*International Journal of Information Science and Management*
*Vol. 17, No. 1, 2019, 59-72*

# Comparing the Citations Counts and Altmetrics of the Top Medical Science Journals in Scopus

**Mozhdeh Salajegheh**
Associate Prof. Department of Knowledge and Information Science,
Shahid Bahonar University of Kerman
Corresponding Author: msala@uk.ac.ir

**Sareh Dayari**
M.A. in Knowledge and Information Science and staff of Literature Library at Shahid Bahonar University of Kerman
d.sareh@gmail.com

## Abstract

Early altmetric investigations have focused on measuring the correlations between citation and altmetrics to partially validate the new metrics articles (Thelwall, Haustein, Larivière, & Sugimoto, 2013; Priem, & Hemminger, 2010; Costas, Zahedi, & Wouters, 2014). The main aim of this research is to study the relationship between citation count indicator and almetrics or the new metrics in social -web of medical sciences journals. Present research is an applied research and the method used for doing it, is descriptive from correlation type which test relationship between citation count indicators and almetrics or the new metrics in social web. 111 medical sciences journals which have the highest SJR in Scopus databases were selected as research population from Scimago Journal Ranking (SJR) 2013-2014. Altmetrics—alternative metrics usually based on data from the social web which could be seen as a particularly promising approach in efforts to find appropriate measures for assessing Medical Science Journals were extracted through altmetrics.com. Research results show that there is significant correlation between Medical science journals altmetrics tools like F1000, Mention, Facebook, and News and their citation Numbers. There is no significant correlation between Medical science journals altmetrics tools like Reddit, Blog posts, Google plus, Tweets and their citation numbers. Structural equation modeling also shows the same results.

**Keywords:** Altmetrics, Scientometrics, Citations counts, F1000, Mentions, G+, Facebook

## Introduction

Research evaluators often need to measure the impact of academic publications. Traditionally, librarians and information professionals have used re-shelving statistics to examine the value of scholarly artefacts but this is not useful for individual journal articles (Blecic, 1999). Citation analysis is restricted to measuring the impact of publications from the author's perspective but an article could be useful for other contexts such as teaching, commercialization, and daily working life (Schloegl & Stock, 2004; Haustein & Siebenlist, 2011). Citation metrics are more appropriate for the evaluation of theoretical publication than for applied research. Moreover, there is concern that a new generation of authors could believe that "citation analysis is a waste of time because authors do not adequately cite those

who have influenced their work" (Garfield, 2011). Ever-increasing production of scientific documents and expanding knowledge in specialized fields lead to greater importance for science measures and filters and also the importance of the Web as an important resource for assessing effects of scientific products and its ability to cover the shortcomings of the current measures of research evaluation is taken into consideration. The scientific evidence shows the use of available scientific publications on the web as supplementary measures of citation and predictors of future citations related to areas with fewer citations. Many of the traditional citation-based measures, in spite of extensive use in evaluation of scientific publications do not have the ability to evaluate the effect of online resources (for example, through Facebook, Twitter, Reference Managers, blogs, wikis) and also do not have the ability to assess the impact of scientific publications other than journals and conferences and neglect other scientific publications such as data sets, slides, blog posts, etc. So the researchers that publish their products online, and in the formats other than journal articles do not enjoy citation measures (Zahedi, Costas & Wouters, 2014). During the last decade, usage data have been proposed to help measure scientific impact and to supplement citation analysis (Rowlands and Nicholas, 2007; Bollen, Van de Sompel, Smith, & Luce, 2005; Schloegl & Gorraiz, 2011). Recently, social web act as a rich source for measuring effects of scientific communications and it is going to remove the inadequacies of old metrics in research. For instance, the scholarly evidence of the use of publications found on the web are seen as complimentary to citation metrics, also as predictors of later citations (Brody, Harnad & Carr 2006) and being of relevance for fields with fewer citations (Armbruster 2008). Because the web has been transformed to a platform for publication of scientific products, and citations alone do not have the ability to test the validity of scientific publications online and up-to-date, researchers need to quickly identify the most credible and authentic literature and use that in future scheduling and policies on research matters. Citation analysis is a useful evaluation method in the field of science policy and research management. Usually citations are considered as representative of scientific impact. Nevertheless, citations are not free from constraints, and evaluate only a limited aspect of quality (i.e. the impact of resources on other publications) (Zahedi, et al., 2014). Despite the widespread use of citations in assessing research we must, nonetheless, acknowledge that citations alone do not show the full spectrum of research impact. For example, some publications that have not yet been cited are useful and many professionals such as doctors, writers, undergraduate students, common people and speakers that use research publications for professional activities and medical profession and are not writers of research publications read such materials. So it is clear that research impact could be more than the progression of knowledge in scientific products and so research publications impact on society, economics, culture, and the environment, is necessary to evaluate the research (Mohammadi & Thelwall, 2013). In this sense, the more traditional metrics based on citations, although widely used and applied in research evaluation, are unable to measure the online impact of scientific literature (for example via Facebook, Twitter, reference managers, blogs or wikis) and also lack the ability of measuring the impact of scholarly outputs other than journal articles or conference proceedings, ignoring other outputs such as datasets,

software, slides, blog posts, etc. Thus, researchers who publish online and in formats different from journal articles do not really benefit from citation based data metrics (Zahedi, et al, 2014).

The rise of the social web and its uptake by scholars has led to the creation of altmetrics, which are social web metrics for academic publications. These new metrics can, in theory, be used in an evaluative role to give early estimates of the impact of publications or to give estimates of non-traditional types of impact. They can also be used as an information seeking aid to help draw a digital library user's attention to papers that have attracted social web mentions (Sud & Thelwall, 2014). An important approach is "altmetrics" which was introduced in 2010 (Priem, & Hemminger., 2010) as a novel way of "assessing and tracking scholarly impact on social web", to enhance the process of measuring scholarly performances. In recent years, there has been an increase in the diversity of tools (and also companies) that aim to track real-time impact of scientific outputs by exploring the sharing, reviews, discussions, bookmarking, etc. of scientific publications and sources. Among these tools and companies are F1000 (http://f1000.com/), F1000 evaluates over 1500 articles monthly from 3500 different publications (see http://f1000.com/about/whatis/coverage) but the list changes constantly. The most popular and highly prestigious journals of the disciplines related to biology and medicine, such as Nature, Science, Cell, New England Journal of Medicine, and Journal of Experimental Medicine are covered by F1000 (Mohammadi & Thelwall, 2013). Plos article level- metrics (ALM) (http://article-level-metrics.plos.org/), Altmetric.com (http://altmetric.com/), Plum Analytics (http://www.plumanalytics.com/), ImpactStory (http://impactstory.org/), Citeulike (http://www.citeulike.org/), and Mendeley (http://www.mendeley.com/) (Zahedi et al, 2014). Altmetrics are data points that are generated more rapidly than traditional metrics, such as citations, so researchers do not have to wait years to show their worth. Altmetrics attempts to provide timely measures of an impact through the use of metrics from HTML views and downloads of scholarly articles, blog posts, Tweets, bookmarks, etc. By providing real-time (or near real-time) information, altmetrics can be used to show the merit of scientific research not just by researchers (through citations) but also the impact of the research to the public (through social media channels) (Cave, 2012).

A key limitation of citations is timeliness: it may take years for an article to become cited because it must be read and incorporated into future research first, and this then needs to be published for the citation to be indexed. This is a limitation when using citations to help evaluate the work of young scholars or in digital libraries. In the latter case timeliness is a particular problem because scholars who are familiar with a field would mainly need to keep up-to-date with the most recently published work, which would be uncited except in unusual cases. The social web may help to satisfy the need for timely metrics because an article may be publicly endorsed, or at least mentioned in the social web within hours of publication. For example, those who read or scan new articles on the day of publication may subjectively select the most interesting to tweet or blog about, archive in a reference manager site like Mendeley.com or Citeulike, mention in a social network site or discuss in an online forum

(Sud & Thelwall 2014).

Moreover, article download indicators had also been previously investigated. Nevertheless, altmetrics have been radically more successful because of the wide range of social web services that could be harnessed, from Twitter to Mendeley, and because of the ease with which large scale data could be automatically harnessed from the social web through Applications Programming Interfaces (APIS). However, academic research with multiple research approaches is needed to evaluate their value, (Sud and Thelwall 2014). Due to the indistinctive relationship between Altmetrics and citation metrics, this study tries to compare citations with Altmetrics of medical science journals comparatively and evaluate whether there is any correlation between the number of citations and altmetrics? During human writing history, citing others' work was observed. In the past, because of the limitations in the fields of science, information resources and their formats, every researcher was encompassing his/her field sciences. Today, an ever-increasing amount of information exists and is referred to as the information explosion, and distinguishing useful and effective information in science production process is one of the basic challenges in international scientific societies. This study is necessary because it is a new field in measuring science and is the first research work done in this field in Iran. In this study altmetrics, a new method for measuring scientific products has been used, and new measures have been validated with correlation studies approaches. The results of this research are used to evaluate publications and electronic information sources as a new indicator of evaluation in research centers and national universities next to the citation indices. This study aimed to investigate the relation between citations and altmetrics (number of mentions in Twitter, Facebook, Google+, F1000, blogs, Reddit, news ...) of medical science journals.

## Review of Literature

Altmetrics is of the young fields which appear in scientometrics and its age is less than 5 years. So researches in this field are few. According to studies that were done for this paper, research done on the altmetrics field in Iran is scarce. Although altmtrics is young, many studies have been done in the world. Some of the altmetrics studies have been done on altmetrics itself and many studies which measured the relationship between altmetrics and citations as literature review will be shown below.

Bloggers regularly cite well-known, high-impact journals which publish multidisciplinary science and core journals (Shema, Bar-Ilan, & Thelwall, 2012). Groth and Gurney's (2010) findings showed that Read Blogs posts about chemistry often cite papers from high-impact journals either because of the scientific importance of these papers or because of the reputation of the journals. In addition, the bloggers might be reflecting the mainstream media's tendency to cover papers from core journals in order to criticize media coverage of scientific issues. Some studies have explored the effects of social media on the dissemination of research. Shuai, Pepe, & Bollen, (2012) found that the number of tweets citing preprints on arxiv.org correlated with the number of downloads and early citations. Allen, Stanton, Di Pietro & Moseley (2013) posted sixteen PLOS ONE articles on Facebook, Twitter, linkedin,

and researchblogging.org on either a random release date or a control date. They found that the dissemination of research through social media increased the number of views and downloads. Haustein, Peters, Bar-Ilan, Priem, Shema, & Terliesner (2014) found that the coverage and readership of articles published by sampled bibliometricians were higher on Mendeley than on citeulike. Some studies showed that there is a relationship between the altmetrics and traditional journal rankings (Alhoori & Furuta, 2014). Shema, Bar-Ilan & Thelwall (2014) found that articles cited on blogs received more citations. Ortega (2015) concluded that the poor correlations between social and usage indicators and bibliometric ones confirm that they contain different information that has to be appreciated in the research evaluation of a scientist.

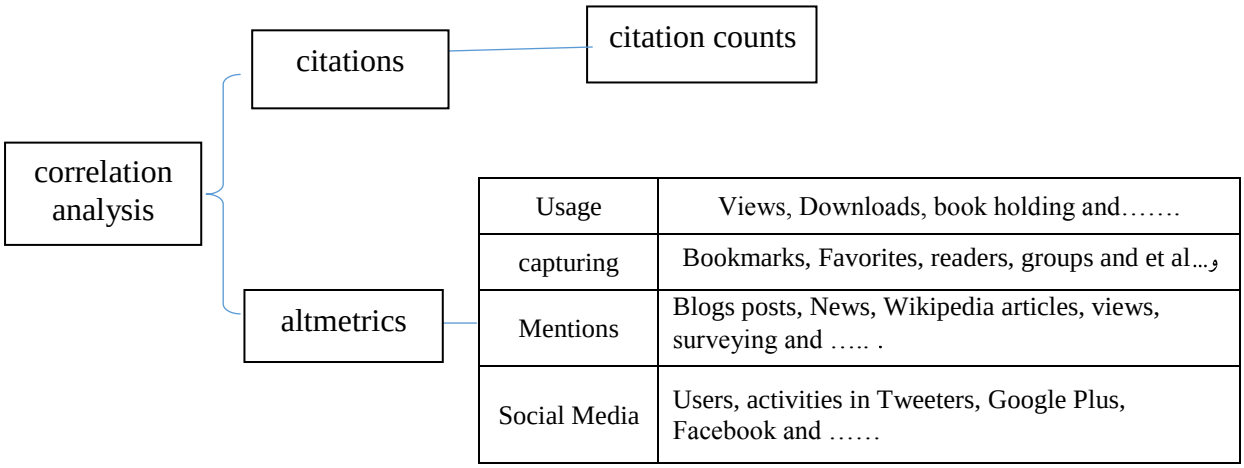
Altmetrics could reflect an alternative dimension of the research performance to science popularization and networking abilities, but is far from citation impact. Costas et al. (2014) concluded that correlations between citations and altmetrics exist. Brody et al. (2006) study results showed that a significant correlation exists between the citations and downloads of articles in physics, mathematics, and astrophysics. Waltman and Costas (2014) concluded that the correlation between citations and F1000 recommendations is weak. Bar-Ilan Haustein, Peters, Priem, Shema & Terliesner (2012) research results showed that there is a moderate correlation between Scopus citations and Mendeley readerships. Alhoori, Choudhury, Kanan, Fox, Gils, & Lee (2015) in their study report a significant correlation between citations and altmetrics for NOA and OA articles. Downloads correlate positively and significantly with Scopus citations, but the correlation is weak (0.3) because some software has a large natural audience outside of academia (Thelwall & Kousha, 2016).

Alhoori's findings showed that there is a significant relationship among individual journal-level altmetrics, Mendeley and citeulike readers and all journal rankings, News has the highest correlation with citation counts and Eigenfactor and also concluded that most journal-level altmetrics have moderate correlations with journal citation counts (Alhoori & furuta, 2014). Bornmann (2014) concluded that the recommendations of the Faculty members are correlated with field- and time-normalized citation impact scores. Bar-Ilan et al (2012) findings showed substantial differences between altmetrics counts and citation counts.

There is a significant relationship between higher metric scores and higher citations (Thelwall et al, 2013). Eysenbach (2011) concluded that Tweets can predict highly cited articles in only 3 days after article publication. Haustein, Thelwall, & Giustini (2012) findings showed that there is a weak correlation between citation and tweets. Li, Thelwall, & Giustini, (2012) concluded that the relationship between online readership and traditional citations count is significant Twitter and blog citations seem to measure something different from traditional citations (Bornmann, 2014). Wang Mao, W; Xu, S & Zha (2013) findings showed that among article views and citations, and also altmetric score and article view, a significant relationship exists, although the correlation between altmetric scores and citations; and social attention and citation is low. Thelwall and Wilson's (2015) findings showed that there are strong and statistically significant positive correlations between Mendeley readership counts and Scopus citation counts for all fields except for the smallest sample, for which the

correlation was weak but still positive and significant. Telwall et al. (2013) concluded that six of the eleven altmetrics (tweets, Facebook wall posts, research highlights, blogs, mentions, mainstream media mentions and forum posts) were associated with citation counts, at least in medical and biological sciences and for articles with at least one altmetric mention. Robinson-García, Torres-Salinas, Zahedi, & Costas (2014) research showed that Altmetric.com is a transparent, rich and accurate tool for altmetric data. Nevertheless, there are still potential limitations on its exhaustiveness as well as on the selection of social media sources that need further research (ibid). Downloads correlate positively and significantly with Scopus citations, but the correlation is weak (0.3) because some software has a large natural audience outside of academia (Thelwall & Kousha, 2016).

***Research Conceptual Model:***




## Methodology

The commonest altmetrics evaluation strategy is by testing the correlation between the new and the conventional metrics (Bornmann and Leydesdorff, 2013; Sud and Thelwall, 2014; Zahedi et al. 2014; Allen et al., 2013). Early altmetric investigations have focused on measuring the correlations between citation and altmetrics to partially validate the new metrics articles (Thelwall et al, 2013; Priem et al, 2010; Costas, Zahedi, & Wouters, 2014).

## Research Method

This study is one of these studies.111 medical sciences journals which have the highest SJR in Scopus databases were selected as research population from Scimago Journal Ranking (SJR) 2013-2014. First, a dataset of Medical Science journals of Scopus database according to SJR rank from Scimago.com based on citation counts in Scopus database were downloaded. The downloaded data contains abbreviated journal title, ISSN, citation counts, article count, SJR and SNIP. Each abbreviated journal title was matched with its full journal title. Then, our data were paired with the full set of SJR journal rankings using ISSNs and the full journal names since some ISSNs did not match. We obtained the total citations for one hundred and

eleven medical science journals with the highest SJR, from Scopus database for testing research hypotheses. Citation Indicator is medical science journals citation counts. Altmetrics—alternative metrics usually based on data from the social web— in this research include: Medical Science Journal posts or mentions in CiteULike, F1000 reviews, blogs, Twitter, Facebook, mainstream news outlets, Google Plus and Reddit which could be seen as a particularly promising approach in efforts to find appropriate measures for assessing Medical Sciense Journals altmetrics were extracted through altmetrics.com. For altmetrics data, we matched Scopus journals with highest SJR with altmetrics data extracted from altmetric.com for each journal. Then correlation between medical science Journals citation-based data and altmetrics data were tested. Present research is an applied research and the method used for doing it, is descriptive. Altmetric data collected through the scientomeric tools like Scimago.com and Altmetics.com. Descriptive statistics and Pearson correlation approach were used to analyzing data in SPSS and AMOS.

## Findings

Frequencies in figure 1 show that Altmetrics for One hundred and eleven medical science journals include: Tweets; 2840, Mentions; 401, Facebook; 287, Blogs Posts; 116, Google posts; 50, F1000; 32, Reddit stories; 11 and News Stories 206.

Table 1
*medical science journals altmetrics*

| Title | G+ posts | Facebook Pages | Tweets | Articles mentioned | F1000 reviews | News stories | Reddit stories | Blog posts | mean of article scores, all time |
|---|---|---|---|---|---|---|---|---|---|
| average | 50 | 287 | 2840 | 32 | 401 | 206 | 11 | 116 | 4637 |

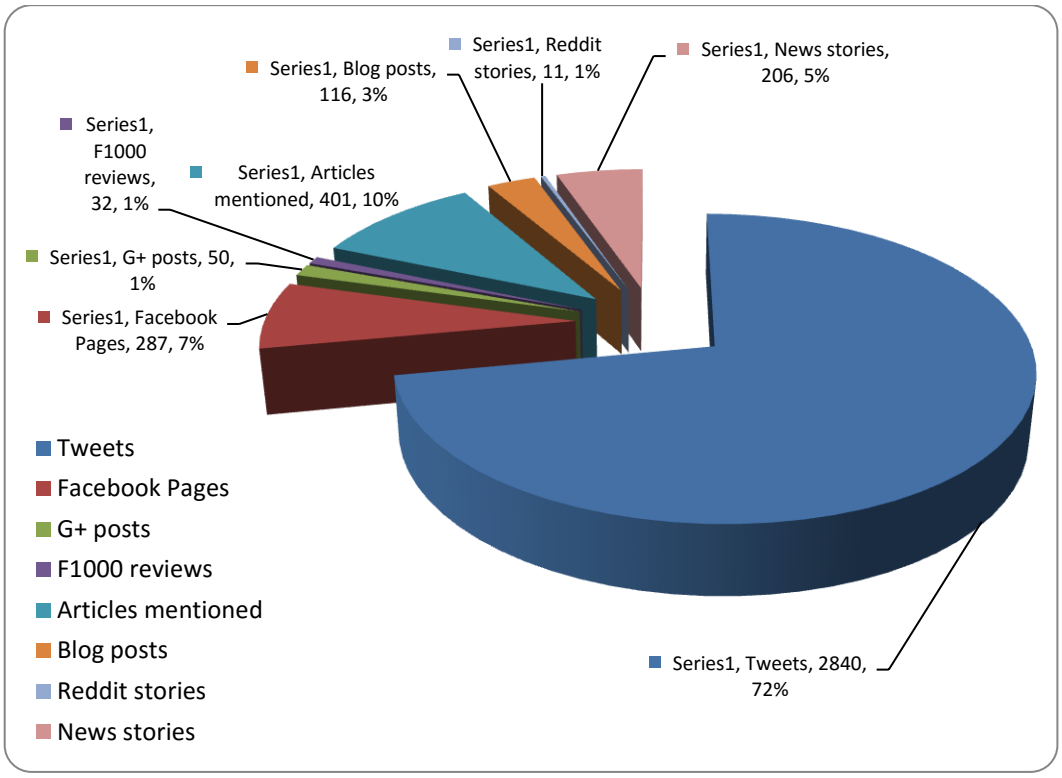



*Figure 1*. altmetrics Frequencies collected from Altmetrics.com

Pearson Correlation results in Table 2 show that medical science journals Citation counts and Altmetrics like: Tweet, Facebook, Google Plus, F1000, Blogs, Reddit have correlation. According to table 2 data, P-value shows that there is a relationship among citation counts and F1000, mentions, Facebook and News, and null hypothsis is rejected, but is accepted for Google Plus, Tweets, Blogs, and Reddit. In other words, there is a correlation among Citation counts and F1000, mentions, Facebook and News and there is no correlation among Citation counts and Google Plus, Tweets, Blogs, and Reddit.

Table 2

*Correlation between altmetrics and citations*

| | | tweets | Facebooks | +G | Blogs | Reddit | News | F1000 | Mentions |
|---|---|---|---|---|---|---|---|---|---|
| Citations | P- Value | 0/057 | 0/006 | 0/079 | *0/078* | 0/219 | 0/003 | ٭ | ٭ |
| | Pearson | 0/17 | 0/27 | 0/168 | 0/168 | 0/118 | 0/277 | 0/433 | 0/448 |

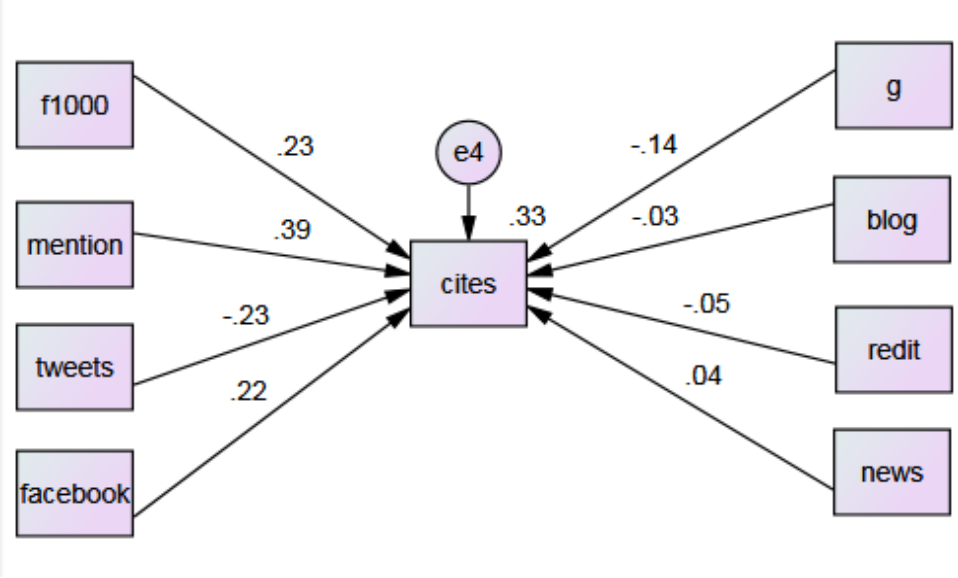



*Figure 2*. Medical Science Journals citation counts and Altmetrics analyzed by AMOS

In figure 2 the results of Chi-Square, degree of freedom ($\chi$2= 83.22 and df= 28) and root mean square approximation error (-0/0458), show that medical science journals have a fit Model. Results of dividing Chi-Square on degree of Freedom which is 2.97, confirms an appropriate fit model of citation counts and altmetrics in medical science journals. Also, for determining whether the fit model is good for medical science journals or not, Fit indexes are used. Results showed that TLI (Toker- Lois Index) is 1; NFI (Normalized Fit Indexes) is equal to 1; Increased Fit Indexes is equal to 1, CFI (comparative FIT Index) is equal to 1; AGFI(Adjustment good Fit Index) is 0./986 and good Fit index model is 0.956.These

Table 3

*Significance level in structural Equation Model of correlation among citation counts and altmetrics of medical science journals*

| | Level of Significant | Standard error | Path Coefficient | | |
|---|---|---|---|---|---|
| | | | t-value | None standard Parameters | Standard Parameters |
| F1000 Citation counts | 0.003 | 151.44 | 5/65 | 448.663 | 0.231 |
| Mention Citation counts | **** | 15.99 | 7.12 | 79.52 | 0.338 |
| Tweets Citation counts | 0.003 | 1.41 | 1.35 | -4.204 | -0.231 |
| Facebook Citation counts | 0.005 | 12.413 | 4.32 | -34.82 | 0.219 |
| G + Citation counts | 0.067 | 75.56 | 1.53 | -138.3 | -0.143 |
| Blogs Citation counts | 0.655 | 32.06 | 1/.2 | -14.32 | 0.035 |
| Redit Citation counts | 0.511 | 285.28 | 1.68 | -178.49 | -0.051 |
| News Citation counts | 0.05 | 19.66 | 2.11 | 10.741 | 0.043 |

With reference to Table 3 which is analyzed by factor analysis measurement Model, it is

observed that F1000, News, Facebook and Mentions variables have positive standard and non-standard path coefficient and according to t-coefficient is a good explanation for citation counts. But the other variables with negative standard coefficient have no effect on citation counts. In other words, among variables, "mentions" have higher path coefficient (0.338) and "tweets" have the lowest path coefficient (-0.231) in Structural model. It is seen that Pearson Test also confirms Structural Equation Modeling.

## Discussion

Findings in table 2 and figure 2 show the correlation among citation counts and F1000. The studies which have been done before show the same result. F1000 judgement ratings correlate significantly and positively with citations (Bornmann & Leydesdorff, 2013; Li et al, 2012; Mohammadi & Thelwall, 2013; Waltman & Costas, 2014; Wouters & Costas, 2012), but Wardle's (2010) results reject our results for ecological articles. It seems that the F1000 score is able to recognize appropriate articles for clinical practice better than citations and this is logical because citation practice is restricted to authors' activities while the suitability of an article for clinical section should be investigated from the practitioners' points of view (Mohammadi & Thelwall, 2013).

According to Li, it should be noted that F1000 measures article quality from users, point view, while citations measure article effect from authors, point of view. In other words, these two reflect different types of effects. Therefore, it is expected that F1000 recommendations sometimes identify many of the important journals which are ignored by citation analysis (Li et al, 2012).

In table 2 and figure 2 it is observed that among Facebook, Mentions and News have correlation with citations counts. One of the possible reasons for this correlation is that medical journals are seen in social networks by their citation and link and hypertext technology, moreover, every journal which has higher citation is used more. So users view them by their links in social network, and mentioned them and read them as news. The other possible reason for this result is the subject field of medical science, it is a field that all users refer to for their health and medicine needs in social networks. Thelwall et al. (2013) results show that Facebook, wall posts and mentions associated with citation counts, at least in medical and biological sciences and for articles with at least one altmetric mention, confirm the results of this research. News has the highest correlation with citation counts (Alhoori & Furuta, 2014). His results confirm our results with regard to correlation between News and Citation counts.

According to research results commented in table 2 and figure 2 Reddit, Blogs, G+ and Tweets are not associated with Citation Counts. The possible reason for this result is that reddit is a free news social site and many of the people who use it are different from citation system users. Reddit is like a bulletin board and its subject fields are more than fifteen. The possible reason for the lack of correlation among G+ and Blogs and citation counts is that G+is a social layer for Google services and its users are social public users. Generally, Reddit, G+, Tweeter and Blogs do social services more than Scientific and educational services.

Users search Tweeters for news not scientific information and journalists are one of the important reasons for tweeters development. Some results of previous studies show that Tweets, Blogs, Google+ and Reddit, are associated with citation counts in medical and biological sciences and for articles with at least one altmetric mention (Thelwall, et al, 2013; Costas, et al, 2014; Zahedi et al, 2014) reject the results of this research. Groth and Gurney's (2010) findings also reject our research findings. They conclude that RB posts about chemistry often cite papers from high-impact journals either because of these papers' scientific importance or because of the reputation of the journals. The possible reason for the difference between this research result and the researches before this on tweets, blogs, Google+ and Reddit, can be geographical and time categories. Blogs could play an important role in the generation of societal impact by research (Fausto, Machado, Bento, Iamarino, Nahas & Munger, 2012). The blogs do not just deal with research results themselves, but also many topics associated with science, such as the relation between science and society, a researcher's life, and problems of academic life (Colson, 2011; Wolinsky, 2011). Some studies confirm our results with regard to lack of correlation among Twitter and blogs and citations counts (Haustein et al, 2014 and also Bornmann, 2014; Shuai et al. 2012).

A significant point in using social media is researchers, information seeking behavior and professional position. Young researchers use electronic articles, because they are more compatible to new technology and ideas, the experienced and older researchers prefer print articles and information resources to social web services. Physicians study journal articles and engineers study through partners, communications, internal documents, proceedings and journals articles. In many professions which are out of universities and research centers do not study like researches and therefore they do not cite others, so the effects of these articles will not be resounded by citations (Mohmmadi & Thelwall, 2013).Twitter is used by scientists and those interested in science mainly to publicized or to discuss scientific results (and other products of scientific work, such as data sets) and to follow or to comment on live events in science such as conference talks or workshop discussions (Bik & Goldstein, 2013; Holmberg & Thelwall, 2014).The people who cite articles are researchers but, social media users involve different groups of people. Furthermore, altmetrics does not have the same value, in an altmetric like download, an article may be downloaded for educational purpose not research purpose. Altmetrics have added-value, it means that they measure different aspects of research effects cannot be seen in citation (Bornnman, 2014).

Finally, research results show that there is relationship among altmetrics and citation counts. Previous researchers, studies confirm our research results (Alhoori & Furuta, 2014; Thelwall, et al, 2013). With regard to the correlation between Altmetrics and citation counts, some studies disagree with our findings (Wang, et al, 2013; Bar-Ilan et al, 2012 ; Ortega, 2015).

## Conclusion

According to research results, Pearson Correlation and Structural Equation Modeling show that there is significant correlation between Medical science journals altmetrics in tools

like F1000, Mention, Facebook, and News and Citation Numbers. According to research results commented in table 2 and figure 2altmetrics tools like: Reddit, Blogs, G+ and Tweets has no significant correlation with Citation Counts. Structural equation modeling also shows the same results. Therefore, Medical science journals altmetrics somewhat are correlated with Journals citations counts in Scopus database.

## References

Alhoori, H., & Furuta, R. (2014). Do altmetrics follow the crowd or does the crowd follow altmetrics?. In Proceedings of the 14th ACM/IEEE-CS Joint Conference on Digital Libraries (pp. 375-378). IEEE Press

Alhoori, H., Choudhury, S.R., Kanan, T., Fox, E. A. and Gils, C. Lee. (2015). On the relationship between open access and altmetrics. Proceedings of the iConference 2015, Retrieved from http://hdl.handle.net/2142/73451.

Allen, H.G., Stanton, T.R., Di Pietro, F. & Moseley, G.L. (2013). Social media release increases dissemination of original articles in the Clinical Pain Sciences. *PLOS ONE*, 8(7), 1-6. Retrieved from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0068914

Armbruster, C. (2008). Access, usage and citation metrics: what function for digital libraries and repositories in research evaluation? Retrieved from http://ssrn.com/abstract=1088453

Bar-Ilan, J., Haustein, S., Peters, I., Priem, J., Shema, H., & Terliesner, J. (2012). Beyond citations: Scholars' visibility on the social Web. arXiv preprint arXiv:1205.5611.

Blecic, D. D. (1999). Measurements of journal use: An analysis of the correlations between three methods. *Bulletin of the Medical Library Association*, 87(1), 20–25.

Bollen, J., Van de Sompel, H., Smith, J.A., and Luce, R. (2005). Toward alternative metrics of journal impact: A comparison of download and citation data. *Information Processing and Management*, 41(6), 1419-1440.

Bornmann, L. (2014). Validity of altmetrics data for measuring societal impact: A study using data from Altmetric and F1000Prime. Journal of Informetrics, 8(4), 935-950.

Bornmann, L. & Leydesdorff, L. (2013). Statistical tests and research assessments: A comment on Schneider. *Journal of the Association for Information Science & Technology*, 64(6), 1306-1308.

Brody, T., Harnad, S. and Carr, L. (2006), Earlier Web usage statistics as predictors of later citation impact. *Journal of the American Society for Information Science*, 57(8), 1060–1072.

Cave, Richard (2012) Overview of the altmetrics landscape. *Proceedings of the Charleston Library Conference* (pp.348-356). Retrieved from http://www.webcitation.org/6h1nqBKGY

Colson, V. (2011). Science blogs as competing channels for the dissemination of science news. *Journalism*, 12(7), 889-902.

Costas, R., Zahedi, Z. & Wouters P. (2014). Do altmetrics correlate with citations? Extensive

comparison of altmetric indicators with citations from a multidisciplinary perspective. *Journal of the Association for Information Science and Technology*, 66(10), 2003-2019.

Eysenbach, G. (2011). Can tweets predict citations? Metrics of social impact based on twitter and correlation with traditional metrics of scientific impact. *Journal of Medical Internet Research*, 13(4),e123. doi: 10.2196/jmir.2012

Fausto, S., Machado, F. A., Bento, L. F. J., Iamarino, A., Nahas, T. R., & Munger, D. S. (2012). Research blogging: Indexing and registering the change in science 2.0. *PLoS ONE*, 10(4). Retrieved from https://journals.plos.org/plosone/article?id=10.1371/ journal. pone.0050109

Garfield, E. (2011). Full Text downloads and citations: Some reflections. In Keynote lecture at the Seminar "Scientific Measurement and Mapping." Santa Fe, New Mexico. Retrieved from http://www.garfield.library.upenn.edu/papers/santafe2011.pdf

Groth, P. & Gurney, T. (2010). Studying scientific discourse on the Web using bibliometrics: A chemistry blogging case study. *Proceedings of the Web Science: Extending the Frontiers of Society On-Line*, Raleigh, NC, USA.

Haustein, S. & Siebenlist, T. (2011). Applying social bookmarking data to evaluate journal usage. *Journal of Informetrics, 5*(3), 446-457. doi:http://dx.doi.org/10.1016/j.joi. 2011.04.002.

Haustein, S., Peters, I., Bar-Ilan, J., Priem, J., Shema, H., & Terliesner, J. (2014). Coverage and adoption of altmetrics sources in the bibliometric community. *Scientometrics*, 101(2), 1145-1163.

Holmberg, K., & Thelwall, M. (2014). Disciplinary differences in Twitter scholarly communication. *Scientometrics*. 102(2), 1027-1042.

Li, X., Thelwall, M., & Giustini, D. (2012). Validating online reference managers for scholarly impact measurement. *Scientometrics*, 91(2), 461-471.

Mohammadi, E., & Thelwall, M. (2013). Assessing non-standard article impact using F1000 labels. *Scientometrics*, .97(2), 383-395.

Ortega, J. L. (2015). Relationship between altmetric and bibliometric indicators across academic social sites: the case of CSIC's members. *Journal of Informetrics*, 9(1), 39-49.

Priem, J., & Hemminger, B. M. (2010). Scientometrics 2.0: Toward new metrics of scholarly impact on the social Web. *First Monday, 15*(7). Retrieved from https://firstmonday.org /article/view/2874/2570

Robinson-García, N., Torres-Salinas, D., Zahedi, Z., & Costas, R. (2014). New data, new possibilities: exploring the insides of Altmetric. com. arXiv preprint arXiv:1408.0135.

Rowlands, I., & Nicholas, D. (2007). The missing link: journal usage metrics. *Aslib Proceedings*, 59(3), 222–228.

Schloegl, C., & Gorraiz, J. (2011). Global usage versus global citation metrics: The case of pharmacology journals. Journal of the American Society for Information Science and Technology, 62(2005), 161–170.

Schloegl, C., & Stock, W.G. (2004). Impact and relevance of LIS journals: A scientometric analysis of international and German-language LIS journals—Citation analysis versus

reader survey. *Journal of the Association for Information Science and Technology*, 55(3), 1155-1168. https://doi.org/10.1002/asi.20070

Shema, H. Bar-Ilan, J. & Thelwall, M. (2012). Research blogs and the discussion of scholarly information. *PLos ONE*, 7(5). Retrieved from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0035869

Shema, H. & Bar-Ilan, J. & Thelwall, M. (2014). Do blog citations correlate with a higher number of future citations? *Journal of the American Society for Information Science and Technology*, 65(5), 1018-1027.

Shuai, X. Pepe, & Bollen, J. (2012). How the scientific community reacts to newly submitted preprints: article downloads, twitter mentions, and citations. *PLoS ONE*, 7(11),e47523. https://doi.org/10.1371/journal.pone.0047523.

Sud, P. & Thelwall, M. (2014). Evaluating altmetrics. *Scientometrics*, 98(2), 1131-1143.

Thelwall, M. & Kousha, K. (2016). Academic software downloads from Google Code: useful usage indicators? Information Research, 21(1). Retrieved from http://www.informationr.net/ir/21-1/paper709.html#.XAO_8uJdLcs

Thelwall, M., & Wilson, P. (2016). Mendeley readership altmetrics for medical articles: An analysis of 45 fields. *Journal of the Association for Information Science and Technology*, 67(8), 1962-1972.

Thelwall, M., Haustein, S. Larivière, V. & Sugimoto, C.R. (2013). Do altmetrics work? Twitter and ten other social web services. *PLoS ONE*, 8(5), e64841. https://doi.org/10.1371/journal.pone.0064841

Waltman, L., & Costas, R. (2014). F 1000 Recommendations as a potential new data source for research evaluation: A comparison with citations. *Journal of the Association for Information Science and Technology*, 65(3), 433-445.

Wang, X., Mao, W., Xu, S. & Zhang, C. (2013). Usage history of scientific literature: Nature metrics and metrics of Nature publications. *Scientometrics*, 98(3), 1923-1933.

Wardle, D. (2010). Do Faculty of 1000 (F1000) ratings of ecological publications serve as reasonable predictors of their future impact? *Ideas in Ecology and Evolution*, 3. Retrieved from http://library.queensu.ca/ojs/index.php/IEE/article/viewArticle/2379

Wolinsky, H. (2011). More than a Blog. *EMBO reports, 12*(11), 1102-1105.

Wouters, P., & Costas, R. (2012). Users, narcissism and control: tracking the impact of scholarly publications in the 21st century (pp. 847-857). Utrecht: SURF foundation.

Zahedi, Z., Costas, R., Wouters, P. (2014). How well developed are altmetrics? A cross-disciplinary analysis of the presence of 'alternative metrics' in scientific publications. *Scientometrics.* 102(2), 1491-1513.