

Factors affecting number of citations: a comprehensive review of the literature

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Abstract The majority of academic papers are scarcely cited while a few others are highly cited. A large number of studies indicate that there are many factors influencing the number of citations. An actual review is missing that provides a comprehensive review of the factors predicting the frequency of citations. In this review, we performed a search in WoS, Scopus, PubMed and Medline to retrieve relevant papers. In overall, 2087 papers were retrieved among which 198 relevant papers were included in the study. Three general categories with twenty eight factors were identified to be related to the number of citations: Category one: “paper related factors”: quality of paper; novelty and interest of subject; characteristics of fields and study topics; methodology; document type; study design; characteristics of results and discussion; use of figures and appendix in papers; characteristics of the titles and abstracts; characteristics of references; length of paper; age of paper; early citation and speed of citation; accessibility and visibility of papers. Category two: “journal related factors”: journal impact factor; language of journal; scope of journal; form of publication. Category three: “author(s) related factors”: number of authors; author’s reputation; author’s academic rank; self-citations; international and national collaboration of authors; authors’ country; gender, age and race of authors; author’s productivity; organizational features; and funding. Probably some factors such as the quality of the paper, journal impact factor, number of authors, visibility and international

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cooperation are stronger predictors for citations, than authors' gender, age and race; characteristics of results and discussion and so on.

Keywords Citations · Impact factor · Determinant factors · Predictive factors · Citation characterization · Citation analysis

Introduction

The majority of academic papers are scarcely cited while a few others are highly cited. In recent years, a number of studies have investigated why some papers are cited more than others. According to Garfield (2006), about 20 % of papers achieve more than 80 % of citations while other papers are either not cited at all or are infrequently cited (Garfield 2006). One might conclude that those with infrequent citations are of lower quality than others (Padial et al. 2010). When a particular paper is cited more frequently than others, it is usually concluded that it has a higher quality compared to other papers (Bornmann et al. 2012).

There are many reasons why researchers cite others' works in their papers. For instance, they cite others to support their own claims, methodology or findings (called supportive citations). Other citations are made to present other researchers' points of view. Furthermore, papers are cited in order to be criticized (Harwood 2008). Some papers are cited so as good research examples, while others might be cited due to the negative samples of poorly designed research (Aksnes and Sivertsen 2004).

Researchers publish their findings so that they can attract the greatest attention and have the highest impact on the scientific community. They often try to publish their papers in high-impact journals to reach more readers and to become more frequently cited (Bhandari et al. 2007). Evaluating the quality of papers is a complex task. The number of citations is the most frequently used indicator in evaluating the quality of papers, researchers, research centers and universities. Some other measures for evaluating the quality of papers are also mentioned in previous studies. For instance, the impact factor of the journal where the paper is published in could be considered as an indicator for the paper's quality. However, impact factor is a consequence of citations, and is often considered as a cause of citations. Thus, assessing the quality of a scientific publication is sometimes tricky.

Given the important role of citations in measuring the quality of research and researchers, it is reasoning to investigate why some papers achieve more citations than others. Actually, the use of citations as an indicator of quality might be only acceptable with the prerequisite that the author of a citing paper has studied the cited paper thoroughly and found it worthy from different aspects such as its innovation and high quality. The reality, however, can be different from this ideal (Nieminen et al. 2006). Some authors indeed have a lack of responsibility in citing papers, whereas some others cite them with this prerequisite. Thus, considering citations as an indicator of a paper's quality is biased and other measures should be taken into consideration for this purpose.

Various studies have been conducted in the past to investigate the meaning of citations in different disciplines. A number of studies have investigated the merits and demerits of using citations for research evaluation purposes, while others have explored the factors influencing citations. Some have attempted to estimate and predict citations of future. A

group of studies have explored the features of highly-cited papers and others examined biases in citations. This study will provide a comprehensive literature review of factors influencing the frequency of citations. Therefore, it is the attempt of this study to review the related literature and to explore the factors that influence citations frequency.

Methodology

Search strategy

Web of Science, Scopus, OVID Medline, and PubMed were searched for identifying relevant papers. The following search strategies were performed in the selected databases:

Web of Science: TI = (Determin* OR Factor* OR Effect* OR Relation* OR Influence* OR Impact* OR Predict* OR Function* OR Significance* OR Feature* OR Characteristic* OR Distribution* OR Inceas*) AND TI = (Citation*) limited to 2000–2015, English papers.

PubMed: (Determin*[title] OR Factor*[title] OR Effect*[title] OR Relation*[title] OR Influence*[title] OR Impact*[title] OR Predict*[title] OR Function*[title] OR Significance*[title] OR Feature*[title] OR Characteristic*[title] OR Distribution*[title] OR Inceas*[title]) AND (Citation*[title]) limited to 2000/01/01 to 2015/12/31, English articles.

OVID Medline: (Determin* or Factor* or Effect* or Relation* or Influence* or Impact* or Predict* or Function* or Significance* or Feature* or Characteristic* or Distribution* or Inceas*).ti. AND Citation*.ti.:, limited to 2000–2015, English articles.

Scopus: TITLE (determin* OR factor* OR effect* OR relation* OR influence* OR impact* OR predict* OR function* OR significance* OR feature* OR characteristic* OR distribution OR inceas*) AND TITTLE (citation*) AND (LIMIT-TO (PUBYEAR, 2000–2015) AND (LIMIT-TO (LANGUAGE, “English”))).

Data collection

The retrieved papers were imported into Endnote and the duplicates were removed. Papers were first screened by titles and abstracts to include relevant papers and exclude non-related papers. Then, the full-texts of potentially eligible studies were investigated to identify relevant papers. The disagreements in identifying relevant papers were reconciled by consensus.

Eligibility criteria

The papers that had investigated the factors influencing number of citation, predictors of citations, relationship between some variables and citations were included in the study. Original English language papers from 2000 to April 2015 were included in the study. Other types of documents such as reviews, editorials, letter to editors, short communications as well as the papers that had investigated predictors of number of citations in patents were excluded.

Findings

In overall, 2087 papers were retrieved: 900 papers were retrieved from Scopus, 750 from WoS, 224 from PubMed and 213 from OVID Medline. 1147 duplicate papers were removed and 940 papers remained. By screening the titles and abstracts of papers, 316 papers were excluded and 624 papers were included for reading the full-texts. By reading the full-text of the retrieved papers, 426 papers were excluded and 198 relevant papers were included in the study (see Table 1 as online supplement). 28 factors, influencing the frequency of citations were identified which were classified into three categories: “Paper related factors”, “Author related factors” and “Journal related factors”.

“Paper” related factors

Quality of paper

One of the main factors related to number of citations is the quality of paper which can predict the paper’s future citation impact (Buena-Casal and Zych 2010; Callaham et al. 2002; Jabbour et al. 2013; Patterson and Harris 2009; Stremersch et al. 2007). Some studies have mentioned that papers with higher quality obtain more citations. Quality of a paper is a factor that influences the impacts of research (Jabbour et al. 2013).

Few measures for judging the quality and impact of scientific papers are mentioned in previous studies because of lacking an appropriate way to quantify them. For example, in the study by Callaham et al. (2002), scientific quality of publications are rated subjectively using a Delphi method. Subjective newsworthiness is mentioned in the study as a quality measure. Also, one study considers readability, relevance, and novelty as three measures of article impact or quality (Walters 2006).

A few studies have quantified the quality of papers by certain measures and have examined the relation of the measures with number of citations received by the papers. For instance, to evaluate the quality of reporting, one study investigates (a) “whether the primary research question or hypothesis is clearly stated in the report’s introduction or methods section; (b) whether sample size and data analysis procedures are described in the report’s methods section, and (c) whether the article is difficult to read due to lack of clarity about the primary response or outcome variable” (Nieminen et al. 2006). Also, Stremersch et al. (2007) considers article order in a journal, journal awards chosen by editorial boards and the article length (number of pages) as indicators of article quality. This study finds that article quality has a significant, positive effect on article citations (article order ($\mu_1 = -.02$, $p < .05$ [reverse-scaled]), awards ($\mu_2 = .34$, $p < .01$) and article length ($\mu_3 = .04$, $p < .01$). Another study uses quality score evaluated by experts. This study indicates that there is a statistically significant relation between the quality of a paper evaluated by experts and the number of citations (Buena-Casal and Zych 2010). Other measures for quality of papers are quoted from other studies by Onodera and Yoshikane (2015) including presence or absence of a control group or randomization, sample size or the type of subjects, the score of clinical relevance and newsworthiness, positivity/negativity of the results or support/rejection of the hypothesis, strength of statistical significance and so on.

It is also mentioned that peer reviewed papers which often have higher quality than non-reviewed papers obtain more citations (Bhat 2009) and longer review times results in an increase in paper quality and greater citations (Hilmer and Lusk 2009).

Novelty, popularity and interest of subject

Besides the quality of a paper, some papers indicate that the novelties of its subject, as well as the popularity of the topic for a large number of academics and the citer's interest in the subject are among the factors influencing citations. Few studies have been conducted on the relationship between the interest in the subject and the frequency of citations (Peng and Zhu 2012). The more attractive and novel the subject is, the more it would be cited. Papers that introduce novel connections between clusters of co-cited references obtain more citations in the future (Chen 2012).

Characteristics of fields/subfields of a discipline and study subject/topics

A number of papers indicated that number of citations varies according to the study topic/subjects, field of study and sub-fields of a discipline. Fields and subfields are very different in citation behavior. Various studies show that the number of citations is different in various subjects and subfields of a discipline (Antoniou et al. 2015; Bettencourt and Houston 2001; Bornmann et al. 2012; Bornmann and Williams 2013; Costas et al. 2009; Dorta-González et al. 2014; Gallivan 2012; Ginsberg 2012; Huang et al. 2012; Kademani et al. 2007; Kousha and Thelwall 2011; Mansiaux and Carrat 2012; Miettunen and Nieminen 2003; Patsopoulos et al. 2005; Poomkottayil et al. 2011; van Eck et al. 2013). Certain topics, subjects and disciplines are typically cited much more or much less often than others (Ayres and Vars 2000; Gargouri et al. 2010; Jabbour et al. 2013; Mishra et al. 2010; Willis et al. 2011). The chance of getting cited is correlated with the number of papers published in different fields and subjects. Therefore, papers of small fields may achieve fewer citations than more extensive and general fields (Bornmann et al. 2012). For example, in chemistry papers published on analytic chemistry, organic chemistry and physical chemistry achieve more citations than those on biochemistry (Bornmann et al. 2012). In another study on clinical psychological journals, it was shown that biology and psychopharmacology have achieved more citations than other sub-fields (Miettunen and Nieminen 2003). Besides, in epidemiologic publications, highly-cited papers are more frequently discussed about risk factors of diseases, while low cited papers are more likely to address other general topics (Filion and Pless 2008). Disciplines have different citation practices. For example, number of citations per paper is significantly higher for social science special topics than natural science special topics (Skilton 2006). Another study mentions that the average citations received by papers in a venue can predict future citations. It is revealed that the average number of citations received per paper in that venue during two preceding years is a predictor for number of citations. This is called the recent impact of the venue. This study also indicates that the different fields covered by the papers published in that venue might be another predictor of number of citations. Thus, the diversity of study topic is contributed to number of citations (Chakraborty et al. 2014).

The study scope and subject area will influence the number of citations, while some studies show that study topic is not so important (Bhandari et al. 2007). For example, hot topics usually attract more attention and receive more citations (Fu and Aliferis 2010; Gallivan 2012). However, it is shown that number of subjects in a paper is less likely to be associated with number of citations (Annalingam et al. 2014).

Size of literature that is the number of papers published in the field (Biscaro and Giupponi 2014), and the entropy of the research fields where the author publish are also contributed to number of citations a paper receives (Biscaro and Giupponi 2014;

Chakraborty et al. 2014). Besides, the percentage of increase in number of citation for individual faculty members changes significantly based on their research areas (Meho and Yang 2007).

Methodology

A number of papers show that features of methodology in general, can be associated with citations. Although, methodology is considered as an important factor for citations, some studies pointed to some methodological features of a paper (e.g. sample size and effect size) that had no or had little influence on citations. One study shows that papers with higher methodological quality (e.g. Randomized Controlled Trials (RCTs) in the medical field) and without methodological biases increase the number of citations (Nieri et al. 2007; Willis et al. 2011). An adequate description of methods, citing statistical literature in the methodology section as well as mentioning the name of the statistical software are among primary factors influencing the frequency of citations, while the type of statistical methods (e.g. basic statistical methods) might not be related to the citation number (Miettunen and Nieminen 2003). Moreover, the provision of adequate information about the procedures and methods of research may influence the frequency of citations.

While sample size features (higher sample size) are shown to be important for a paper to obtain more citations (Kulkarni et al. 2007), some studies have come to opposite results (Bhandari et al. 2007; Farshad et al. 2013; Leimu and Koricheva 2005; Nieminen et al. 2006; Willis et al. 2011; Winnik et al. 2012). It is also shown that statistical mistakes is not correlated with the frequency of citations (Nieminen et al. 2006). Also, statistical reporting such as the use of 95 % CI, SEM, SD, p value and use of validated scores for outcome measures (Farshad et al. 2013), and effect size in a methodology are not contributed to number of citations (Leimu and Koricheva 2005; Lortie et al. 2013; Schneider and Henriksen 2013). Furthermore, in a study on Randomized Controlled Trials (RCTs), it is shown that the statistical quality of a paper is not related to number of citations (Nieri et al. 2007).

Document type

Some types of documents receive more citation than others. A number of studies investigated the relationship between the document type (review, letter to editor, short communication, and so on) with the number of citations (Annalingam et al. 2014; Bornmann 2013; Bornmann and Williams 2013; Ginsberg 2012; Hilmer and Lusk 2009; Ingwersen and Larsen 2014; Kademani et al. 2007; Lokker et al. 2008; Padial et al. 2010; Patsopoulos et al. 2005; Walters 2006). Generally, review papers achieve more citations than research papers (Biscaro and Giupponi 2014; Fu and Aliferis 2010; Gargouri et al. 2010; Ruano-Ravina and Alvarez-Dardet 2012; Sin 2011; Vanclay 2013; Weale et al. 2004). It is also shown that reviews receive more citations than intervention studies (Frosch et al. 2010). However, reviews of low quality and those written hastily won't be so (Vanclay 2013).

Study design

In the medial field some study designs are more likely to obtain more citations than others. For example, randomized trials, systematic reviews and meta-analysis studies achieve more citations than observational studies (Andersen and Schneider 2011; Annalingam et al. 2014; Antoniou et al. 2015; Bhandari et al. 2007; Falagas et al. 2013; Farshad et al. 2013;

Ginsberg 2012; Lira et al. 2014; Miettunen and Nieminen 2003; Patsopoulos et al. 2005; Perneger 2004, 2015). One study shows that among the different factors influencing the frequency of citations (e.g. self-citation, sample size, the number of authors and institutes), the two factors of study design and topic of the paper are the most predictive factors of the frequency of citations (Willis et al. 2011). Besides, one regression analysis reveals that among the investigated factors including the study design, sample size, self-citation, geographical region where the study was set in and the study subject, the “design of the study” was statistically significantly related with the number of citations. This study indicates that meta-analysis studies and randomized trials achieve more citations than observational studies and case reports (Bhandari et al. 2007). In overall, among various study designs in the medical field, such as RCTs, prospective observational, retrospective observational and case studies, “clinical trials” obtain the more number of citations (Andersen and Schneider 2011; Bhandari et al. 2007; Falagas et al. 2013; Ginsberg 2012; Romero et al. 2009; Winnik et al. 2012). Moreover, Meta-analysis studies achieve a high number of citations (Bhandari et al. 2007; Farshad et al. 2013; Patsopoulos et al. 2005). It is also indicated that reporting the study design in the title of a paper leads to more citations (Antoniou et al. 2015).

Although, methodological studies tend to become highly cited because of introducing new scientific tools (Padial et al. 2010), one study shows a lower number of citations for methodological studies (Stremersch et al. 2015).

However, two studies show not such relationship between study design and number of citations (Kulkarni et al. 2007; Marx and Cardona 2003). For example, it is indicated that the features of the study design (randomization, blinding, prospective and retrospective) have lower effects on citations, while the presence of a control group in the study increases the citation frequency (Callaham et al. 2002).

Characteristics of results, discussions and other sections

Characteristics of results, discussions and other sections of a paper can influence citations. For example, positive and statistically significant findings seem to be attractive and cause citations. If the result of a paper is statistically significant, it achieves more citations than those with statistically insignificant results. A reason for this phenomenon is that researchers tend to cite studies with statistically significant results (Annalingam et al. 2014). However, another study reveals that there is not a relationship between number of citation and significance of results (Callaham et al. 2002). It is also shown that “slicing the results of a study into the ‘minimal publishable units’ significantly decreases the number of citations per publication” (Leimu and Koricheva 2005).

Policy discussions are strongly associated with number of citations and in medical journals discussions of practice implications significantly increase numbers of citation, while theory discussions have a negative association with the frequency of citation (Frosch et al. 2010).

It is also reported that there is a negative relationship between number of equations and citation (Stremersch et al. 2007, 2015) and papers containing differential, partial differential, or integral equations obtain fewer citations than those that do not (Robson and Mousquès 2014). Also, one study shows that “reporting an equation in a study” reduces average citations, and fewer footnotes per page increases citations (Ayres and Vars 2000).

Failing to provide essential information of a study in a paper, including clear formulated research questions and outcome variables (Nieminen et al. 2006) and presenting a hypothesis in the study (Callaham et al. 2002) are not correlated with the frequency of

citations. However, it should be taken into consideration that papers that share more details of their research such as sample attributes, clinical factors, patient outcomes, DNA sequences, raw mRNA microarray measurements significantly increases number of citations ($p = .006$) (Piwowar et al. 2007).

Use of figures and appendix in papers

The use of figures to present the results (Ayres and Vars 2000; Miettunen and Nieminen 2003), number of images (Nieri et al. 2007) and the presence of appendices in a paper (Stremersch et al. 2007, 2015) increases the frequency of citations. Readers seem to perceive findings much better with figures. Obviously, figures provide more useful information for readers than any other means. However, one study shows that papers with appendices do 50 percent worse than average number of citations that is papers with appendices receive fewer citations than average (Ayres and Vars 2000).

Characteristics of the title, abstract and keywords

The features of the title, abstract and keywords of a paper are factors that may influence citations; while these are not identified as determinant factors for citations in some other papers. For example, Jamali and Nikzad (2011) show that an informative title increase the use of a paper, its frequency of downloads and citations. They show that papers with titles in a question form are downloaded more than those with declarative titles. However, they are less frequently cited. Also, it is shown that the attractiveness of a title cannot be a mere criterion of receiving citation. They find in general that the characteristics of the title more affect the number of downloads than citations. This study also shows that there is not a significant correlation between title length and citations (Jamali and Nikzad 2011) as is also shown by other studies (Rostami et al. 2014).

Diversity and number of keywords in a paper increase citations (Chakraborty et al. 2014; Rostami et al. 2014; So et al. 2014). The presence of certain words such as automated, nucleotide, dynamic and entire in the abstracts of papers in the field of bioinformatics affect number of citations (Ibáñez et al. 2009). Also, number of words in the title and abstract are related to citation numbers (Annalingam et al. 2014; Falagas et al. 2013; Rostami et al. 2014). It is maintained that the title length negatively affects number of citations (Stremersch et al. 2015) that is longer titles receive less citations than shorter titles (Jacques and Sebire 2010; Stremersch et al. 2007; Subotic and Mukherjee 2014) and papers with shorter titles receive significantly more citations than papers with longer titles (Ayres and Vars 2000). But, as mentioned in a paper, it depends on the study field. For, example, in “sociology and applied physics” papers with shorter titles received more citations and in “internal & general medicine” longer titles obtain more citations than other fields such as sociology. However, papers with longer abstracts receive more citations than shorter abstracts (van Wesel et al. 2014). The presence of an abstract increases number of citations (Ibáñez et al. 2009), while, it is shown that there is a negative correlation between the presence of a structured abstract and the citation frequency (Lokker et al. 2008).

Papers with punctuation marks such as a hyphen, comma, colons and brackets in the titles are likely to achieve more citations than papers with only alphabets and digits in titles (Buter and van Raan 2011) and titles with two components separated by a colon increases the number of citations (Jacques and Sebire 2010). However, the presence of colons and acronyms in the title of a paper (Subotic and Mukherjee 2014), mentioning a country in the title of a paper (Jacques and Sebire 2010) as well as titles with amusements and the type of

title (compound titles, question titles and descriptive titles) are predictors of citations (Subotic and Mukherjee 2014). As said before, papers that report the study design in their title are more likely to receive more citations (Antoniou et al. 2015), but mentioning of the name of a particular country in the title is negatively related to citations (Jacques and Sebire 2010) and the presence or absence of the main study conclusion in the title of the paper does not influence the frequency of citation (Annalingam et al. 2014).

Characteristics of references

References of a paper can be considered as the knowledge of one author about different strands of the literature. Thus, authors that separate pieces of literature as their references are more likely to receive more citations than others (Biscaro and Giupponi 2014). The number of references, their prestige as well as the variety of the references in a paper increase frequency of citation. Some studies indicate a relationship between the number of references and the number of citations a paper receives (Antoniou et al. 2015; Biscaro and Giupponi 2014; Bornmann et al. 2014; Chen 2012; Didegah and Thelwall 2013; Falagas et al. 2013; Gargouri et al. 2010; Gomes and Vieira 2009; Haslam and Koval 2010; Lokker et al. 2008; Onodera and Yoshikane 2015; Robson and Mousquès 2014; Roth et al. 2012; So et al. 2014; van Wesel et al. 2014; Yu and Yu 2014; Yu et al. 2014). Also, the citation performance of the citing references influences the number of citations (Bornmann et al. 2012). Papers with a low (but not too low) average reference age, probably obtain more citations and papers that mostly cite “old publications” are significantly less cited (Roth et al. 2012). The variety of references or the number of fields being cited by a paper that is called “Reference Diversity Index” (Chakraborty et al. 2014) and the internationality of references increase frequency of citations (Didegah and Thelwall 2013). In contrast, one study investigating 25 million papers and 600 million references from Web of Science, shows that uncitedness is a result of higher number of references per paper (Wallace et al. 2009).

One study finds no significant differences between papers that cite patents as their references and “not citing patents” in regard with their citation impact. This study also shows that if a paper is being cited in patents, it will be cited also by other papers as well (Glänzel and Zhou 2011). Besides, if a paper appears in a literature that builds on a common base of articles, this paper would have the chance to obtain a high number of citations (Biscaro and Giupponi 2014).

Length of paper

A number of studies indicate that the length of a paper (the number of its pages) is among the factors increasing the number of citations (Antoniou et al. 2015; Ayres and Vars 2000; Bornmann and Daniel 2007, 2010; Bornmann et al. 2014; Bornmann and Williams 2013; Falagas et al. 2013; Farshad et al. 2013; Frosch et al. 2010; Gargouri et al. 2010; Gomes and Vieira 2009; Holsapple and Luo 2003; Lee et al. 2010; Lokker et al. 2008; Padial et al. 2010; Peng and Zhu 2012; Perneger 2004; Robson and Mousquès 2014; So et al. 2014; Stremersch et al. 2015; van Wesel et al. 2014; Yuan and Hua 2011). The longer the paper, the more citations it achieves. This might be due to the fact that longer papers contain more information (Leimu and Koricheva 2005). According to Bornmann et al. (2014) the number of pages is an influential factor of the number of citations, especially during the initial years after the publication of the paper. This study also shows that papers longer in length tend to be highly cited more often, but also mentions that additional pages of a paper

might decrease the probability of the paper to be cited. In contrast to the above results, some studies show that there is not a relationship between the length of a paper and number of citations (Haslam and Koval 2010; Royle et al. 2013; Walters 2006).

Age of cited paper (age effect)

Another important factor affecting the citations of a paper (total citations till a given date) is the age of the cited paper (Lachance et al. 2014; Marx and Cardona 2003; McMinn and Fleming 2011; Peng and Zhu 2012; Piwowar et al. 2007). Citations per year rise quickly in the first few years after publication (Ayres and Vars 2000; Bornmann and Williams 2013; De Araújo et al. 2012; Filion and Pless 2008; Frosch et al. 2010; Gallivan 2012; Gargouri et al. 2010; Georgas and Cullars 2005; Guerrero-Bote and Moya-Anegón 2014). Although papers published years ago (older paper) may receive more citations than younger papers (Bornmann and Williams 2013; Ruano-Ravina and Alvarez-Dardet 2012), it is shown that: the likelihood of being discovered significantly decreases with age (Lynn 2014); recent papers are cited more than older papers (Meadows 2004; Sin 2011; Wang et al. 2009) and a negative relationship exists between the year of publication and number of citations (Padial et al. 2010). In general the number of citations increase in the first years after publication to reach a peak and then are less cited when time passes. One possible reason could be that the paper's information becomes increasingly outdated and obsolete (Barnett and Fink 2008).

The issue variable is not associated with number of citations and papers published in spring and fall does not statistically receive more citations than other seasons (Ayres and Vars 2000). In contrast, a study reveals that papers published at the beginning of the year (early issues) achieve more citations than those published later in the year (later issues) (De Araújo et al. 2012).

Early citation and speed of citation

Initial citations (early citation) that a paper receives are the early feedback of the scientific community about that paper. The number of citations a paper receives in the immediate next years of its publication can be considered as a predictor of its future citations (Chakraborty et al. 2014; Hilmer and Lusk 2009). Moreover, based on the speed with which the results of a research is disseminated in the scientific community and is being cited, future citations can be predicted (Adams 2005; Bornmann and Daniel 2010; Chakraborty et al. 2014; Garner et al. 2014; Guerrero-Bote and Moya-Anegón 2014). However, early citation may be related to citations in large samples of publications not individual papers (Adams 2005). Thus, “papers that get cited further away will tend to take longer to pick up cites” (Garner et al. 2014).

Accessibility and visibility of papers

Visibility and accessibility is mentioned in a large amount of studies to be related to citations (Henneken et al. 2006; Rees et al. 2012; Yue and Wilson 2004), while, few papers show that these variables are not related to the frequency of citation. A number of studies in different disciplines such as medicine, computer, physics, astronomy, mathematics, etc. point out that papers published in “open-access” journals are cited more often in comparison to papers published in non-open-access journals (Antonioni et al. 2015; Ayres and

Vars 2000; Bernius and Hanauske 2009; Brody et al. 2006; Chu and Krichel 2007; Dietrich 2008; Falagas et al. 2013; Gargouri et al. 2010; Koler-Povh et al. 2014; Sotudeh and Horri 2007, 2009; Xia et al. 2011).

One study that investigates 100 top journals, ranked according to yearly impact factors in the Journal Citation Reports (JCR) of Thomson Reuters, finds that open-access leads to a significant increase in cites to the top-50 journals and a statistically significant decrease in cites to the 50 bottom-ranked journals (McCabe and Snyder 2014). In contrast to the general belief, one study shows that “online access decreases the percentage of papers within a volume that do not receive any cites” (McCabe and Snyder 2015).

Although a paper may have a low quality and may not be published in a high impact journal, but it is possible to acquire high international recognition if its visibility increases by self-archiving (Ebrahim et al. 2014; Kousha and Abdoli 2010; Metcalfe 2006) or by being indexed in numerous databases (Lokker et al. 2008). Once a paper is cited, its visibility is increased and this leads to further citations (Aksnes 2003). This phenomenon has been named as accumulative advantage.

There is a positive relationship between the number of citation and paper downloads. The most downloaded papers achieve the highest number of citations (Guerrero-Bote and Moya-Anegón 2014; Jahandideh et al. 2007; O’Leary 2008a, b, Perneger 2015; Subotic and Mukherjee 2014). Full-text downloads can be considered as a proxy for papers’ readership. There is a significant correlation between number of citations and download impact of papers in fields such as physics and mathematics (Brody et al. 2006), while there is a moderate relationship between number of downloads and number of citations in fields such as economics (Chu and Krichel 2007). In addition, some studies find no such relationship between accessibility/visibility and number of citations (Craig et al. 2007; Davis 2010; Jabbour et al. 2013; Kurtz et al. 2005; Moed 2005; Peng and Zhu 2012).

Another study points out to the role of internet in facilitating literature searches which leads to the use of more recent citations. This study indicates that Internet lengthen the average life of citations by 6–8 months (Barnett and Fink 2008). It is also shown that online journals receive more citations than printed journals (de Groote and Barrett 2010; de Groote et al. 2005). Also, the number of times a paper is accessed online, influence citation frequency (McCabe and Snyder 2015; Perneger 2004). Moreover, papers with links to data obtain more citations than papers without such links (Henneken and Accomazzi 2011). This is proved by another study which shows that correlations are significant between citation counts and web links (Yuan and Hua 2011).

Besides, tweeted papers to a larger extent have the chance to be highly cited than less-tweeted papers (Eysenbach 2011). However, one study which investigates 27,856 published papers in PLOS ONE journal shows that tweets have a weak influence on citations and papers which are visited from non-Twitter sources receive more citations than papers which are acquired their views via twitter (de Winter 2014).

Self-promotion or self-archiving in arXiv, number of downloads, paper position in arXiv are predictors for citation numbers (Dietrich 2008; Haque and Ginsparg 2009, 2010). arXiv is a server providing access to papers before publication that is sponsored by Cornell University. Position of papers in this server affects citations through facilitating access to papers (Moed 2007). In contrast, it is indicated that access to astronomic physics papers by arXiv do not increase the probability of these papers being cited (Kurtz et al. 2005). Thus, self-archiving of papers influences the number citations, while it is indicated that not all mandated open-access papers has a smaller citation advantage than self-archived papers (Gargouri et al. 2010).

The publicity of research findings increases the citations of papers. “Papers published in Proceedings of the National Academy of Sciences are cited more often if they have been featured in newspapers and this effect varies significantly between countries” (Fanelli 2013).

“Journal” related factors

Journal impact factor and prestige

Researchers try to publish their papers in journals with high impact factors to increase their visibility and achieve more citations. Publishing papers in journals with high impact factors would result in more citations than publishing in low impact factor journals (Adusumilli et al. 2005; Aksnes 2003; Bensman 2008; Bjarnason and Sigfusdottir 2002; Bornmann et al. 2014; Bornmann and Williams 2013; Callaham et al. 2002; Chung 2007; Didegah and Thelwall 2013; Falagas et al. 2013; Fu and Aliferis 2010; Garner et al. 2014; Gomes and Vieira 2009; Haslam and Koval 2010; Hunt et al. 2010; Jiang et al. 2013; Kulkarni et al. 2007; Lokker et al. 2008; Padial et al. 2010; Patsopoulos et al. 2005; Peng and Zhu 2012; Piwowar et al. 2007; Ralston et al. 2008; Royle et al. 2013; Schneider and Henriksen 2013; Subotic and Mukherjee 2014; Van Der Pol et al. 2015; van Leeuwen and Moed 2005; Vanclay 2013; Vaughan and Shaw 2005; Weale et al. 2004; Winker 2011). Impact factor or prestige of the journal or conference proceedings that the paper is published in can be considered as a measure for the quality of a paper (Dervos and Kalkanis 2007). In other words, the higher the quality of a paper, the more credible journals the paper will be published in and the more chances it has to be seen and read (higher visibility) (Buena-Casal and Zych 2010). Thus, a weak paper published in a prestigious journal may receive higher citations than a paper which is published in a minor journal (Callaham et al. 2002). Getting published in “Nature” (2014 impact factor = 41.456) can lead to getting cited in 14 other papers per year which would place it among the top 3 % of global papers (Vanclay 2013). It is mentioned that about 75 % of the most cited Norwegian papers are published in journals with relatively high impact factors and only 9 % are published in journals with low impact factor. However, it may be argued that topics that are of broader interest may receive more citations, even though they may appear in journals with a lesser impact factor (Bornmann and Williams 2013).

While many studies confirm the existence of a positive correlation between journal impact factor and citations, some others do not (Leimu and Koricheva 2005; Roldan-Valadez and Rios 2015; Willis et al. 2011). For example, one study shows that impact factor is not a predictor for total cites (Roldan-Valadez and Rios 2015).

Journal circulation which reflects the number of readers of a given journal is also among factors which reflects the number of readers of a given journal that might in turn leads to an increase in the number of citations of papers published in that journal (Filion and Pless 2008). Journal circulation can be a measure related to journal prestige.

Language of journal (paper’s language)

Another factor associated with the number of citations is the language of the paper or the journal’s language (Jabbour et al. 2013; Leimu and Koricheva 2005; Lira et al. 2013, 2014). There is also a relationship between primary language of the first author and number of citations (Borsuk et al. 2009). Some recent studies indicate that English is the most effective language: papers published in English are more frequently read by the

international audiences and will consequently achieve more citations than other languages (Bornmann and Daniel 2010; Diekhoff et al. 2013; Georgas and Cullars 2005). Papers published in an English language journal are more frequently cited than those published in a multiple languages journals or journals in a language other than English (Bornmann et al. 2012). There is also a significant relation between the number of English papers and self-citations and also the impact factor of the journal (Diekhoff et al. 2013). It is however, maintained that there is not a relationship between language of a paper and citations in public health and health policy (Ruano-Ravina and Alvarez-Dardet 2012).

Scope and coverage of journal

The relationship between the scope of a journal where a paper is published in (specialized/general and local/international) and the number of citations the paper receives is investigated in a number of studies. However, it depends on the scope of the journal (Bjarnason and Sigfusdottir 2002). For instance, papers in the field of emergency medicine which are published in unspecialized journals achieve more citations than those published in specific emergency medical journals. One reason could be that unspecialized journals have more readers (Callaham et al. 2001). Papers published in general journals with high impact factors such as “Nature” is expected to achieve more citation impact than papers published in specialized journals (Vanclay 2013). In general, journals that publish papers in fast-developing areas such as genetic, biochemistry, and molecular biology obtain more citations than other fields such as math and statistics (Huang et al. 2012).

International journals receive more citations than national journals (Annalingam et al. 2014; Millet-Reyes 2013; Yue and Wilson 2004) and journals with multidisciplinary publications receive higher number of citations (Tsay and Ma 2003). However, two studies show that interdisciplinary scope of journals (Peng and Zhu 2012) and journal internationality do not influence citation rates (Didegah and Thelwall 2013).

Form of publication and presentation (conference, journal)

The mode of presentation of a paper is contributed to the number of citations it achieves. Journal papers obtain more citations per document and year than conference papers (Ibáñez et al. 2013). However, Winnik et al. (2012) find no relationship between the number of citations and how the paper is presented at a conference (oral presentation or poster). Another study reveals that the citation frequency of papers presented at a conference do not differ from citations frequency of papers submitted in general surgical journals. This study shows that acceptance of a paper for presentation at a meeting has no influence on its citation frequency (Adusumilli et al. 2005). Also, non-acceptance of papers for presentation at a conference doesn't influence the number of citations to these papers (Callaham et al. 2001). It is reported that proceedings papers are statistically significantly less likely to be highly cited than original papers, reviews and other type of documents (Bornmann and Williams 2013). Another study indicates that papers presented in oral sessions receive more citations than that of the papers presented in poster sessions (Ke et al. 2014). It is also revealed that: “journal-based proceedings papers are cited rather than papers published in book series or volumes” (Ingwersen et al. 2014) and “papers published in limited-access journals and in proceedings of conferences published as special issues of journals, results in a decreasing capability of the papers” (Sangwal 2012).

“Author” related factors

Number of authors and co-authorship

The number of authors of a paper and co-authorship is correlated with the paper’s impact so that the more authors a paper has, the more probably it will be cited (Annalingam et al. 2014; Ayres and Vars 2000; Biscaro and Giupponi 2014; Bornmann and Daniel 2010; Bornmann et al. 2014; Bornmann and Williams 2013; Borsuk et al. 2009; Bosquet and Combes 2013; Cerovšek and Mikoš 2014; Chen 2012; Didegah and Thelwall 2013; Falagas et al. 2013; Farshad et al. 2013; Fillion and Pless 2008; Foley and Della Sala 2010; Frenken et al. 2005, 2010; Frosch et al. 2010; Fu and Aliferis 2010; Gazni and Didegah 2011; Gazni and Thelwall 2014; Goldfinch et al. 2003; Gomes and Vieira 2009; Haslam and Koval 2010; Hurley et al. 2013; Ibáñez et al. 2013; Kademani et al. 2007; Kulkarni et al. 2007; Lee et al. 2010; Leimu and Koricheva 2005; Lokker et al. 2008; McMinn and Fleming 2011; Miettunen and Nieminen 2003; Nomaler et al. 2013; Onodera and Yoshikane 2015; Onyancha and Maluleka 2011; Padial et al. 2010; Peng and Zhu 2012; Perneger 2015; Poomkottayil et al. 2011; Puuska et al. 2014; Royle et al. 2013; Sala and Brooks 2008; Sin 2011; Tang et al. 2014; van Wesel et al. 2014; Vieira and Gomes 2010; Wallace et al. 2012; Winker 2011; Yu et al. 2014). The number of authors is a measure that indicates the extent of scientific collaboration. Highly cited papers involve more collaboration between many researchers than in the norm or average (Aksnes 2003). However, some studies show that there is no such relationship between the two variables (Antoniou et al. 2015; Bornmann and Daniel 2007; Bornmann et al. 2012; Collet et al. 2014; Dehghani et al. 2011; Ruano-Ravina and Alvarez-Dardet 2012; So et al. 2014; Yu and Yu 2014). Number of authors is also not related to the number of self-citations as reported in one study (Guilera et al. 2010). Number of authors, fields of authors (Amara et al. 2015), and the presence of authors from different disciplines (authors’ diversity) in a paper increase the frequency of citations (Adusumilli et al. 2005; Skilton 2009). For instance, having a basic scientist in general surgical journals (Adusumilli et al. 2005) and involvement of a biostatistician in the study increase number of citations (Farshad et al. 2013).

Co-authorship is related to number of citations (Biscaro and Giupponi 2014; Chakraborty et al. 2014; Costas et al. 2010; Gargouri et al. 2010; Robson and Mousquès 2014). Co-authored papers are presented in more scientific networks such as conferences, seminars and workshops by their several authors and are eventually more cited. This phenomenon is called the “knowledge diffusion” in which the more the knowledge is distributed in the scientific network, the more it receives attention and citation (Bosquet and Combes 2013). Thus, sociality of an author influences citations because “a paper from a widely connected author has a larger probability to be cited by her co-authors” (Chakraborty et al. 2014). Besides that, the size of the scientific research community (Biscaro and Giupponi 2014) and number of affiliated faculty in a paper can increase number of citations (Biscaro and Giupponi 2014; Bjarnason and Sigfusdottir 2002; Falagas et al. 2013).

Author’s reputation and previous citations

Well-known and highly-cited authors achieve citations, simply due to their prominence and prestige in their field of study (Bjarnason and Sigfusdottir 2002; Collet et al. 2014; Jiang

et al. 2013). If an author is well recognized by the reader, it causes an increase in the number of citation (Bjarnason and Sigfusdottir 2002). Papers published by highly-cited authors (such as the authors of a paper who are listed in ISIHighlyCited.com) achieve more citations than papers without highly-cited authors (Bornmann and Daniel 2010; Bornmann et al. 2012). Also, h-index of the author group influences citation frequency (Hurley et al. 2013). Publications of authors with Nobel Prize are also more likely to receive a greater growth in citations than the non-Nobel publications. This may be related to the globalization increased focus on Noble prize publications (Frandsen and Nicolaisen 2013). If the first or last author of a paper has previous citations, that paper is more likely to receive more citations than papers with first author without citations (Fu and Aliferis 2010). Authors with more citations are more likely to receive more citation in the future than authors with less citation. Thus, the number of citations to an author's previous papers can be considered as a good predictor for citations to future papers (Tang et al. 2014; Walters 2006; Yu et al. 2014). Although some papers show that authors' reputation influences citations, some studies show that author's reputation does not influence citations or it has a weak relationship with citation frequency (Jabbour et al. 2013; Wang 2014; Yu and Yu 2014).

Author's academic rank

The academic rank of an author influences the number of citations the author receive (Ayres and Vars 2000; Biscaro and Giupponi 2014; Farshad et al. 2013; Pagel and Hudetz 2011). For example, chairpersons receive most of citations, followed by full professors, associate professors, assistant professors and lecturers (Pagel and Hudetz 2011) and papers written by professors and emeritus receive more citations than non-affiliated faculty members (Bjarnason and Sigfusdottir 2002). It is also revealed that the academic rank is correlated with author's h-index (Chakraborty et al. 2014). However, one study reveals that the citations to papers do not differ significantly among scholars by different academic ranks (Bjarnason and Sigfusdottir 2002; Jabbour et al. 2013).

Self-citation

Self-citation can be explained in different ways: citations to the papers of a country from the researchers of that country (country self-citation), citations that an institute or organization receives from its own researchers (institute self-citation), citations that a journal receives from the papers published in it (journal self-citation) and finally the most common form of self-citation in which the citing and the cited paper has at least one and the same author (self-citation at the document level) (Costas et al. 2010).

A great number of studies investigated the effect of author self-citation on the number of citations (Bhandari et al. 2007; Willis et al. 2011) Journal self-citation can also influence number of citations. However, some studies show that there is not an association between number of self-citations and number of citations (Bhandari et al. 2007; Willis et al. 2011) and one study shows that country self-citation and author self-citation correlate negatively with the citation frequency (Jaffe 2011). It is shown that self-citations of papers are gradually reduced through the passage of time. However, this can vary between fields (Costas et al. 2010).

Numbers of self-citation vary across disciplines. For instance, the number of self-citations is lower in economic journals than computing, medicine and biology journals (Lievers and Pilkey 2012). Costas et al. (2010) show that for highly-cited papers, the

number of self-citations is lower than for moderate and lowly cited papers. They conclude that as the number of authors and centres increases in a research work, a growth in the number self-citations can be seen. Moreover, they maintain that “research professors” has more author self-citations, while “tenured scientists” have the highest rate of co-author self-citations and that top researchers have more self-citations than middle and low researchers (Costas et al. 2010).

International and national collaboration of authors

There is a significant relationship between the international and national cooperation of authors, number of countries and number of organizations in producing papers and the frequency of citations (Andersen and Schneider 2011; Annalingam et al. 2014; Antoniou et al. 2015; Bárbara et al. 2012; Costas et al. 2010; Farshad et al. 2013; Fu and Aliferis 2010; Gazni and Didegah 2011; Guilera et al. 2010; Ibáñez et al. 2013; Inzelt et al. 2009; Jabbour et al. 2013; Nomaler et al. 2013; Padial et al. 2010; Royle et al. 2013; Sin 2011; Smith et al. 2014; Walters 2006). “Collaboration” can be defined as the co-occurrence of two or more addresses on a publication (Frenken et al. 2010). Highly-cited papers are shown to be the result of teamwork of researchers from different countries (Aksnes 2003). Papers published by the cooperation of authors from several organizations gather significantly more citations than papers authored by authors from one organization (Puuska et al. 2014). It is maintained that papers with international collaboration have a greater impact than papers with national collaborations because of their greater quality and prestige (Bárbara et al. 2012). Number of institutions and countries in a paper as well as the number of the foreign organizations are significantly correlated with the frequency of citations (Aksnes 2003; Costas et al. 2010; Falagas et al. 2013). However, although number of institutions that collaborated in producing a paper is important, it is found that in nanoscience and nanotechnology fields, the internationality of authors does not influence number of citations as well (Didegah and Thelwall 2013). This finding is proved by another research which shows that international papers receive fewer citations than local ones in Harvard law reviews (Ayres and Vars 2000).

Although, cooperation of more authors is expected to be followed by achieving more citations, it also depends on the type of cooperation. For example, an increase in the number of domestic authors is accompanied by a decrease in the number of citations (Goldfinch et al. 2003). Moreover, international collaboration with some western countries such as United States might lead to higher number of citations. Academic collaborations and hybrid collaboration perform better than non-academic and non-hybrid collaborations and also physical proximity of organizations is related to more citations. However, this might be opposite in other fields such as physical sciences (Frenken et al. 2010). In addition, the hypothesis that “collaboration within academic organizations (university) increases citation number more than collaboration with non-academic organizations” is rejected in a study and a significant negative effect of academic collaboration on citation number of a paper is observed. This study also indicates that number of organizations is not related to number of citations (Frenken et al. 2005). One study focuses on other aspects of the international cooperation, investigates the effect of distance (in kilometer) on the frequency of citations and shows that every 1000 km of distance between the residential areas of authors’ leads to an increase in citations of 7 to 9 percent. In other words, the longer the distance, the more citations they would achieve (Nomaler et al. 2013). However, it is shown that the team diversity (teams whose members are distant from one another in organizational tenure) and new entrants (teams that have never published papers relevant to

the field) in a team is not related citations frequency (Collet et al. 2014). Other types of collaboration such as “interdisciplinary cooperation” (Antoniou et al. 2015) and “co-authors collaborated in the past” increase citations frequency (Collet et al. 2014). Moreover, number of institutions in a paper is related to citations (Fu and Aliferis 2010; Gazni and Didegah 2011), while one study shows opposite findings (Antoniou et al. 2015).

Authors' country

A number of papers show that authors who are affiliated with particular countries achieve more (less) citations (Lee et al. 2010; Miettunen and Nieminen 2003; Pasterkamp et al. 2007; Patsopoulos et al. 2005; Piwowar et al. 2007; Vaughan and Shaw 2005; Willis et al. 2011). One reason is that a number of countries are privileged with good (bad) scientific background and (non) adequate financial support to conduct research and thus, publish higher (lower) quality papers (Padial et al. 2010). For example, US institutions usually receive more citations than other countries (Filion and Pless 2008; Gargouri et al. 2010; Peng and Zhu 2012) and papers from low and middle income countries are usually less frequently cited than those in high-income countries (Sin 2011). However, one study reveals that geographical location of study is not related to number of citations (Bhandari et al. 2007).

The gender, age and race of authors

A number of studies indicate that gender, race and the age of authors influence the frequency and pattern of citations (Ayres and Vars 2000; Barnett and Fink 2008; Bjarnason and Sigfusdottir 2002; Bosquet and Combes 2013; Georgas and Cullars 2005; Gingras et al. 2008; Leimu and Koricheva 2005; Merritt 2000; Nosek et al. 2010; Winnik et al. 2012). Male authors seem to achieve more citations than females (Knobloch-Westerwick and Glynn 2013; Maliniak et al. 2013). This is probably because women prefer to cite themselves less than men, and men prefer to cite men more than women (Maliniak et al. 2013). The gender differences in the number of citations can also be attributed to differences in productivity that is the result of lower scientific productivity among women (Ayres and Vars 2000).

However, it is shown that there is no meaningful difference in citation frequency by author's gender (Borsuk et al. 2009) and another study reveals that gender is not a predictor for future citations (Walters 2006). On the other hand, one study which investigate papers published in *International Studies Quarterly* and *International Studies Perspectives* in 2005, shows that women are three times more likely to cite other female researchers, while less than 10 % of all references in papers written by men contain any reference to work by women (Mitchell et al. 2013). One study reveals that women are cited more than men if they more frequently publish papers related to hot topics than men (Gallivan 2012) and if they are more likely than men to cite the papers of other female scholars (Mitchell et al. 2013).

Authors with different races (white women, women of color, and men of color) have different citations (Merritt 2000). It is mentioned that whites and men have higher impact than non-whites and women (Nosek et al. 2010). White women receive more citations than white men by 57 percent and minority women also receive many more citations than white men. This is also revealed that younger authors (below 36 years old) receive more citations than authors over 41 years old (Ayres and Vars 2000).

Author's productivity

Researchers who have more productions are more likely to have larger personal networks which lead to higher citation counts for both network members and their colleagues (Bjarnason and Sigfusdottir 2002). Author's productivity influence the number of citations he/she obtains (Bornmann and Daniel 2007; Bosquet and Combes 2013; Chakraborty et al. 2014; Costas et al. 2009; Fu and Aliferis 2010; Gallivan 2012; Mishra et al. 2010; Onodera and Yoshikane 2015; Padial et al. 2010; Stremersch et al. 2015; Winker 2011). However, one study shows that author's productivity does not influence number of citations (Jabbour et al. 2013). Bornmann and Daniel (2007) indicate that there is a linear relation between total citation counts and number of papers published on a project. They show that publishing more papers from a research study leads to greater reception of the study in the scientific community and results in higher citation counts. However, one study shows that scholars whose impact are below average in a field, more frequently benefit from an increase in number of publications than those scholars in the middle and high field citation density regions (Costas et al. 2009).

Organizational features of authors

Features of organizations that the authors are affiliated to are contributed to the number of citations. For example, department size (number of faculty members), department productivity (total number of papers produced in the department), proportion of professors in the department, belonging to a department with a greater proportion of affiliated faculty members and belonging to a department where faculty members publish more in high impact journals are factors that influence the total number of citations of researchers in that department (Bjarnason and Sigfusdottir 2002). Faculty members in larger departments with more established and more productive scholars obtain more citations. Scholars in departments are usually cited by their colleagues and scholars usually cite works of others who belong to a large or productive department. Faculty members affiliated to the university receive more citations than non-affiliated (regular) faculty members (Bjarnason and Sigfusdottir 2002). The institutional prestige and the university rank where authors are affiliated to increase citation rates. Thus, scientists from top-ranking universities receive more citations than authors from lower-ranking universities (Amara et al. 2015; Ayres and Vars 2000; Collet et al. 2014; Leimu and Koricheva 2005). Thus, papers from highly ranked schools have more citations (Stremersch et al. 2015). In contrast, one study finds no such relationship between institutional prestige and number of citations (Skilton 2009). Moreover, some international organizations receive higher number of citations because of more international reputation: UN publications receive more citations than EU and World Bank (Griffiths 2008). English language institutions also obtain more citations than non-English language organizations (Farshad et al. 2013). Size of interdisciplinary research institutions (the cite delay for smaller interdisciplinary research institutions) is also related to number of citations (Elleby and Ingwersen 2010) and papers by center-affiliated authors receive more citations than papers written by authors without a given center (Youtie 2014).

Funding and grants received by authors

Research projects (papers) that have received higher level of funding and papers of authors who have received grants may receive more citations than non-funded papers (Amara et al.

2015). This relationship is rejected by two studies in the fields of cardiovascular and general urology (Antoniou et al. 2015; Danthi et al. 2014; Willis et al. 2011). Another study also shows little correlation between number of citations and grants (Boyack and Börner 2003). Papers which mention to have received industry funding, receive more citations if their results are industry-favouring against papers that do not mention to have received funding (Farshad et al. 2013; Kulkarni et al. 2007). Also, scholars funded by research councils obtain more citations (Amara et al. 2015). It is also maintained that the percent of GDP spent on research and country's GDP might increase citations (Smith et al. 2014).

Discussion

Many empirical studies have investigated the correlation of determinant variables with the frequency of citations. Based on our knowledge, no similar comprehensive review has been done so far. The present review investigates the factors associated with number of citations a paper achieves. In total, three categories with 28 factors related to number of citations are identified: category one is “paper related factors”: quality of paper; novelty, popularity and interest of subject; characteristics of fields/subfields of a discipline and study subject/topics; methodology; document type; study design; characteristics of results, discussion and other sections; use of figures and appendix in papers; characteristics of the title, abstract and keywords; characteristics of references; length of paper; age of paper; early citation and speed of citation; accessibility and visibility of papers. Category two is “journal related factors”: journal impact factor and prestige; language of journal; scope and coverage of journal; and form of publication and presentation. Category three is “author(s) related factors”: number of authors and co-authorship; author's reputation and previous citations; author's academic rank; author's self-citation; international and national collaboration of authors; authors' country; gender, age and race of authors; author's productivity; organizational features of authors; and funding and grants received by authors. Many of these factors are interrelated with each other which directly and indirectly affect number of citations. For instance, the impact factor of a journal where the paper is published in, affects the visibility of the paper, which leads to an increase in its citations.

Furthermore, there are some other factors related to the frequency of citations which are not classified under the above 28-mentioned categories. For example, the following factors influence an authors' productivity and number of citations: the amount of time dedicated to research activities, the time dedicated to teaching (less time dedicated to teaching increases citations), proactive knowledge transfer activities, administrative activities (less time dedicated to administrative activities increases citations), professional consultation, and the frequency of contacts with companies (less contacts increases citations) (Amara et al. 2015). Different citation sources lead to different numbers of citations. In general, papers in Google Scholar receive citations faster than in Web of Science (WOS) and it shows more frequent citations than Scopus, and WoS (Elleby and Ingwersen 2010). Also, some publishers of journals may obtain higher citations than others. For example, it is revealed that papers published by Springer receive more citations than that papers issued by Taylor and Francis (Franceschini et al. 2014). One study shows that “authors whose surnames begin with letters closer to the beginning of the alphabet receive more citations than do those authors with surnames closer to the end of the alphabet” (Leimu and Koricheva 2005). However, contrary to the general expectations that readability might contribute to the attractiveness of an abstract and a paper, it is shown that “reading ease” may

negatively influences citations (Stremersch et al. 2015; van Wesel et al. 2014). The reason for this surprising result is that readability is probably not always considered positive by peers (Stremersch et al. 2015). Another study also indicates that publishing a paper in journals with higher number of papers abstracted, may increase number of citations (Lokker et al. 2008).

Studies dealing with factors affecting number of citations include two types: (a) investigating relationships of number of citations with individual factors (mainly by correlation analysis), and (b) investigating influences of various potential factors on number of citations (mainly by multiple regression analysis). In general, results obtained by studies of the type (b) are more reliable than those by the type (a), because the former considers interaction between the factors. A number of studies have used the second type for identifying the factors affecting number of citations. For instance, negative binomial multiple regression (NBMR) has been used in some previous studies for predicting citations (Bornmann et al. 2012; Chen 2012; Didegah and Thelwall 2013; Haslam and Koval 2010; Lokker et al. 2008; Onodera and Yoshikane 2015; Walters 2006). Among these studies, Bornmann et al. (2012) perform a multiple regression analysis and show that “citation counts are correlated with the citation performance of the cited references, the language of the publishing journal, the chemical subfield, and the reputation of the authors”. However, this study finds no statistically significant correlation between citation counts and number of authors. Moreover, Chen (2012) uses zero-inflated negative binomial regression models of citation counts for identifying predictors of citations and indicates that structural variations measured by cluster linkage are a better predictor of citation counts than other commonly investigated variables such as the number of references cited. This study also finds that the number of coauthors and the number of references are both good predictors of global citation counts to a lesser extent. Didegah and Thelwall (2013) use a zero-inflated negative binomial regression model in nanoscience and nanotechnology. This model is able to identify variables that are significant in predicting future citations. They show that number of authors is not a significant determinant of citation counts ($p > .05$) and among the studied factors, journal impact factor and the impact of references have a stronger association with citation counts. This study shows that if other variables are held constant; these two variables contribute to a 59.2 and 29.2 % increase, respectively, in citation counts of publications. Also, another study using NBMR shows that the price index (ratio of references within the last 5 years before the citation occurred) is the strongest predictor of citations, and number of references is the next; while the influence of number of authors and authors’ achievement measures are rather weak (Onodera and Yoshikane 2015). One limitation in this review is that we combined the results of both types of studies. In further studies this important point should be taken into consideration.

It is not doubtful that if an author has no knowledge about the existence of a citable document, the document cannot find the chance to be cited. Thus, both visibility and accessibility are of high importance for a document to be cited. Papers that are disseminated through many different scientific communities, open access and self-archived papers, papers written by the international collaboration of many authors and by authors who are affiliated with well-known organizations are more likely to be recognized and be cited by other researchers. Most of all, number of authors and international teamwork with foreign researchers increase the likelihood of visibility by peers.

As expected, the quality of paper is a major factor influencing the frequency of citations. There are few criteria for evaluating the quality of a paper such as the impact factor of the journal where the paper is published in, methodological quality of the paper, novelty of

paper, and so on. However, academics have different views concerning quality. For example, according to a scholar's viewpoint, a paper with a hot topic has a high quality, while for another scholar the creativity and novelty of a paper and the innovation and importance of the research subject can be considered as quality indicators. The problem is that it is difficult to find a quantitative indicator of the quality of a paper or to quantify these qualitative measures. As mentioned in results, some studies have tried to quantify indicators of paper's quality; however, there is not a consensus on the definition of the quality of a paper and how it can be measured.

Citation behavior is different from one discipline to another one. One possible reason is that in some fields, researchers cite recent works, while in others fields they more frequently refer to older works. Because of such differences between fields and sub-fields of a discipline, documents in one field may on average receive many more or less citations than publications in another field (van Eck et al. 2013). The majority of factors influencing the frequency of citations are related to the subject of a paper and the field sub-disciplines. In general, hot topics in each field receive more citations than out dated topics. A number of studies investigated the determining factors of the citations frequency in subject domains such as medicine, ecology, mathematics, physics, etc. and indicated that the identified factors were closely related to the subject of the study. Craig et al. (2007) maintain the importance of the study subject and show that citation is highly influenced by the relevance and importance of the research subject to other researchers in the field, while other factors might have moderate effects on the number of citations. Different patterns of citations are observed in different areas. Thus, researchers from different disciplines should not be compared in terms of the number of citations they receive and their h-index.

As mentioned, papers with more authors are more likely to obtain a higher number of self-citations, external citations, visibility and more total citations. There are several reasons for the authorship effect: (1) An increase in the number of authors raises the probability of self-citations; (2) Papers with more authors probably have authors from multiple disciplines and one can expect citations from multiple disciplines; (3) With an increase in the number of authors, the paper is recognized more frequently (Leimu and Koricheva 2005); and (4) Co-authored papers might have fewer mistakes and/or might alter a common paradigm due to interdisciplinary cooperation and this might be more attractive (Padiál et al. 2010).

Self-citations are the important part of an ordinary process in scientific communications, because researchers have to cite previous works in order to continue their own research. Since, citing one's own previous work adds to the number of his/her citations, it is possible in some cases that the total number of one's citations gets extremely increased merely as a result of self-citation. It is shown that self-citations are more effective in the case of young and novice researchers than in the case of highly-cited authors with many publications to increase their citation impact (Costas et al. 2010).

There are numerous recognized features about a document that may convince and influence the author to cite it. For instance, researchers tend to cite reputable authors and authors affiliated to high ranked institutions. Also international cooperation is known as one of the most noticeable features of research in today's world. In recent years, there has been a growth in co-authored papers written by international researcher teams. One feature of internationally co-authored papers is the collection of more citations than those written by national authors. Different reasons have been proposed for this fact. For instance, international projects receive higher budgets than national projects and, therefore, are of a higher quality (Nomaler et al. 2013).

The methodology, study type and design are among the factors influencing the number of citations. Medical studies such as meta-analyses, systematic reviews and RCTs have higher citation impact. Review papers achieve more citations than original papers, letters to editors and short reports, because they refer to a great body of previous research and readers can, therefore, obtain a great deal of information by just perusing one review paper.

Features of the source of publication including; journal impact and prestige, language of journal, accessibility, type of journal, visibility and citation source, time of achieving the first citation and so on, affect the number of citations a paper receives. In case a paper is presented through a well-known and well-recognized way such as in a famous journal, it will be more visible and receive more citations. Also, general journals are used and cited more frequently than specialized journals and are read by more scholars of different specializations.

However, it should be mentioned that some variables are followed by biases. For example, older papers are likely to obtain more citations than younger papers only because there has been more time to cite them. There is also a bias in citing papers with well-known authors, organizations or countries. Another bias can be observed in differences in the number of citations that occur for distinct groups of authors such as authors with more production versus new authors, male authors versus female authors and older authors versus younger scholars.

Conclusion

Citation as a single measure is considered for assessing the quality and impact of a paper, researcher or institution. However, this is a critical issue whether citation is really adequate for describing the quality and impact of research or not. In this literature review, we included 198 relevant papers and found 28 factors contributed to number of citations. We found that the citation impact of a paper depends on many factors: (1) Paper related factors, (2) Journal related factors, and (3) Author(s) related factors.

Some factors are not directly related to the content of a paper which can be named as “extrinsic factors” such as: early citation and speed of citation; accessibility and visibility of a paper, funding and grants, journal related factors and author(s) related factors. Other factors affecting number of citations which are related to the content of a scientific paper such as the novelty of the subject can be named as “intrinsic factors”. Also, they can be classified as scientific (e.g. quality of paper and characteristics of papers’ methodology) and non-scientific (e.g. length of paper, number of authors, characteristics of references) factors associated with the frequency of citations.

Probably some factors such as the journal impact factor, international cooperation and number of authors are strongly correlated with the frequency of citations, while other factors such as the organizational features, age, gender and race of authors, characteristics of title and references and use of figures to present the results are weakly correlated with the number of citations. What seems to be certain is that some of the 28 factors identified in this review are more effective to gather citations than others. However, whereas some factors have been widely investigated (such as impact factor), others have not and require further research.

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