RESEARCH

A BIBLIOMETRIC AND ALTMETRIC ANALYSIS OF ALZHEIMER'S DISEASE: TOP 100 ARTICLES

Turkish Journal of Geriatrics
DOI: 10.31086/tjgeri.2022.301
2022; 25(3): 422-431

Aysegül AKKAN SUZAN[1]

Abstract

Introduction: Alzheimer's disease is the most common cause of dementia in elderly people, and aging is the most important risk factor. Our aim is to provide bibliometric and altmetric approaches to Alzheimer's disease for better evaluation.

Materials and Method: The word 'Alzheimer' was searched from the Web of Science database and Altmetric.com website to create, respectively, the Top 100 citation and altmetric lists. The articles were analyzed and compared according to study type, topic of study, publication year, citation number, journal quartile in category, impact factor, and altmetric attention score.

Results: The median citation number of Top 100 cited articles was 2,043 (range: 1,411-3,212) and median altmetric attention score was 22 (range: 0-566). The median altmetric attention score of T100 altmetric articles was 771 (range: 550-3,378) and median citation number was 43 (range: 0-1,917). There was a significant correlation between citation number and altmetric attention score in citation list ($p < 0.001$, $r = 0.438$). In the citation list, most common study type, topic of study, and publication year were 'original scientific paper,' 'pathophysiology, genetic,' and '1993,' while in the altmetric list, it was 'original scientific paper,' 'etiology, risk factors,' and '2017 and 2018,' respectively.

Conclusion: While academia tries to better understand disease mechanisms to find new treatment options, social media is more curious about how to be protected from a particular disease. Combining altmetric analysis with bibliometric analysis could be useful to develop convenient policies on the awareness of the society about Alzheimer's disease.

Keywords: Alzheimer Disease; Geriatrics; Dementia.

CORRESPONDANCE

[1] Aysegül AKKAN SUZAN

Phone : +905354707050
e-mail : ayseg_akkan@hotmail.com

Received : Apr 28, 2022
Accepted : Aug 04, 2022

[1] University of Health Sciences, Kartal Dr. Lutfi Kirdar City Hospital, Istanbul, Turkey, Department of Neurology, Istanbul, Turkey

INTRODUCTION

Alzheimer's disease (AD) is the most common cause of dementia in elderly. The most important risk factor for AD is aging. There are 5.3 million Alzheimer's patients in the United States and only 200 thousand of them are younger than 65 years (1,2). Due to the aging of the world's population, AD has become the second most costing disease after cancer. According to 'amyloid-cascade hypothesis", accumulation of beta-amyloid plaques outside neurons, and tau tangles inside neurons activate immune system cells in the brain (3). This chronic inflammation causes cell loss, so atrophy or shrinkage of the brain occurs. Currently, there are many clinical trials for prevention and treatment of this fatal disease (4,5).

Today, despite some debates and criticisms, the strength of an article is generally defined by the impact factor of the journal in which it was published and the number of citations the article received after publication (6). Researchers frequently benefit from bibliometric analysis to identify the most valuable publications in their field. For this reason, bibliometric analysis (citation analysis) gains importance. Today, academic research is also shared, interpreted and disseminated on social media. In 2011, the concept of 'Altmetric Attention Score' (AAS) had emerged after Altmetric Explorer (Altmetric, London, UK) began to analyze social media data. The AAS gives an opinion on how often articles are discussed and disseminated on social media. Nowadays, publishers are also interested in altmetric and they have started to give AAS in addition to the citation number on their site (7).

This study aims to provide a bibliometric and altmetric perspective on Alzhiemer's diesase, and evaluate the relationship between the Top100 (T100) citation list and the T100 altmetric list with respect to the number of citations, AAS, IF, study type, article subject and journals.

METHODS

This study does not require approval from an ethics committee because it performs a bibliometric analysis/citation analysis of the existing published classical studies. The author declares that the research has been conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects".

Data collection and inclusion criteria

We searched on January 1, 2021 for the keyword "Alzheimer" in articles published between 1975-2021 years, from the Thomson Reuters Web of Science (WoS) all databases (Philadelphia, Pennsylvania, USA). The WoS database lists all articles with "Alzheimer" in any of the title, abstract, keywords and keywords plus. Two researchers independently read the articles, removed the articles not related to "Alzheimer" and unanimously created the T100 citation list by finding the first one hundred articles. As former articles were likely to have more citations than newer articles, we used the average number of citations per year (ACpY) values derived from WoS to eliminate time as a factor. With the consensus of the two researchers, the T100 citation list categorised according to the study type, the subject of the study, the first author, the year of publication, the number of citations, the Q rank and IF values of the journal they were published in. In addition, the keywords and institutions of the T100 citation list were given in the form of network visualization map.

The keyword ‚Alzheimer' was scanned on the Altmetric.com website (Altmetric, London, UK) on the same day with scanning of WoS, January 1, 2021 and the T100 altmetric list was created by excluding the publications unrelated to AD by the researchers independently. AAS is calculated automatically by using an algorithm, based on the weighted amount of all the attention on a research. Altmetric score is presented in the middle of the donut. Each color in the donut indicates a source (e.g. red for News, blue for Twitter), and the area of each color is proportion-

al to contribution of the relevant source to AAS (8). The highest coefficient in calculating AAS belongs to News, and this coefficient also varies according to where the news is published. Blogs, policy documents, patent, Wikipedia, Twitter, Facebook, Sina Weibo, Syllabi, Google+, LinkedIn, Reddit, Youtube and Pinterest are other highest contributors after News. Mendeley readers, Dimensions citation counts and CiteULike bookmarks do not contribute to the score (9). In addition to all these, on the same date, the AAS of the articles in the T100 citation list were controlled from 'altmetric.com' website and the number of citations of the articles in T100 altmetric list were obtained from WoS.

Statistical analysis

Numerical variables were defined as median (minimum-maximum). Since the data are not normally distributed, Mann-Whitney U was used for two groups; and The Kruskal-Wallis test was used to compare three or more groups. Spearman correlation analysis was used to evaluate the correlation between AAS, ACpY and citation in the T100 citation list; between AAS and citation in the T100 altmetric list. Analyzes were performed by using IBM SPSS-20 (Statistical Package for Social Sciences, Chicago, Illinois, USA).

RESULTS

When we searched for the word ,' Alzheimer ,' in the Web of Science, 212.254 articles were found. The median of the citation number of the Top 100 cited article was 2,043 (range: 1,411-23,212), while the median of the altmetric score was 22 (range: 0-566). The article titled ,Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of the Department of Health and Human Services Task Force on Alzheimer's Disease', written by McKhann et al in 1984 in the journal of ,Neurology' had the highest citation and ACpY (n = 23,212; n = 610 respectively) (10). And also the article, ,The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease, written by McKhann et al. and published in 'Alzheimer's & Dementia in 2011, had the second highest AcpY (n = 560) and was the 6th article in T100 citation list (n=6161) (11). When Spearman correlation analysis was used to define the correlation between citation number and altmetric score of the T100 citation articles, a significant positive correlation was found ($p < 0.001$, $r = 0.438$). There were also a significant positive correlation between AcpY with citation and AAS ($p < 0.001$, $r = 0.659$; $p < 0.001$, $r = 0.627$, respectively).

When the word 'Alzheimer' was scanned on the 'altmetric.com' website, 62.453 research outputs were obtained. While the median of the citation count of the Top 100 articles with highest altmetric scores was 43 (range: 0-1.917), the median for the altmetric score was 771 (range: 550-3.378). The article titled 'Porphyromonas gingivalis in Alzheimer's disease brains: Evidence for disease causation and treatment with small-molecule inhibitors' published in 'Science Advances' in 2019 had the highest altmetric score (n = 3.378) (5). The article 'Meta-analysis of 74,046 individuals identifies 11 new susceptibility loci for Alzheimer's disease', also included in the Top 100 citation list, had the highest number of citations in the Top 100 articles with highest altmetric scores (n = 1917) (12). This article was the only article being in both the T100 citation and altmetric lists. According to Spearman correlation analysis, there was no correlation between citation number and AAS of T100 altmetric articles ($p = 0.839$, $r = -0.021$).

When the keywords of the articles in the T100 citation list were evaluated, most commonly used keywords were AD, acute phase protein and chemokine, respectively. Network visualization cluster map for keyword analysis in the field of AD for the top 100 cited articles was given in Figure 1. The most contributing institutions to T100 citation list were

Harvard University, Brigham and Women's Hospital and Duke University, respectively. The correlation and clusters of contributing institutions in the field of AD for the top 100 cited articles were given in Figure 2. The first three countries of the authors with the most articles in the T100 citation list were the United States of America, the United Kingdom, and Canada, respectively.

The first three journals with the highest number of articles in the T100 citation list were Nature (n = 15, IF 42.7), Science (n = 10, IF 41.8) and Neurology (n = 9, IF 8.7), respectively. First three journals with the highest number of articles in the T100 altmetric list were Nature (n = 15, IF 42.7), Alzheimer's & Dementia (n = 9, IF 17.1) and Journal of Alzheimer's Disease (n = 8, IF 3.9), respectively. The median of the time passed since the publication of the article were 24 (range: 5-40) years in the T100 citation list and 4 (range: 1-15) years in the T100 altmetric list. The year with the highest number of published articles in the T100 citation list was 1993 with seven articles. The years with the highest number of pub-

Figure 1. Network visualization map for keyword analysis

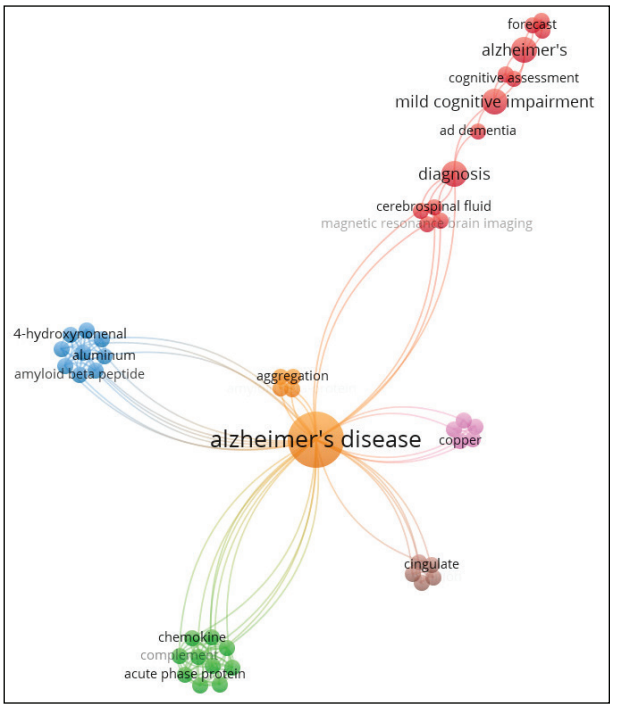
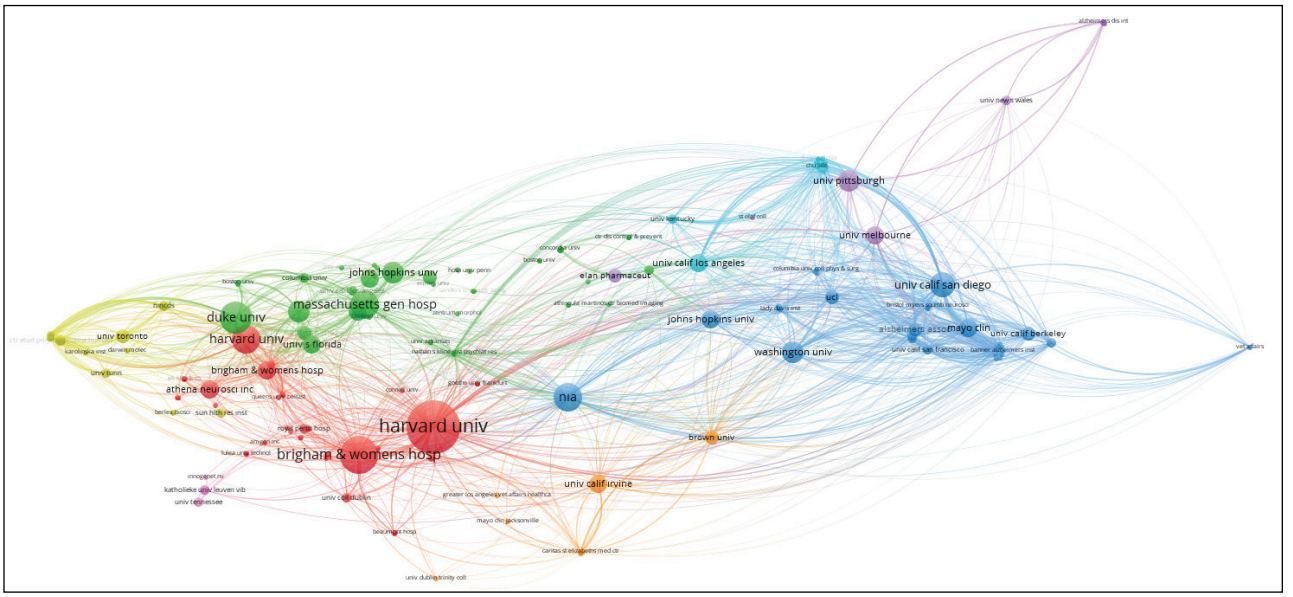


Figure 2. The clusters of contributing institutions



lished articles on the T100 altmetric list were 2017 and 2018, each with twenty articles.

When we evaluated the study types in the T100 citation list, the first two lines were original scientific paper (n = 57) and review (n = 21). Similar to citation list, the most common study type was original scientific paper (n = 56) and animal study (n = 21) was the second in the T100 altmetric list. The lists according to the study types, including AAS and citation numbers, were given in Table 1.

According to the subject, we categorized the articles as 'Etiology, risk factors', 'Treatment, prevention', 'Definition, diagnosis', 'Pathogenesis, physiology, genetic', 'Epidemiology, health policy', and others. The lists according to the topics of the articles, including AAS and citation numbers, were

Table 1. Study types top 100 altmetric and citation list

Type	Number of articles	Citations, median (minumum-maximum)	*p* value	AAS, median (minumum-maximum)	*p* value
Top 100 citaiton list	**100**	**2043 (1411-23212)**		**22 (0-566)**	
Original scientific paper	57	1879 (1413-9546)		19 (0-448)	
Review	21	2186 (1426-9629)	0.453	26 (0-240)	0.177
Others	22	2609 (1411-23212)		55 (0-566)	
Animal Study	10	2238 (1467-3354)		29 (0-90)	
Guidelines and advisory documents	9	2896 (1466-23212)		66 (3-136)	
Systematic reviews and meta-analyses	2	2252 (1917-2587)		333 (101-566)	
Case report	1	1411		0	
Top 100 altmetric list	**100**	**43 (0-1917)**		**771 (550-3378)**	
Original scientific paper	56	35 (0-1095)		795 (550-3012)	
Animal Study	21	116 (11-518)		693 (559-3378)	
Review	13	13 (0-1245)	**0.041**	772 (663-2054)	0.386
Others	10	31 (1-1917)		846 (566-2851)	
Systematic reviews and meta-analyses	6	31 (1-1917)		846 (566-1407)	
Case report	2	29 (4-55)		1713 (575-2851)	
Editorial	1	7		611	
Guidelines and advisorydocuments	1	54		928	

Abbreviations: AAS, Altmetric Attention Score

given in Table 2. The most frequent topics were 'Pathogenesis, physiology, genetic' (n = 54) and 'Definition, diagnosis' (n = 18) in the T100 citation list. In the T100 altmetric list, the first two most common topics were "Etiology, risk factors" (n = 32) and "Treatment, prevention" (n = 28).

When the subaltmetric analysis of the 10 articles with the highest AAS was done according to the source, Twitter was the most contributing social networking service with an average number of 1882 tweets. The article with the highest AAS and number of tweets belonged to Dominy SS et al (5). Twitter was followed by news outlets with an average of 141 and Facebook posts with an average of 31. Detailed analysis was given in Table 3.

Table 2. Topics of the top 100 citation and altmetric list

	Number of articles	Citations, median (minumum-maximum)	*p* value	AAS, median (minumum-maximum)	*p* value
Top 100 citation list	**100**	**2043 (1411-23212)**		**22 (0-566)**	
Pathogenesis, physiology, genetic	54	1838 (1461-9629)		19(0-566)	
Definition, diagnosis	18	3008 (1466-23212)		31 (0-121)	
Treatment, prevention	6	1768 (1470-3354)	**0.002**	31 (0-74)	0.300
Etiology, risk factors	6	1720 (1546-6401)		108 (1-448)	
Epidemiology, health policy	5	1986 (1588-3521)		49 (0-101)	
Others	11	3401 (1708-7929)		20 (0-248)	
Top 100 altmetric list	**100**	**43 (0-1917)**		**771 (550-3378)**	
Etiology, risk factors	32	39 (0-1001)		868 (550-2851)	
Treatment, prevention	28	94 (1-906)		885 (569-3378)	
Definition, diagnosis	14	30 (3-498)	0.707	893 (551-1860)	
Pathogenesis, physiology, genetic	9	60 (11-584)		648 (559-763)	**0.008**
Epidemiology,health policy	7	51 (3-195)		653 (557-809)	
Others	10	20 (7-1917)		673 (556-928)	

Abbreviations: AAS, Altmetric Attention Score

Table 3. Sub-altmetric distribution of altmetric score for top 10 articles

Rank	Title	Altmetric Score	News Outlets	Blogs	Policy sources	Twiters	Facebook Pages	Wikipedia page	Google+ users	Redditors	Weibo users	Patents
1	Porphyromonas gingivalis in Alzheimer's disease brains: Evidence for disease causation and treatment with small-molecule inhibitors		134	28	0	6247	43	3	18	7	0	0
2	The antibody aducanumab reduces Aß plaques in Alzheimer's disease		253	29	0	1194	61	2	19	2	0	6
3	Resistance to autosomal dominant Alzheimer's disease in an APOE3 Christchurch homozygote: a case report		262	11	0	3013	12	2	0	0	0	0
4	Multiscale Analysis of Independent Alzheimer's Cohorts Finds Disruption of Molecular, Genetic, and Clinical Networks by Human Herpesvirus		217	27	0	771	37	1	0	3	0	0
5	In Alzheimer Research, Glucose Metabolism Moves to Center Stage		1	0	0	3063	49	0	0	3	0	0
6	Discriminative Accuracy of Plasma Phospho-tau217 for Alzheimer Disease vs Other Neurodegenerative Disorders		147	7	0	1143	5	1	3	0	0	0
7	Aluminium in human brain tissue from donors without neurodegenerative disease: A comparison with Alzheimer's disease, multiple sclerosis and autism		1	0	0	2121	13	0	0	3	0	0
8	Sauna bathing is inversely associated with dementia and Alzheimer's disease in middle-aged Finnish men		135	14	0	522	69	1	2	3	0	0
9	Evidence-based prevention of Alzheimer's disease: systematic review and meta-analysis of 243 observational prospective studies and 153 randomised controlled trials		113	3	0	681	8	0	0	1	0	0
10	Alzheimer's disease drug-development pipeline: few candidates, frequent failures		152	21	3	67	11	2	3	1	1	3

DISCUSSION

Although there are a few bibliometric studies about AD in the literature, we could not find any altmetric studies. Dong et al. demonstrated the study trends of AD in the world and in China with their bibliometric study (13). Pozo et al. divided 40 years of research in AD into four decades and evaluated the trends by decades (14). We believe that this is the first bibliometric and altmetric study of the top 100 most-mentioned articles on AD. In addition, to the best of our knowledge, this is the first study paying attention to the correlation between citation numbers and AAS in both the T100 altmetric and citation lists.

While there was a correlation between citation with AAS and citation with average citation per year in the T100 citation list, there was no correlation between citation and AAS in the T100 altmetric list. The reason for the correlation in the T100 citation list but not in the T100 altmetric list may be that the articles in the T100 citation list had enough time for citation and AAS to accumulate. Again, the fact that the journal with the most articles in T100 citation and altmetric lists was Nature , suggests that the citation numbers and AAS can be correlated in the T100 altmetric list after enough time. Similar to our study, the most-cited 300 articles in 15 journals with the highest IF in the field of urology were evaluated and a correlation was found between the AAS and the number of citations (15). Again, in a study with 140 most-cited articles from 14 journals with the highest IF in the field of pediatric surgery, a correlation was found between AAS and number of citations (16).

The most attractive topics in the T100 citation list as well as the first two most-cited articles were 'pathogenesis, physiology, genetic' and 'definition, diagnosis'. The most-cited article written by McKhann et al. focused on the clinical diagnosis of AD (10). The second most-cited article was about the amyloid hypothesis in AD (17). When we evaluated the T100 altmetric list, we found the most interesting topics to be 'etiology, risk factors' and 'treatment, prevention', as in the first three articles with the highest AAS. The article with the highest AAS score was an experimental study that indicates porphyromonas gingivalis, which is the cause of chronic periodontitis in the brain in AD, and its neurotoxic effect can be reduced with gingipain inhibitors (12). The second article in the list was a clinical experiment showing that aducanumab reduces beta-amyloid plaques in AD (4). The article in the third place in the list was aimed at the discovery of risk-reducing genes in AD (18). As can be seen, social media users are more interested in 'etiology, risk factors' and 'treatment, prevention', which is different from the interests of academia. Academia cares more about the pathogenesis, genetics, and diagnosis of AD to understand the disease mechanism and thus find new treatment options. Social media users are more curious about what AD does, what should be done to be protected, and what the new treatments are; thus social media users want information that could be useful to them in their daily life.

According to the subaltmetric analysis of 10 articles with the highest AAS, the highest interaction averages were in Twitter and news outlets, respectively, but news outlets had more impact on AAS. The reason is that when calculating AAS, the highest multiplier in mainstream social media is in news outlets, while the multiplier of Twitter is in the 12th place (9).

Limitation

The number of citations of both T100 citation and T100 altmetric lists were searched from the WoS database; as a result, articles not included in the WoS database could not be taken into account. Another limitation is that self-citation was not excluded while defining the number of citations.

CONCLUSION

This study gave us a bibliometric and altmetric overview, along with the evaluation of Alzheimer's

literature. The most attractive topics in the T100 citation list were 'pathogenesis, physiology, genetic' and 'definition, diagnosis' and the same for the T100 altmetric list were 'etiology, risk factors' and 'treatment, prevention'. This showed us that the interests of academia and social media users are different. Based on our study, we think that it will be beneficial to evaluate articles using both altmetric and bibliometric analyses because AAS can give us an idea about what society wants to know. Through such analyses, it is possible for scientists not only to formulate relevant policies on the awareness of the society about AD but also develop appropriate policies for the diagnosis, prevention, and treatment of this fatal disease.

Acknowledgments: The author is very grateful to Veysel Suzan for his contribution on composing the T100 altmetric and citation lists as the second researcher.

Conflict of Interest: No conflict of interest has been declared by the author.

Financial Disclosure: The author declares this study to have received no financial support.

REFERENCES

1. Tiwari S, Atluri V, Kaushik A, Yndart A, Nair M. Alzheimer's disease: pathogenesis, diagnostics, and therapeutics. Int J Nanomedicine. 2019 Jul 19;14:5541-5554. (PMID: 31410002)
2. Murphy MP. Amyloid-Beta Solubility in the Treatment of Alzheimer's Disease. N Engl J Med. 2018;378(4):391-392. (PMID: 29365295)
3. Selkoe DJ; American College of Physicians; American Physiological Society. Alzheimer disease: mechanistic understanding predicts novel therapies. Ann Intern Med. 2004;140(8):627-38. (PMID: 15096334)
4. Sevigny J, Chiao P, Bussière T, et al. The antibody aducanumab reduces Aß plaques in Alzheimer's disease. Nature. 2016;537(7618):50-6. (PMID: 27582220)
5. Dominy SS, Lynch C, Ermini F, et al. Porphyromonas gingivalis in Alzheimer's disease brains: Evidence for disease causation and treatment with small-molecule inhibitors. Sci Adv. 2019;5(1):eaau3333. (PMID: 30746447)
6. Garner RM, Hirsch JA, Albuquerque FC, Fargen KM. Bibliometric indices: defining academic productivity and citation rates of researchers, departments and journals. J Neurointerv Surg. 2018;10(2):102-106. (PMID: 28824008)
7. 7.https://www.springeropen.com/get-published/indexing-archiving-and-access-to data/article-metrics (Internet) (Accessed: 1 January 2022)
8. 8.https://www.altmetric.com/about-our-data/the-donut-and-score/ (Internet) (Accessed: 1 January 2021)
9. 9.https://help.altmetric.com/support/solutions/articles/6000233311-how-is-thealtmetric-attention-score-calculated (Internet) (Accessed: 1 January 2021)
10. McKhann G, Drachman D, Folstein M, et al. Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology. 1984;34(7):939-44. (PMID: 6610841)
11. McKhann GM, Knopman DS, Chertkow H, et al. The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimers Dement. 2011;7(3):263-9. (PMID: 21514250)
12. Lambert JC, Ibrahim-Verbaas CA, Harold D, et al. Meta-analysis of 74,046 individuals identifies 11 new susceptibility loci for Alzheimer's disease. Nat Genet. 2013;45(12):1452-8. (PMID: 24162737)
13. Dong R, Wang H, Ye J, Wang M, Bi Y. Publication Trends for Alzheimer's Disease Worldwide and in China: A 30-Year Bibliometric Analysis. Front Hum Neurosci. 2019;13:259.(PMID: 31447661)
14. Serrano-Pozo A, Aldridge GM, Zhang Q. Four Decades of Research in Alzheimer's Disease (1975-

2014): A Bibliometric and Scientometric Analysis. J Alzheimers Dis. 2017;59(2):763-783. (PMID: 28671119)

15. Nocera AP, Boyd CJ, Boudreau H, Hakim O, Rais-Bahrami S. Examining the Correlation Between Altmetric Score and Citations in the Urology Literature. Urology. 2019;134:45-50. (PMID: 31560915)
16. Chang J, Desai N, Gosain A. Correlation Between Altmetric Score and Citations in Pediatric Surgery Core Journals. J Surg Res. 2019;243:52-58. (PMID: 31154133)
17. Hardy J, Selkoe DJ. The amyloid hypothesis of Alzheimer's disease: progress and problems on the road to therapeutics. Science. 2002;297(5580):353-6. (PMID: 12130773)
18. Arboleda-Velasquez JF, Lopera F, O'Hare M, et al. Resistance to autosomal dominant Alzheimer's disease in an APOE3 Christchurch homozygote: a case report. Nat Med. 2019;25(11):1680-1683. (PMID: 31686034)