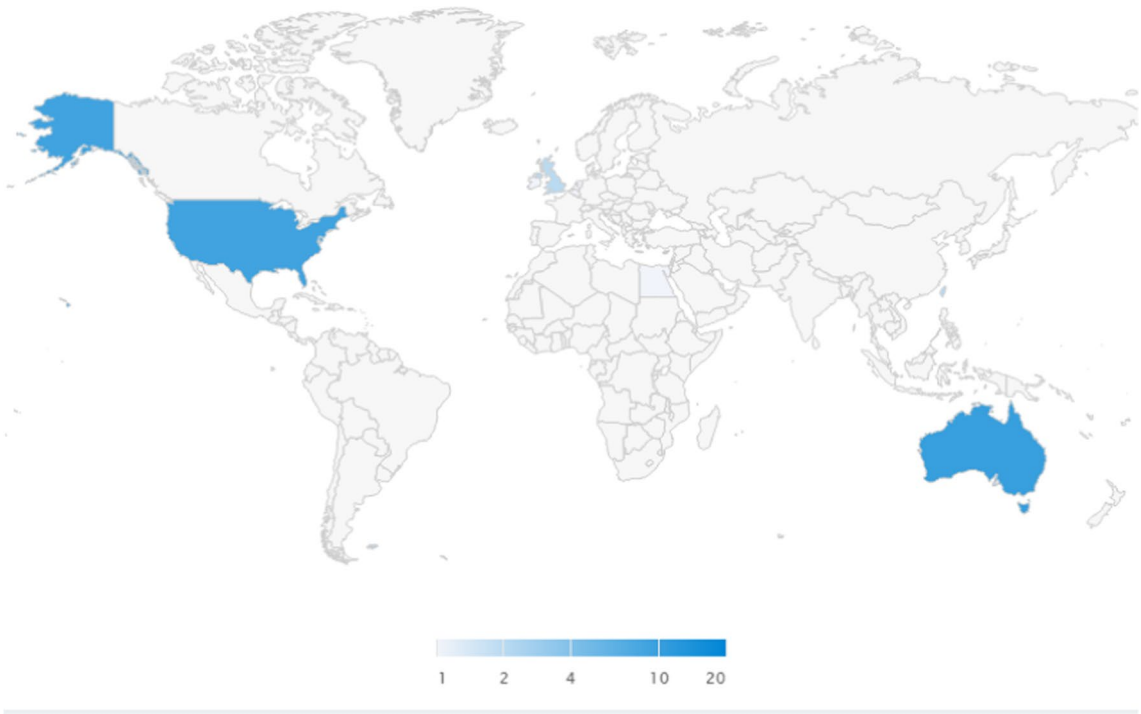

Fig. 11 Tweets demographics from altmetric.com in the category of education in diabetes

The study used Altmetric.com to gather research data on education in diabetes with an available DOI (n=79 items). The analysis showed that out of the total outputs tracked [18], 15 received attention, with a total of 54 mentions. Social media platforms accounted for 96% of the mentions, while news and blogs contributed to 4% (Fig. 12).

The article with the highest altmetrics score in the education in diabetes category was "Validity Study of Video Teleconsultation for the Management of Diabetes: A Pilot Randomized Controlled Trial" published in Diabetes, Technology & Therapeutics in 2015 with a score of 11 [23].

Figure 13 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study.Among institutional affiliations, Tehran University of Medical Sciences had the highest number of outputs with 8 (70%) and a total of 38 mentions. The University of Queensland had 3 outputs (33%) with a total of 18 mentions, while Princess Alexandra Hospital had 3 outputs (33%) with 18 mentions.

According to Altmetric.com, the frequency of subjects discussed on social media platforms varied depending on the type of platform. Medical and Health Sciences had the highest percentage of mentions on social media platforms

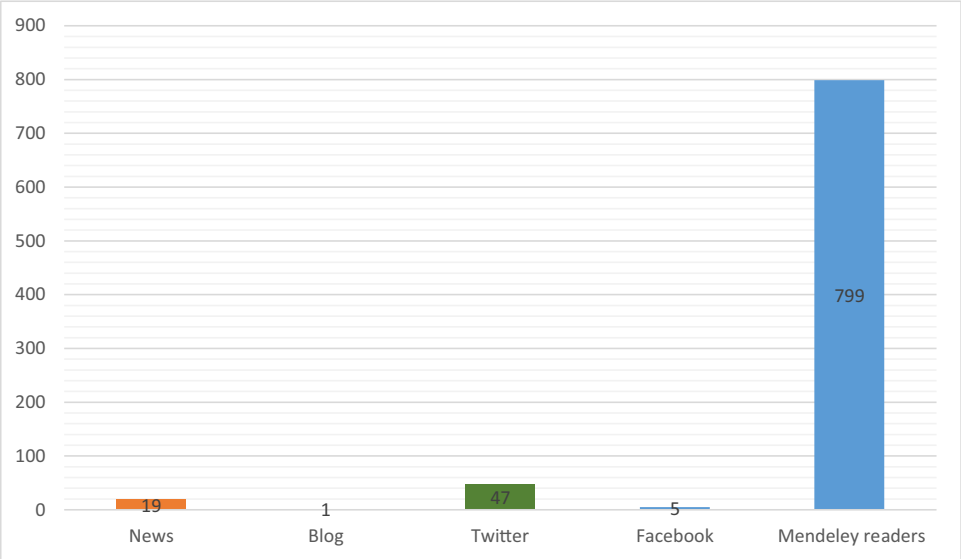

Fig. 12 Altmetrics Attention Score in the category of education in diabetes

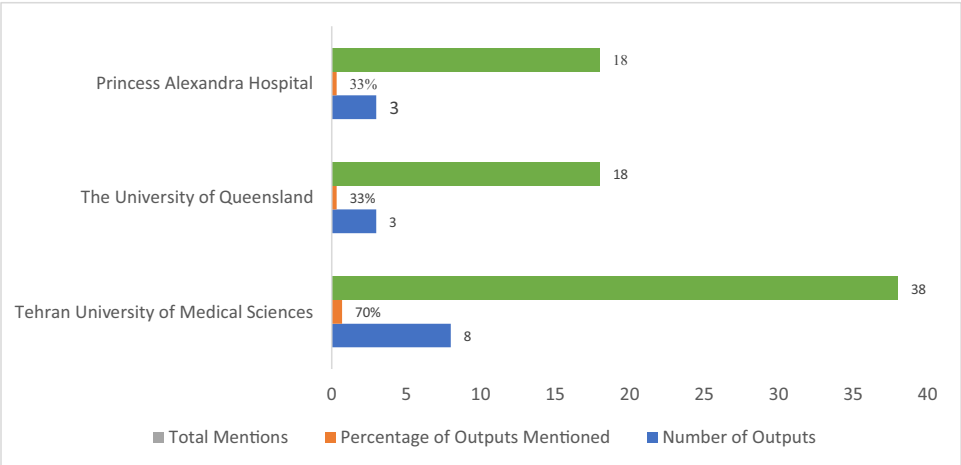

Fig. 13 Top Institutional Affiliations and Mentions in diabetes education

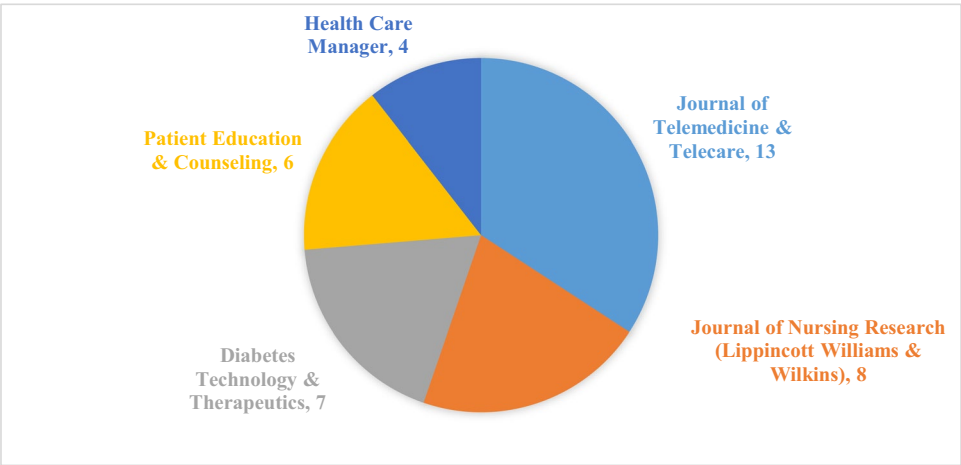

Fig. 14 Journals with the highest frequency on social media in the category of education

at 100%, followed by Public Health and Health Services, which were mentioned in 87% of the posts. Clinical Sciences were the third most commonly discussed subject, mentioned in 46% of the posts.

When analyzing journals, Altmetric.com identified 13 journals with varying degrees of interaction on social media. The top five journals with the highest total mentions were not specified in the text, but The Journal of Telemedicine & Telecare was mentioned as being at the top among them(Fig. 14).

Gestational diabetes

The study used Altmetric.com to gather research data on gestational diabetes with an available DOI (n=77 items). The analysis showed that out of the total outputs tracked [24], 20 received attention, with a total of 145 mentions. Social media platforms accounted for 96% of the mentions, while news and videos contributed to 3% and 1% of the mentions, respectively.

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 102 tweets from 85 unique tweeters across 17 countries. No

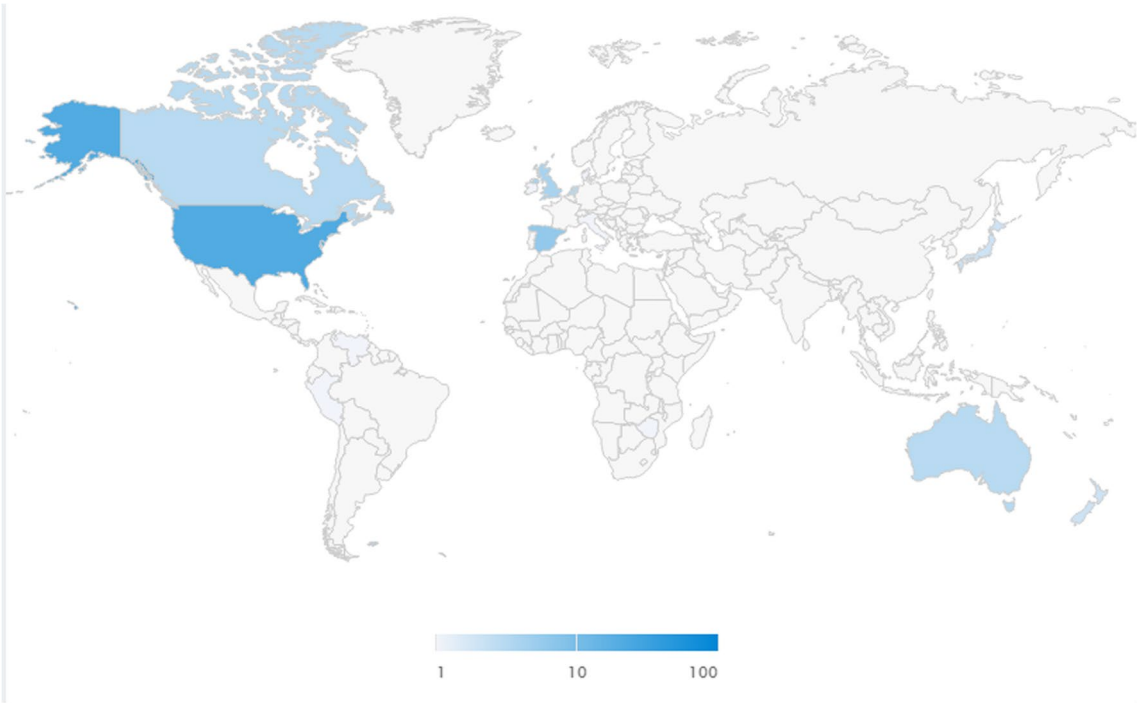

Fig. 15 Tweets demographic of altmetric.com in the category of gestational diabetes

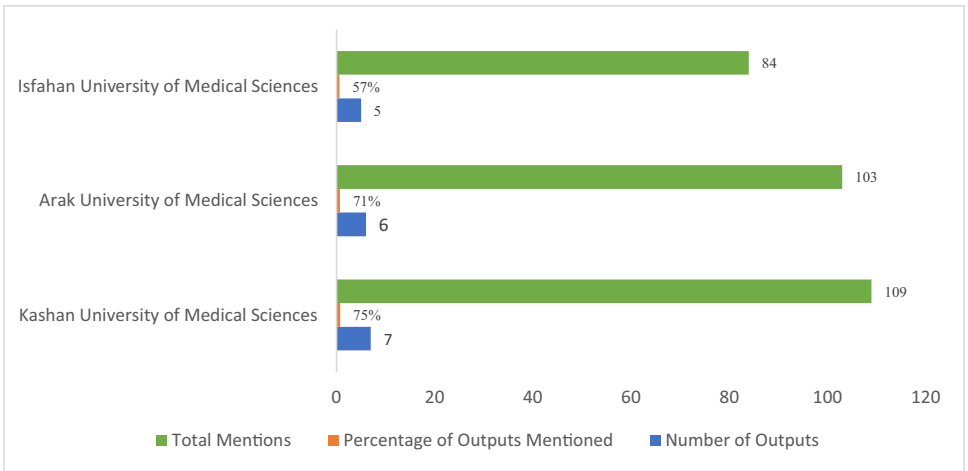

Fig. 16 Top Institutional Affiliations and Mentions in the category of gestational diabetes

information was provided regarding the demographics of the tweeters (Fig. 15).

The article with the highest altmetrics score in the gestational diabetes category was "Magnesium supplementation affects metabolic status and pregnancy outcomes in gestational diabetes: a randomized, double-blind, placebo-controlled trial" published in the American Journal of Clinical Nutrition in 2015 with a score of 31 [25].

Figure 16 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the studyAmong institutional affiliations, Kashan University of Medical Sciences had the highest number of outputs with 7 (75%) and a total of 109 mentions. Arak University of Medical Sciences had 6 outputs (71%) with a total of 103 mentions, while Isfahan University of Medical Sciences had 5 outputs (57%) with 84 mentions.

It is interesting to note that the frequency of subjects varied across different social media platforms in the present study. Medical and Health Sciences received the highest frequency of mentions on social media platforms (99%), followed by Clinical Sciences (89%) and Paediatrics and Reproductive Medicine (52%). This suggests that certain subjects may be more popular or relevant on certain social media platforms, and that researchers should consider tailoring their dissemination strategies accordingly.

The analysis of journals on Altmetric.com also provided valuable insights into the interactions between research and social media. The study identified 20 journals with different interactions on social media, and Figure 13 illustrated the top 5 journals with the highest number of mentions (Fig. 17).

Overall, these findings highlight the importance of considering the different social media platforms and journals when disseminating research. By understanding which subjects and journals are most popular on social media, researchers can tailor their dissemination efforts to reach a wider audience and promote the impact of their research.

Genetics of diabetes

The study used Altmetric.com to gather research data on the genetics of diabetes with an available DOI (n=132 items). The analysis showed that out of the total outputs tracked [26], 26 received attention, with a total of 64 mentions. Social media platforms accounted for 100% of the mentions.

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 61 tweets from 48 unique tweeters across 10 countries. No information was provided regarding the demographics of the tweeters (Fig. 18).

Figure 19 shows that the most popular platform for interaction was Mendeley readers. However, no information was provided regarding the number of mentions or level of engagement on Mendeley compared to other social media platforms (Fig. 19).

The article with the highest altmetrics score in the genetics of diabetes category was "Recessively Inherited LRBA Mutations Cause Autoimmunity Presenting as Neonatal Diabetes" published in Diabetes (the top journal based on altmetrics data in this category) in 2017 with a score of 14 [27].

Tables 5 and 6 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. Among institutional affiliations, Tehran University of Medical Sciences had the highest number of outputs with 12 (32%) and a total of 21 mentions. Shahid Beheshti University of Medical Sciences had 4 outputs (7%) with a total of 10 mentions, while Tarbiat Modares University had 4 outputs (7%) with 5 mentions.It highlights the role of institutional affiliations in research and how they can impact the visibility and impact of research outputs. It also emphasizes the importance of tracking altmetrics to

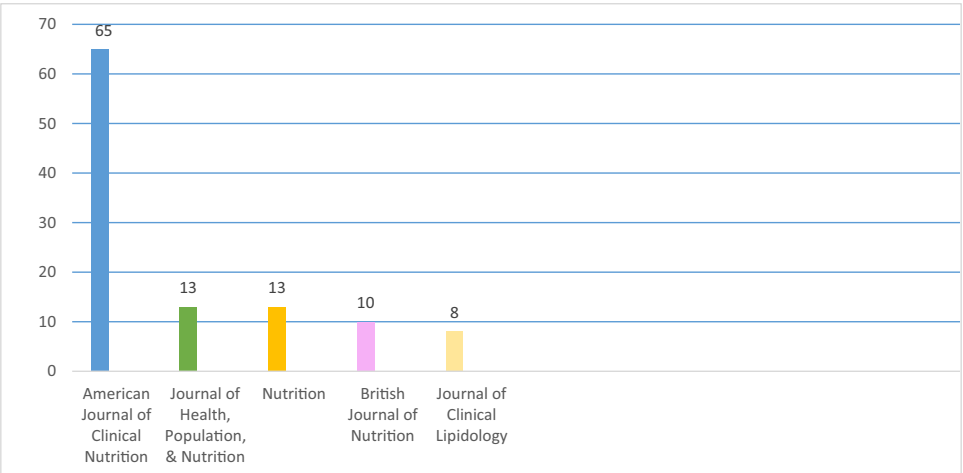

Fig. 17 Journals with the highest frequency on social media in the category of gestational diabetes

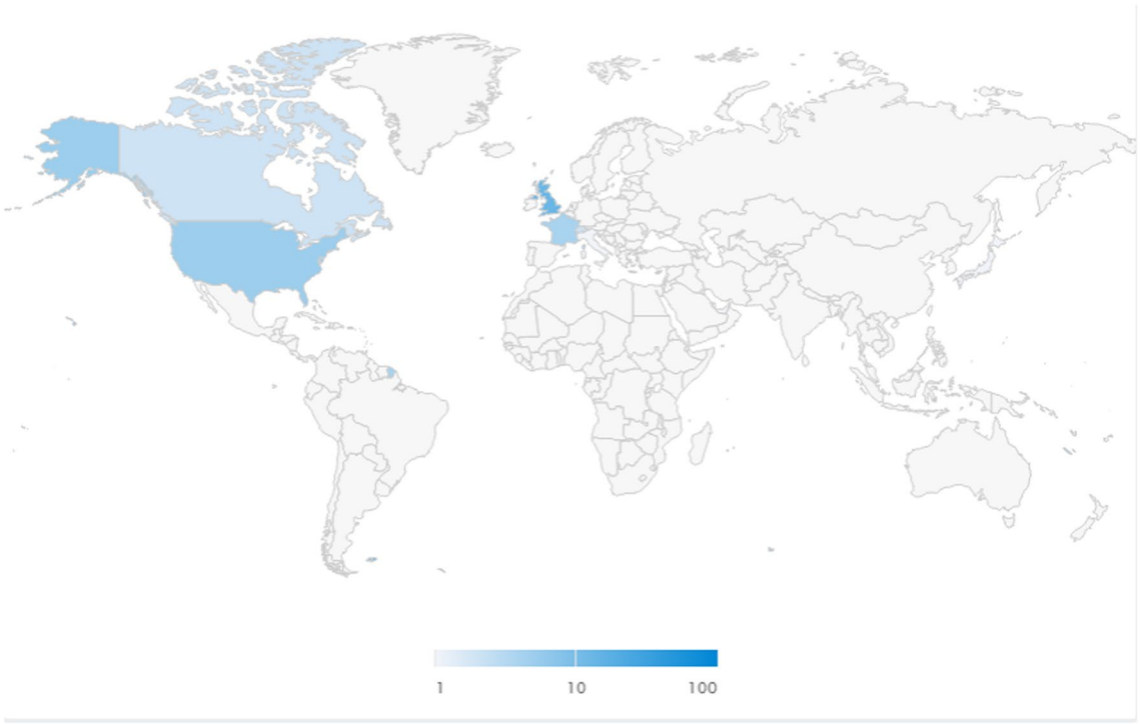

Fig. 18 Tweets demographics of altmetric.com in the area of genetics of diabetes

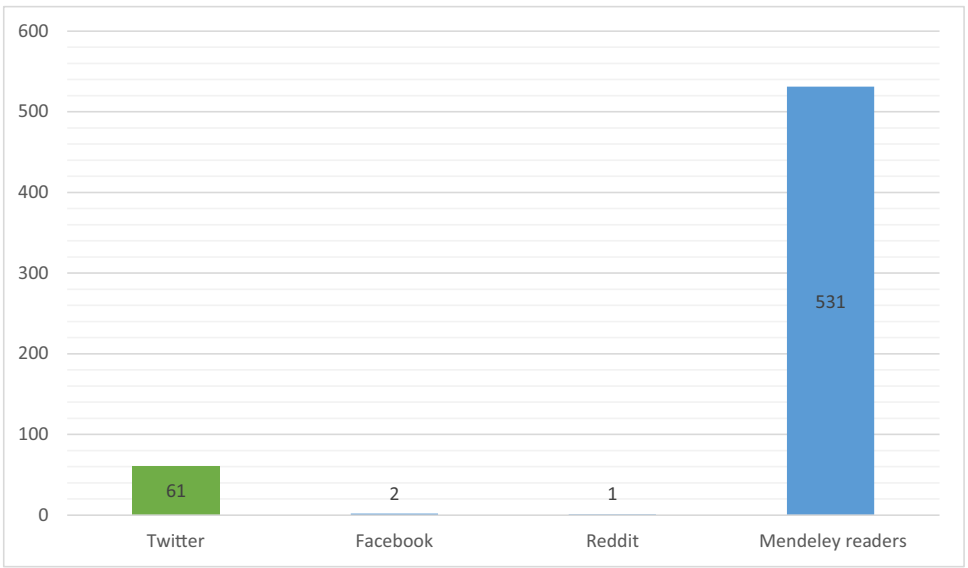

Fig. 19 Altmetrics Attention Score in the category of the genetics of diabetes

Table 5 Top institutional affiliations and mentions in the category of genetics of diabetes

Institutional affiliation	Number of outputs	Percentage of outputs mentioned	Total mentions
Tehran University of Medical Sciences	12	32%	21
Shahid Beheshti University of Medical Sciences	4	7%	10
Tarbiat Modares University	4	7%	5

Table 6 Top Institutional Affiliations and Mentions in the category of nutrition

Institutional affiliation	Number of outputs	Percentage of outputs mentioned	Total mentions
Tehran University of Medical Sciences	49	44%	1096
Novindiet Clinic	1	26%	653
Shahid Beheshti University of Medical Sciences	36	15%	390

gain insights into the broader reach and influence of research beyond traditional academic metrics.

According to Altmetric.com, the frequency of subjects discussed on social media platforms varied depending on the type of platform. Medical and Health Sciences had the highest percentage of mentions on social media platforms at 78%, followed by Immunology at 39%. Clinical Sciences were the third most commonly discussed subject, mentioned in 25% of the posts.

When analyzing journals, Altmetric.com identified 23 journals with varying degrees of interaction on social media. The top five journals with the highest total mentions were not specified in the text, but Diabetes was mentioned as being at the top among them, as shown in Fig. 20.

Nutrition in diabetes

The study used Altmetric.com to gather research data on nutrition in diabetes with an available DOI (n=459 items). The analysis showed that out of the total outputs tracked (241), 225 received attention, with a total of 2469 mentions. Social media platforms, including Twitter, Facebook, Google+, Reddit posts, and Sina Weibo, accounted for 93% of the mentions, while news and blogs contributed to 6%, and other sources, such as videos and Wikipedia, accounted for 1%. Policies and academic sources, such as research highlights and peer review, also accounted for 1% of the total mentions.

According to Altmetric.com, the major interactions among researchers took place on Twitter, with 1784 tweets from 1294 unique tweeters across 63 countries. No information was provided regarding the demographics of the tweeters (Fig. 21).

The map provided in the study shows that Iran had only 1 mention by 1 unique tweeter, accounting for 0.01% of the total interactions on Twitter among researchers discussing nutrition in diabetes.

The Altmetrics Attention Score in other platforms, such as Weibo, Patent, and F1000, was very low, with only 1 mention in total, as shown in Fig. 22.

The article with the highest altmetrics score in the nutrition in diabetes category was "Beneficial effects of replacing diet beverages with water on type 2 diabetic obese women following a hypo energetic diet: A randomized, 24-week clinical trial" published in The Diabetes, Obesity & Metabolism (the top journal in this category) in 2016 with a score of 568.

Tables 5 and 6 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. Among institutional affiliations, Tehran University of Medical Sciences had the highest number of outputs with 49 (44%) and a total of 1096 mentions. Novindiet Clinic had 1 output (26%) with a total of 653 mentions, while Shahid Beheshti University of Medical Sciences had 36 outputs (15%) with 390

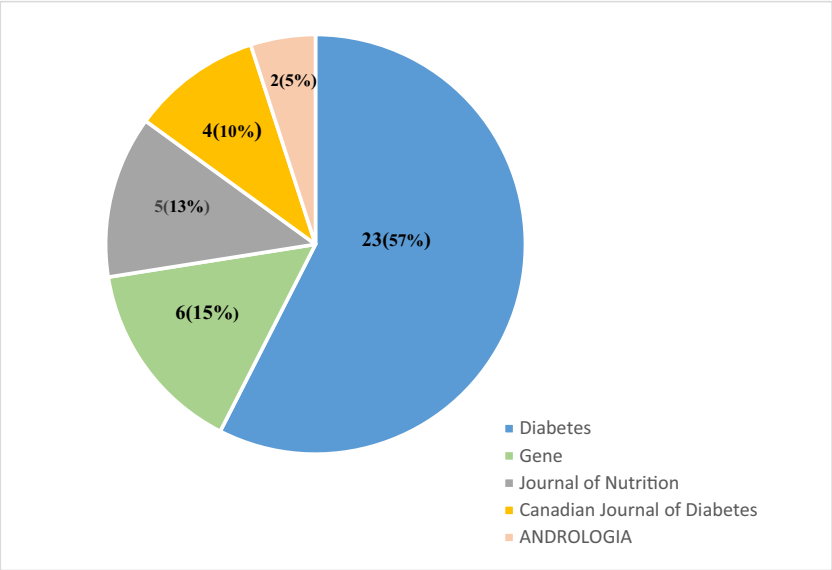

Fig. 20 Journals with the highest frequency on social media in the category of Genetics of diabetes

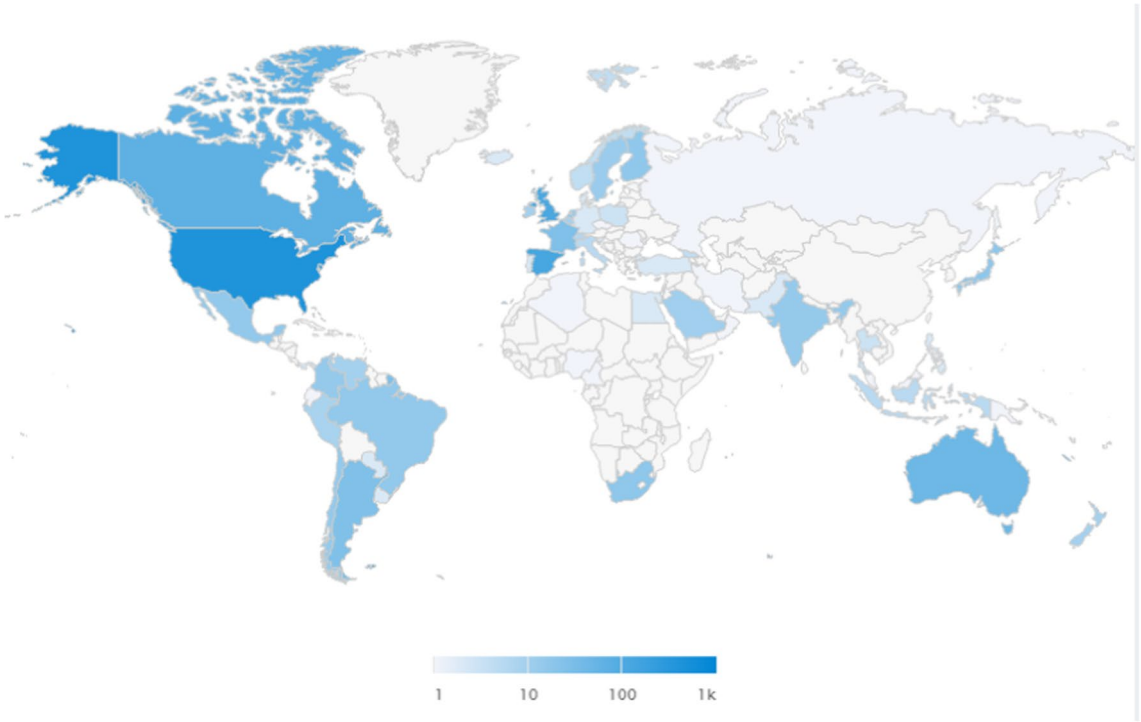

Fig. 21 Tweets demographics of altmetric.com in the area of nutrition

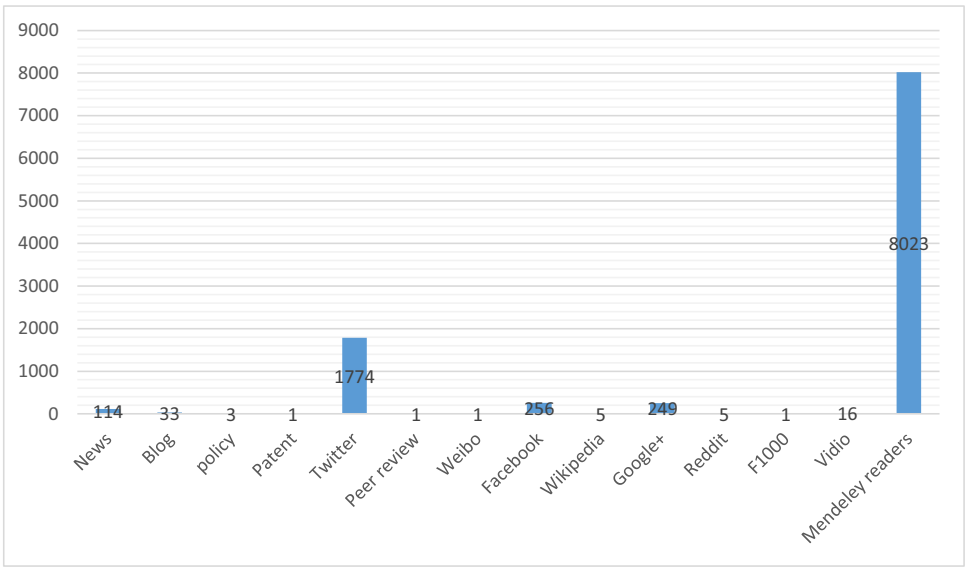

Fig. 22 Altmetrics Attention Score in the category of nutrition

mentions.It highlights the role of institutional affiliations in research and how they can impact the visibility and impact of research outputs. Additionally, it underscores the potential for research outputs from smaller or specialized institutions to gain significant online attention. It also emphasizes the importance of tracking altmetrics to gain insights into the broader reach and influence of research beyond traditional academic metric.

According to Altmetric.com, the frequency of subjects discussed on social media platforms varied depending on the type of platform. Medical and Health Sciences had the highest percentage of mentions on social media platforms at 97%, followed by Clinical Sciences at 89%. Public Health and Health Services were the third most commonly discussed subject, mentioned in 10% of the posts.

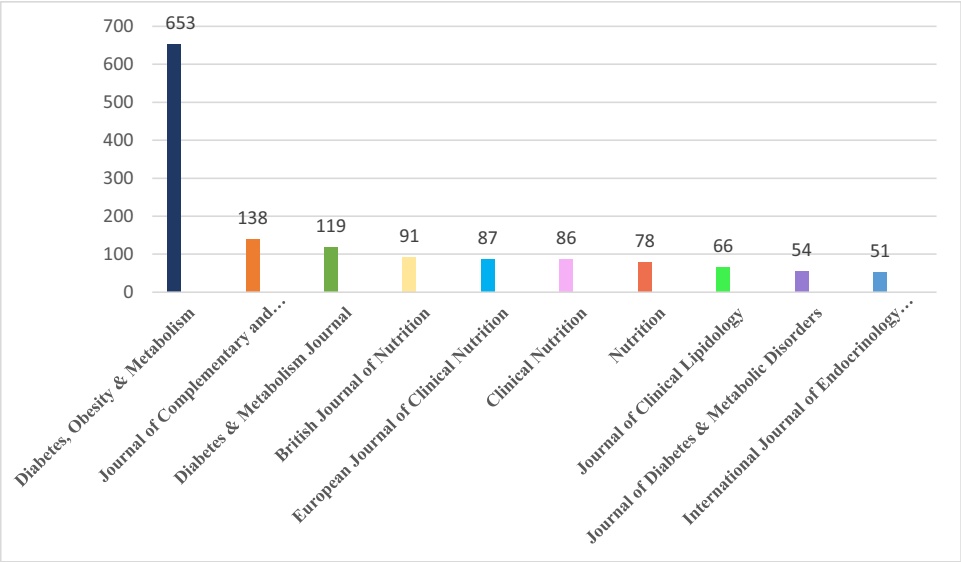

Fig. 23 Journals with the highest frequency on social media in the category of nutrition

According to the journal-wise analysis conducted by Altmetric.com, there were 117 journals with varying degrees of interaction on social media platforms in the nutrition in diabetes category. The top 10 journals with the highest total mentions were not specified in the text, but Diabetes, Obesity & Metabolism was mentioned as being at the top among them, as shown in Fig. 23.

The study also conducted further analysis of policy documents, recognizing their importance. The data showed three policy mentions from three individual posts of research outputs from the results of the search query. The Centers for Disease Control and Prevention (CDC) and the Food and Agriculture Organization of the United Nations were the most cited sources.

Additionally, the data showed one patent mention related to the treatment of genotyped diabetic patients with DPP-IV inhibitors, such as linagliptin. The patent citation included research outputs, but no specific information was provided regarding those outputs in the text.

- Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin [28]
- 2-year efficacy and safety of linagliptin compared with glimepiride in patients with type 2 diabetes inadequately controlled on metformin: a randomized, double-blind, non-inferiority trial [21]

In the Economics category, only four out of six available research outputs were tracked, with four mentions on Twitter (in the UK). One article published in PLoS ONE by Iran University of Medical Sciences had three Mendeley readers.

In Dentistry and Diabetes, all 10 available research outputs were retrieved, but only four outputs were tracked, with a total of 11 mentions and four outputs with attention. The article "A Traditional Mouthwash (Punica granatum var pleniflora) for Controlling Gingivitis of Diabetic Patients" published in the Journal of Evidence-Based Complementary & Alternative Medicine had the highest altmetrics score of 3 with 21 mentions.

In Psychology and Diabetes, out of 77 research outputs, 27 were tracked, with 21 outputs having attention and a total of 98 mentions. Social media had 92% of the mentions, with 75 tweets by 72 unique tweeters in 13 countries. The article "Psychosocial factors and obesity in 17 high-, middle-, and low-income countries: the Prospective Urban Rural Epidemiologic study" published in the International Journal of Obesity had the highest altmetrics score of 27.

In Physical Activity and Diabetes, out of 64 available research outputs, 26 outputs were tracked, with 23 outputs having attention and a total of 193 mentions. The highest altmetrics score of 22 belonged to an article titled "Effects of antenatal diet and physical activity on maternal and fetal outcomes: individual patient data meta-analysis and health economic evaluation" published in Health technology assessment: HTA / NHS R&D HTA Programme. Social media had 94% of the mentions, with 171 tweets by 141 unique tweeters in 18 countries.

In Prevention of Diabetes, out of 43 research outputs, 18 were tracked, with 15 outputs having attention and a total of 80 mentions. The highest altmetrics score of 29 belonged to an article titled "Nut consumption is associated with lower incidence of type 2 diabetes: The Tehran Lipid and Glucose Study" published in Diabetes & Metabolism. Social media had 94% of the mentions, with 67 tweets by 64 unique tweeters in 13 countries.

In Treatment of Diabetes, out of 191 available research outputs, 63 outputs were tracked, with 57 outputs having attention and a total of 276 mentions. Social media had 87%

of the mentions, with news and blogs accounting for 12% of the mentions, and other sources such as videos accounting for 1%. No policy documents or patents were mentioned in this category.

Economics

In the Economics category, only four out of the six available research outputs were tracked, with a total of four mentions on Twitter in the United Kingdom. One of the articles published in PLoS ONE belonged to Iran University of Medical Sciences and had three Mendeley readers. The Mendeley readership is displayed on the detail pages but not included in the Altmetric score, and the number of Mendeley readers for this output was 77.

Dentistry and diabetes

All 10 research outputs with an available DOI were retrieved from Altmetric.com's advanced search option, but only four of them were tracked. The total mentions for these outputs were 11, and only four of them received attention. The primary interaction among researchers occurred on Twitter, with nine tweets by nine unique tweeters in four countries, and there were two mentions on Facebook. The highest altmetrics score of three belonged to an article titled "A Traditional Mouthwash (Punica granatum var pleniflora) for Controlling Gingivitis of Diabetic Patients," published in the Journal of Evidence-Based Complementary & Alternative Medicine in 2016. This article had the highest mention in this category [29].

Psychology and diabetes

Out of the 77 research outputs in this category, 27 were tracked, with 21 of them receiving attention and a total of 98 mentions. Social media platforms, including Twitter, Facebook, Google+, and Reddit posts, accounted for 92% of the mentions, while news accounted for the remaining 8%. According to the demographics map, there were 75 tweets about this content by 72 unique tweeters in 13 countries. The number of Mendeley readers in this category was 820, but Mendeley is not included in the Altmetric score and is only displayed on the details pages.

The highest altmetrics score of 27 belonged to an article titled "Psychosocial factors and obesity in 17 high-, middle-, and low-income countries: the Prospective Urban Rural Epidemiologic study," published in the International Journal of Obesity in 2015. This article was published in the top journal of this category [24].

In this category, the top three journals in terms of mentions were PLoS ONE with 27 mentions, Nutrition, Metabolism, and Cardiovascular Diseases with 19 mentions, and International Journal of Obesity with 9 mentions.

Figure 24 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. The top institutional affiliations in the tracked outputs were Shahid Beheshti University of Medical Sciences (with two outputs, accounting for 31% of the total mentions), Tarbiat Modares University (with one output, accounting for 27% of the total mentions), and Kharazmi University (with one output, accounting for 27% of the total mentions).It shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study.

The frequency of subjects varied across different social media platforms, with Medical and Health Sciences being the most frequent subject (100%), followed by Clinical Sciences (75%). Public Health and Health Services had the third-highest score, accounting for 48% of the mentions.

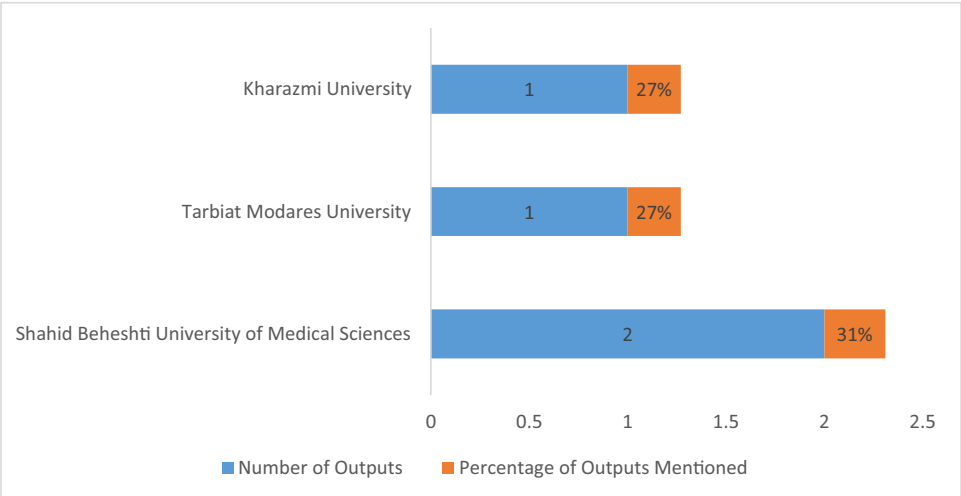

Fig. 24 Top institutional affiliations and mentions in psychology and diabetes

Table 7 Mentions and Demographics of Tracked Research Outputs on Physical activity in diabetes

Research outputs tracked	Total mentions	Social media(Twitter, Facebook, Google+)	Academic sources	News and blogs	Videos	Mendeley readers	Tweets	Unique tweeters	Countries
26	193	94%	4%	2%	1%	1086	171	141	18

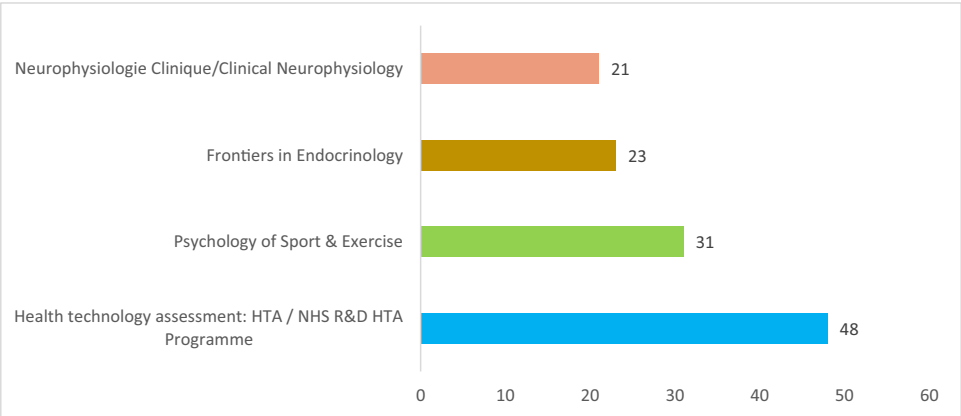

Fig. 25 Top Journals and Mentions in physical activity in diabetes

Table 8 Top institutional affiliations and mentions in physical activity in diabetes

Institutional affiliation	Number of outputs	Total mentions
Federal University of Sao Paulo	1	48
California Polytechnic State University	1	48
King's College London	1	48

Physical activity in diabetes

All 64 research outputs with an available DOI were retrieved from Altmetric.com's advanced search option, but only 26 of them were tracked.

Table 7 shows the total mentions for these outputs were 193, with social media platforms such as Twitter, Facebook, and Google+ accounting for 94% of the mentions, academic sources accounting for 4%, news and blogs accounting for 2%, and videos accounting for 1%. The number of Mendeley readers in this category was 1086, but Mendeley is not included in the Altmetric score and is only displayed on the details pages. According to the demographics map, there were 171 tweets about this content by 141 unique tweeters in 18 countries.

Figure 25 shows the top journals and their corresponding number of mentions based on Altmetric.com data analyzed in the study. The top journal in this category was Health technology assessment: HTA / NHS R&D HTA Programme, with 48 mentions, followed by Psychology of Sport & Exercise with 31 mentions, Frontiers in Endocrinology with 23 mentions, and Neurophysiologie Clinique/Clinical Neurophysiology with 21 mentions. Other journals had less than 20 mentions.

Table 8 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. The top institutional affiliations in the tracked outputs were the Federal University of Sao Paulo, California Polytechnic State University, and King's College London, each with one output and a total of 48 mentions.It highlights the impact of institutional affiliations on the visibility and impact of research outputs. Additionally, it underscores the potential for research outputs from smaller or specialized institutions to generate significant online attention. It also emphasizes the importance of tracking altmetrics to gain insights into the broader reach and influence of research beyond traditional academic metrics.

The frequency of subjects varied across different social media platforms, with Medical and Health Sciences being the most frequent subject (93%), followed by Clinical Sciences (67%). Public Health and Health Services had the third-highest score, accounting for 42% of the mentions.

The highest altmetrics score of 22 belonged to an article titled "Effects of antenatal diet and physical activity on maternal and fetal outcomes: individual patient data meta-analysis and health economic evaluation," published in Health technology assessment: HTA / NHS R&D HTA Programme (the top journal in this category) in 2017 [30].

Prevention of diabetes

Out of the 43 research outputs in this category, 18 were tracked, with 15 of them receiving attention and a total of 80 mentions. Social media platforms such as Twitter and Facebook accounted for 94% of the mentions, while academic sources and news each accounted for 3% of the mentions. Other sources, such as videos, accounted for 1% of the mentions. The number of Mendeley readers in this category was 452, but Mendeley is not included in the Altmetric score and is only displayed on the details pages. According to the demographics map, there were 67 tweets about this content by 64 unique tweeters in 13 countries.

The highest altmetrics score of 29 belonged to an article titled "Nut consumption is associated with lower incidence of type 2 diabetes: The Tehran Lipid and Glucose Study," published in Diabetes & Metabolism, which is the top journal in this category, in 2017 [31].

In this category, the top three journals in terms of mentions were Diabetes & Metabolism with 44 mentions, Diabetologia with 7 mentions, and Fertility & Sterility with 6 mentions.

Figure 26 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study. The top institutional affiliations in the tracked outputs were Shahid Beheshti University of Medical Sciences (with six outputs, accounting for 72% of the total mentions), Tehran University of Medical Sciences (with three outputs, accounting for 65% of the total mentions), and University of Tehran (with two outputs, accounting for 10% of the total mentions).

The frequency of subjects varied across different social media platforms, with Medical and Health Sciences being the most frequent subject (98%), followed by Public Health and Health Services (67%) and Clinical Sciences (32%).

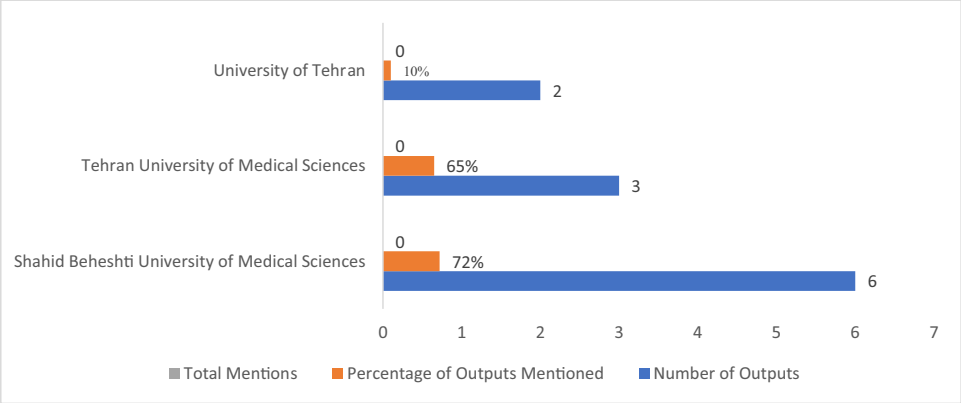

Fig. 26 Top Institutional Affiliations and Mentions in prevention of diabetes

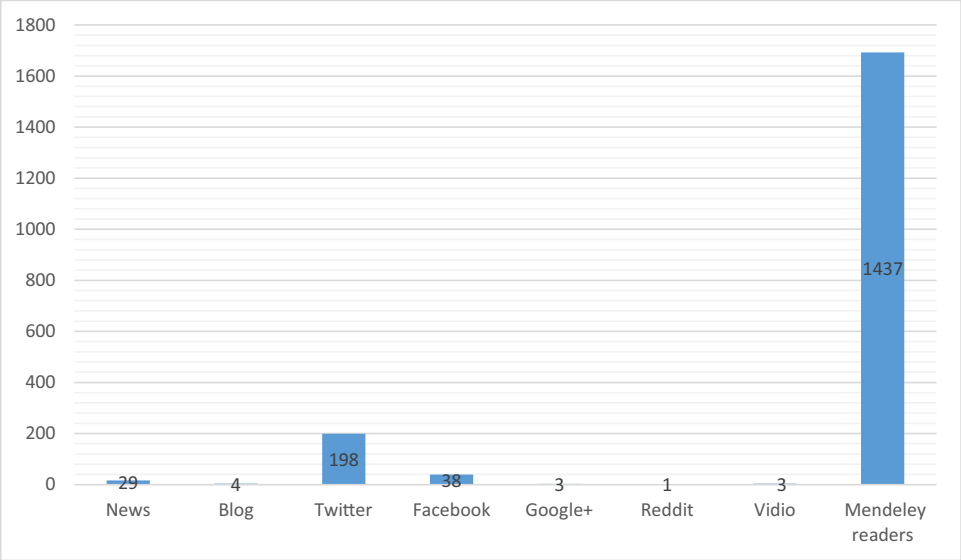

Fig. 27 Altmetrics Attention Score in the category of treatment of diabetes

Treatment of diabetes

In the treatment of diabetes category, all 191 research outputs with an available DOI were retrieved from Altmetric.com, but only 63 of them were tracked. The total mentions for these outputs were 276, with social media platforms such as Twitter, Facebook, Google+, and Reddit posts accounting for 87% of the mentions, news and blogs accounting for 12% of the mentions, and other sources such as videos accounting for 1% of the mentions. Policy documents and patents, as well as academic sources, were not mentioned in this category (Fig. 27).

According to Altmetric.com, the major interaction of researchers in the treatment of diabetes category has taken place on Twitter, with 198 tweets by 142 unique tweeters in 18 countries (Fig. 28). The map also shows that Iran had 8 (4%) of the mentions by 2 unique tweeters.

The highest altmetrics score in the treatment of diabetes category belonged to an article titled "Curcuminoids modify lipid profile in type 2 diabetes mellitus: A randomized controlled trial," with an 81 altmetrics score. This article

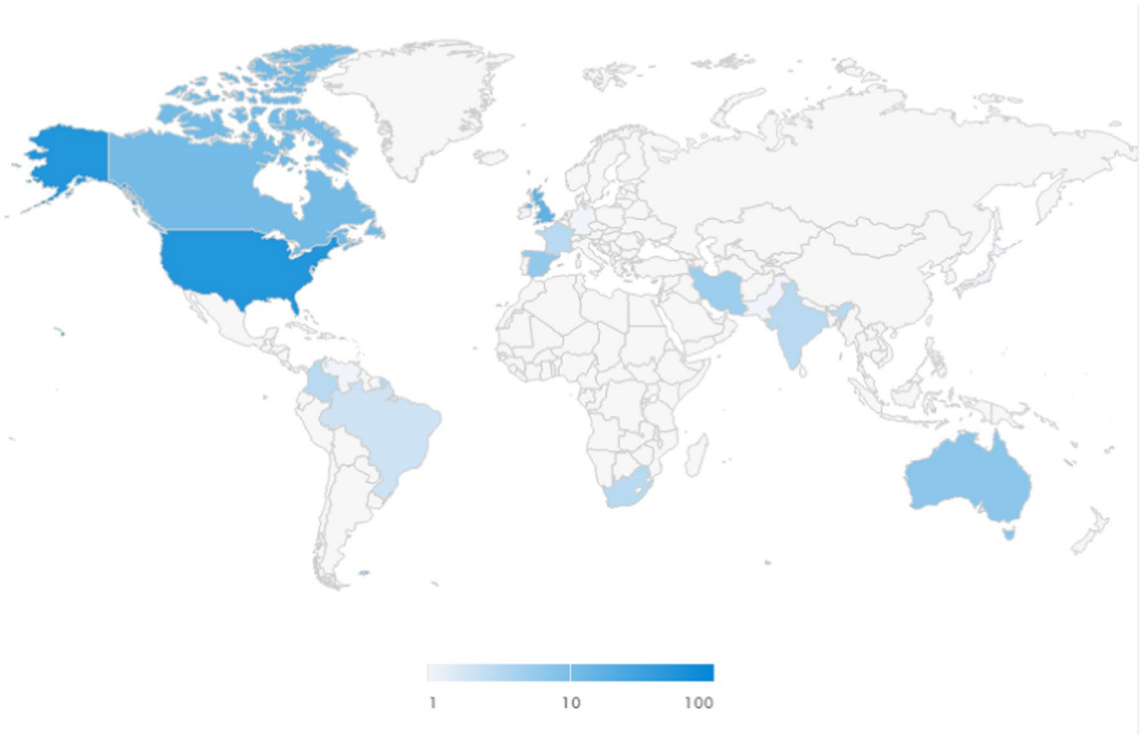

Fig. 28 Tweets demographics of altmetric.com. in the category of treatment of diabetes

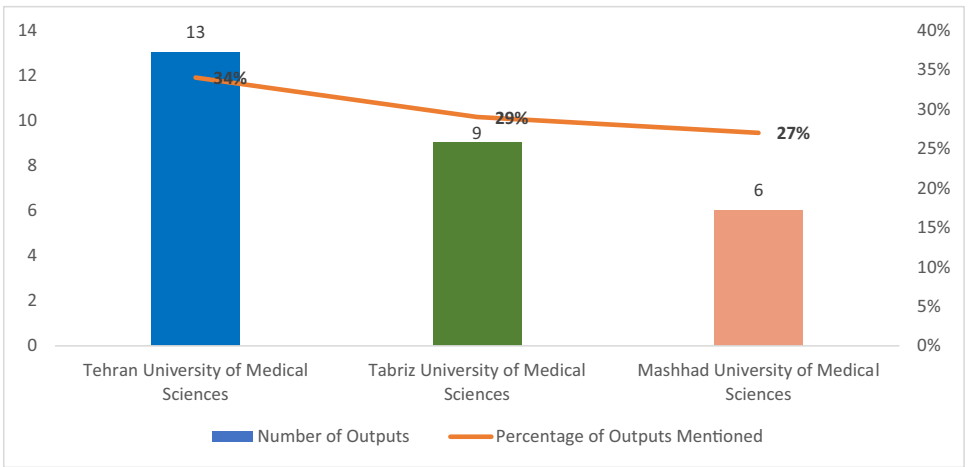

Fig. 29 Top Institutional Affiliations and Mentions in treatment of diabetes

was published in The Complementary Therapies in Medicine, which is the top journal based on altmetrics data in this category, in 2017 [32].

Figure 29 shows the institutional affiliations and their corresponding outputs and mentions based on Altmetric.com data analyzed in the study.The top institutional affiliations in the tracked outputs were Tehran University of Medical Sciences (with 13 outputs, accounting for 34% of the total mentions), Tabriz University of Medical Sciences (with nine outputs, accounting for 29% of the total mentions), and Mashhad University of Medical Sciences (with six outputs, accounting for 27% of the total mentions).

The frequency of subjects varied across different social media platforms, with Medical and Health Sciences being the most frequent subject (90%), followed by Clinical Sciences (85%), and Biological Sciences (11%).

According to Altmetric.com, there were 46 journals with different interactions on social media in this category, with The Complementary Therapies in Medicine being at the top in terms of total mentions (Fig. 30).

Discussion

The provision of altmetrics to authors can serve as an effective strategy to encourage them to disseminate their research and connect with a wider audience. Altmetrics can offer authors a more comprehensive understanding of the impact of their work beyond the traditional citation metrics. By monitoring the reception of their research on social media, news outlets, and other platforms, authors can gain valuable insights into how their work is being perceived and discussed by a diverse audience. This can motivate authors to engage in outreach activities and promote a dialogue about their work, ultimately leading to increased engagement and impact [1].

Engagement by authors is particularly important in the dissemination of research in the field of diabetes, where the impact of research can have significant implications for public health [26]. By engaging with the public, policymakers, and other stakeholders, authors can help to promote the translation of research into practice and improve health outcomes for individuals with diabetes. Overall, altmetrics can be a valuable tool for authors to track and increase the impact of their research and to engage with a broader audience beyond the academic community.

This can motivate authors to engage in outreach activities and create a conversation about their work that can lead to further engagement and impact. By making research more accessible to non-experts, authors can promote a greater understanding of key societal issues, such as diabetes, which can benefit society as a whole [33, 34].

The subject categorization of Altmetrics Company using machine learning techniques is a useful approach to providing more specialized and precise keyword selection. Our finding shows that Medical and Health Sciences and Public Health and Health Services have received the highest Altmetric Attention Scores in all fields is not surprising, given the significant impact of research in these areas on public health and wellbeing. The high score for Clinical Sciences further highlights the importance of research in this field for advancing our understanding of diseases such as diabetes and improving patient outcomes.

Overall, by tracking the outcomes of broader engagement activities, such as social media engagement and public outreach, authors can demonstrate the influence of their work to potential funders, hiring committees, and national research performance reviews. This can help to promote

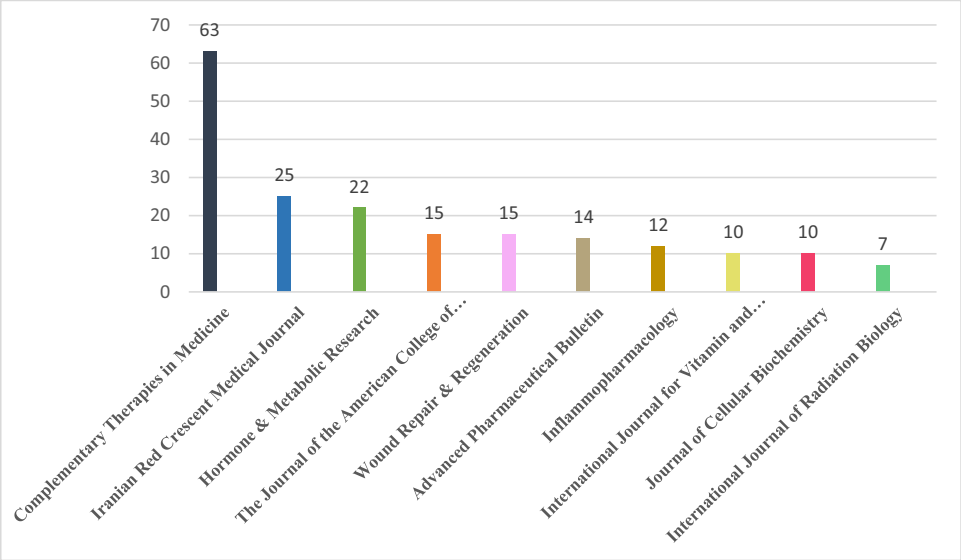

Fig. 30 Top journals with the highest frequency on social media in the category treatment of diabetes

the translation of research into practice and improve health outcomes for individuals with diabetes and other health conditions

Mendeley readership data can offer valuable insights into the impact of research among academics and other researchers, which I consider to be significant. While it's crucial to engage with laypersons, tracking readership data can help authors gauge the extent to which their research is being regarded by other researchers and potentially being used in future publications. This data can provide authors with a better understanding of their research's impact and enable them to make more informed decisions about future publications, thereby contributing to the advancement of their field of study [35].

The fact that Mendeley readership data is not included in the Altmetric score does not diminish its value as a measure of impact. By providing information on the demographics of Mendeley users who have saved a paper in their academic library, authors can gain a better understanding of the reach of their research within the academic community. This information can be particularly useful for researchers looking to build collaborations and partnerships with other researchers in related fields [36].

Overall, while Altmetric scores provide valuable insights into the impact of research beyond traditional citation metrics, readership data such as that provided by Mendeley can provide a more nuanced understanding of the reach of research among the academic community. By tracking both engagement with laypersons and readership data, authors can gain a more comprehensive understanding of the impact of their research and use this information to inform future dissemination and collaboration efforts [37].

Mendeley readership data can provide valuable insights into the impact of research among academics and other researchers, including geographic and discipline information for readers who have saved a paper in their academic library. It has been demonstrated that Mendeley readership data is a highly effective predictor of future citations, and can be used in conjunction with other altmetrics indices to differentiate between highly-cited publications and those whose citation counts increase rapidly. This highlights the importance of monitoring readership data in order to fully understand the impact of one's research and the value of altmetrics in providing a more comprehensive view of research impact [38].

The positive correlation between altmetrics indices and citation counts has been demonstrated in several studies, including the one by Scarlat et al. This suggests that utilizing the tools of altmetrics alongside traditional citation counts is a strong indicator of the impact of research [13].

The study on the relationship between alternative measures in the F1000 system with Google Scholar citation count further supports the use of altmetrics as a complementary measure of research impact. The strong positive correlation between altmetric indexes themselves indicates that they capture different aspects of research impact and can provide a more comprehensive understanding of the reach and influence of research [25].

Overall, the use of altmetrics, including Mendeley readership data, can provide a useful tool for authors to track the impact of their research beyond traditional citation metrics. By combining altmetrics with citation counts, authors can gain a more comprehensive understanding of the impact of their research and use this information to inform future dissemination efforts and collaboration opportunities [39].

Using Twitter as a platform for researchers to engage with the public and promote their research can be highly beneficial. The large number of tweets related to the article in this study suggests that public outreach to the article is effective and that there is significant interest in the research among the Twitter user community. However, as previously mentioned, tweets made by researchers may be outnumbered by those made by the general public. This issue has been explored in prior research, including a study conducted by Malik in 2019 that surveyed Twitter users to understand their use of Twitter for academic purposes [40].

Another study by Aryani et al. assessed the research capabilities of postgraduate students considering the role of social media. The findings of their study suggest that students who use social media with hypertext function are significantly more capable in terms of research capabilities compared to other students. This highlights the potential benefits of using social media platforms such as Twitter for academic purposes, including promoting research and enhancing research capabilities [16]. In Ouchi study,focused on studying the presence of highly cited papers from the journal Nature on social media platforms and tools; 98.9% of the highly cited articles were mentioned at least once on different social media platforms and the most used altmetric source in these articles is Mendeley, followed by Citeulike and Wikipedia [41].

Overall, in our study,twitter can be a useful tool for researchers to engage with the public and promote their research. While researchers' tweets may be in the minority compared to the tweets made by the general public, studies have shown that social media platforms can enhance research capabilities and provide a valuable tool for academic purposes.

Itis widely acknowledged that news coverage can significantly influence public understanding and perceptions of research. The findings of this study, which indicate that news outlets received more attention than Facebook, highlight the continued importance of mainstream news outlets and magazines as a source of information for the public. Moreover, the study's results reinforce the notion that coverage in these outlets can have a substantial impact on the public's perception of research

Altmetric's collection of online mentions of scholarly papers from news outlets is a valuable tool for tracking the impact of research in the media. By tracking a manually-curated list of RSS feeds from news websites and adding each news source individually, Altmetric can provide a comprehensive overview of the frequency of mentions in mainstream news outlets and magazines, including those in non-English-speaking countries. In Erfanmanesh study, Out of the 563 Iranian Information Scienes & Library of Science articles, 72 papers (12.8%) were mentioned at least once on different social media platforms. Twitter emerged as the most promising altmetric source for Iranian IS & LS papers, followed by Mendeley and CiteULike;it shows that found statistically significant but moderate relationships between Mendeley and CiteULike readership counts and the number of citations in Web of Science and highlightes highlights the importance of considering altmetrics alongside traditional citation metrics for evaluating research impact in the field of IS & LS [42].

Altmetric's impact classification framework gives weight to an article based on its frequency of mentions and also the social platform. This method gives mentions in news stories a different weight from those in policy documents, which can provide a more nuanced understanding of the impact of research across different types of media.In shenavar study, Mendeley and Twitter were identified as the most important social media platforms for distributing Iranian journal articles, with Mendeley having the highest coverage (94%) and Twitter following closely (81.8%);and suggested that altmetric indicators, specifically readership on Mendeley and mentions on Twitter, can be associated with higher citation rates [43].

Overall, news coverage can be an important factor in promoting the impact of research and shaping public understanding of scientific discoveries. By tracking news coverage alongside other altmetrics, authors can gain a more comprehensive understanding of the reach and influence of their research and use this information to inform future dissemination efforts

It is widely recognized that the dissemination of false and fake news stories can pose a significant challenge for authors, especially when it comes to ensuring that their research is being accurately portrayed in the media [19]. The recent publication of research in Science, which demonstrates that false news stories are shared at a much higher rate than those based on truth, underscores the importance of proactively managing the narrative and ensuring that accurate information is being conveyed to the public. This highlights the need for authors to be vigilant about the accuracy of the information being presented and to take proactive steps to prevent the spread of false news stories that could misrepresent their research [44].

Without access to this news data, authors might miss misinterpretations of their research and miss opportunities to respond or clarify their findings. They might also miss opportunities to engage with interested communities, which can limit the impact and reach of their research.

Overall, the aggregation of news stories can be a valuable tool for authors to track how their research is being positioned in the media and to ensure that accurate information is being presented to the public. By staying ahead of the story and engaging with interested communities, authors can promote the impact and reach of their research and ensure that their findings are being properly understood and utilized [45].

Public peer review platforms such as Publons can provide researchers with a valuable tool for obtaining feedback on their research in an open format. By enabling users to respond to relevant criticism within their field, public peer review can facilitate inter-group conversations about research and allow for more direct feedback on the publication. This can help to promote a more transparent and collaborative approach to research, ultimately leading to improvements in the quality of research output and the advancement of knowledge within the field [46].

Through public discussions on these platforms, concerns about results, data collection, and other aspects of research can be addressed and resolved, which can lead to improvements in the quality and impact of research.

While the mention of academic sources like peer review and research highlights was low in the study, this may be due to limitations in the data collection methods used by Altmetric. However, it is important to note that academic sources play a critical role in the peer review process and can provide valuable feedback to authors to improve the quality and impact of their research.

While academic sources may not be mentioned as frequently in Altmetric scores, they remain an important source of feedback and guidance for authors seeking to improve the quality and impact of their research [47].

It is widely recognized that services such as F1000 can provide authors with valuable insights into which academics have recommended their paper, which can be perceived as a more direct engagement with the paper and a public endorsement of its content. This can allow authors to gain a better understanding of who is engaging with their research and can contribute to promoting the impact and reach of their work. By tracking recommendations, authors can obtain valuable insights into the level of interest in their research and the extent to which it resonates with their target audience. This can enable authors to make more informed decisions about future publications and outreach initiatives, contributing to the advancement of knowledge within their field [48].

While the mention of these types of recommendations may be low in Altmetric scores, it is important to note that

they remain a valuable source of feedback and engagement for authors seeking to promote the impact of their research. By tracking which academics have recommended their paper, authors can identify potential collaborators and engage with a broader community of researchers and scholars. Overall, services like F1000 can provide valuable insights into the engagement and impact of research among academics and can help to promote the impact and reach of research. While they may be mentioned less frequently in Altmetric scores, they remain an important source of feedback and engagement for authors seeking to promote the impact of their research [49].

Analyzing mentions of subjects in different policy documents to gain insights into the impact of science and technology output on policy development has been noted as a useful approach. Policy documents often emphasize topics that are important for policymakers and governments, and the presence of scientific and technological citations in these documents can indicate the influence of research on policy development;In the era of COVID-19, altmetrics tools have proven to be valuable in assessing the impact and reach of research in a more comprehensive and timely manner. It goes beyond traditional citation-based metrics by considering various online sources such as social media, news articles, policy documents, and online platforms where research outputs are discussed and shared;Based on this study, A total of 4,308 studies focused on COVID-19 were identified. Twitter discussions accounted for 95% of the mentions related to COVID-19 research;among the policy documents, seven were specifically conducted as randomized controlled trials [50].

In the case of the health and medical field, which was the subject of the present study, the presence of scientific and technological citations in medical documents can demonstrate the impact of research on the development of domestic and foreign policies related to health and medical issues;in the field of obesity,90% of the articles focused on social media, with Twitter, news, and Facebook being the primary platforms for research interaction; A positive correlation was found between citation counts and altmetrics scores, indicating that altmetrics can serve as complementary indicators to traditional citations;it contributes to international scientific collaboration in business and healthcare industries and provide insights for emergency managers in the field of obesity research [51].

It is noteworthy that only the Nutrition and Epidemiology categories received policy mentions in the present study. This could be due to several factors, including the research focus of the articles included in the study, as well as the specific policy priorities of the countries and organizations that were analyzed.

Overall, analyzing mentions of subjects in policy documents can provide a valuable tool for understanding the impact of research on policy development. By identifying which subjects are receiving policy attention, authors can gain insights into the policy priorities of policymakers and governments and use this information to inform future research and dissemination efforts.

Patents play a crucial role in innovation, often building upon existing ideas and referencing other patents. However, they also rely on original research as evidence for their ideas. Altmetric's patent data is sourced from IFI CLAIMS, which has the world's largest index of patents and is used by organizations to understand and track patents globally, including the Google Patents index. Given the significant role of patents in the modern world, Altmetric's data identified a patent mention for microencapsulated cannabinoid compositions that cited specific research outputs.

- A Molecular Link between the Active Component of Marijuana and Alzheimer's Disease Pathology [52]
- The Potential Therapeutic Effects of THC on Alzheimer's Disease [53]

It has been noted that mentions in patents can be a significant indicator of the commercialization and economic potential of scholarly and organizational research. By tracking mentions in patents, researchers can gain valuable insights into the potential applications and commercial value of their research, which can inform future research and development efforts. This can contribute to the advancement of knowledge and the development of research that aligns more closely with industry needs, ultimately leading to more successful commercial outcomes and greater economic impacts.

However, it is noteworthy that patent records were low in the present study, with only two categories receiving mentions: Basic Mechanism of Diabetes and Nutrition. This could be due to several factors, including the research focus of the articles included in the study and the specific industries and markets that were analyzed.

Despite the low number of patent records in this study, it is important for researchers to consider the potential commercial applications of their research and seek to protect their intellectual property through patents and other means. By doing so, researchers can promote the translation of their research into real-world applications and economic benefits.

Overall, mentions in patents can be an important indicator of the commercialization and potential economic impacts of scholarly and organizational research. While patent records were low in the present study, researchers should still consider the potential commercial value of their research and seek to protect their intellectual property through patents and other means where appropriate.

Conclusion

It is widely acknowledged that providing altmetrics to authors extends beyond simply providing a count of the number of news stories and social media posts. Altmetrics data can offer a more comprehensive view of the attention that has been given to an author's publication, providing valuable insights into how the article has been received and interacted with by both the scholarly community and wider audiences. By incorporating different types of altmetrics, such as reader engagement and citation metrics, authors can gain a more complete picture of the impact and reach of their research, which can inform future research and outreach efforts. This can contribute to the advancement of knowledge and the development of research that is more closely aligned with the needs and interests of both scholarly and non-scholarly audiences.

By gathering article performance data from various sources, including traditional citations, online platforms, and alternative metrics (altmetrics), journals can provide authors with a range of different data that can help them to see areas of interest in their publication and build connections to others who might be interested.

Furthermore, article performance data is not only about addressing potential issues and positioning the research in the media, but also about allowing authors to see the whole story. By providing a variety of different data, journals can show the value of a publication beyond its appearance in that journal and help authors to understand the broader impact and reach of their research.

Overall, providing article performance data to authors is an important way for journals to support the dissemination and impact of research. By providing a more complete picture of how the article has been received and interacted with, journals can help authors to build connections and promote the impact of their research among a wider audience.

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Author contributions **S.S** Validation;final approval of the version to be published **K.A.** revising it critically for important intellectual content. **F.D.** implementation of the computer code and supporting algorithms. **S.D** screening the data **A.S** Conceptualization **S.S** contributed data **L.N.A** analysis and interpretation **AA** write the paper and development or design of methodology

Data Availability Published articles are made available to institutions and individuals who subscribe to Journal of Diabetes & Metabolic Disorders or who pay to read specific articles.

Declarations

Conflict of interest The authors declare that they have no conflict of interests that are relevant to the content of this article.

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