

## Scientific Journal Articles Output from Medical Doctoral Theses. A Comparative Study

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### Abstract

The scope of the present study was to contrast publication rates and particularities of original scientific articles related to medical PhD theses defended between 2009 and 2013 from one developing country (Romania) and two developed countries (France and the United Kingdom) within the European Union. A sample from each of the three countries was evaluated and then compared based on the journal type (national/international), time span between two consecutive articles from the same thesis, number of articles, journal impact factor and journal rank. The results of our quantitative analysis suggest that the majority of Romanian articles were published in Romanian journals, while French and the United Kingdom articles were published in greater proportions in journals outside the borders of their own country. The time span between two consecutive articles from the same thesis was similar for the three groups. Even though articles from Romanian theses were significantly more numerous than in those from France or the United Kingdom, they were published in less cited journals, according to their impact factor. Furthermore, most of the Romanian articles were published in the bottom half of the journals' ranking, while the majority of articles from France or the United Kingdom were published in the top half of the ranking.

**Keywords:** Medical research; PhD thesis; Publication rate; Scientific publication

### Introduction

There have been multiple interpretations of article publication rate. Some have viewed it as a mean to define the merit of a scholar [1], others as a measure that reflects the degree of supervision and the research proficiency of the graduate student's institution/university [2]. According to previous research, some factors like: international collaboration, access to international conferences and to technology proved to increase publication rates [3]. Earlier studies show that young scientists and recruits produced large quantities of knowledge [4] and that young researchers have contributed to a large amount of major scientific discoveries [5].

Nowadays, there is an elevated emphasis on publications as an important indicator of competence and distinction and this supported by a highly competitive academic job market. A list of publications is considered proof of core research skills and an indicator for future

achievements [1]. Research is considered a main pillar of modern higher education systems and publication in peer-reviewed journals is the preferred research dissemination form [6]. Universities consider doctoral research an important source of scientific publications [7] and there is a growing pressure on doctoral students to publish during candidature [1,5,8,9]. Also, publishing before graduation is influential in the employment, tenure and promotion of graduates [9]. This might have originated from the need to align the quality of the thesis with the standards of peer-reviewed academic journals - significance, rigor and topicality [10]. Publication data have been used to measure faculty performance and to determine associated research income, and also stress that there is an increasing expectation for students to complete their PhD in a shorter time frame [11]. Furthermore, there is pressure on academics to publish their articles in high impact scientific journals [12] and manage large amounts of work [13]. To enter the scientific community nowadays, it is not enough to merely write a thesis, given the increased competition of academia today [4]. Publication, during doctoral candidature, is a good predictor of later scholarly productivity [9].

Theses analysis has been largely avoided because of the text's length, the low quality or inadequate design of many dissertations, and the difficulty to access the full-text of theses in university libraries [7].

A quantitative comparison between Romania and European Union's developed countries regarding doctoral article productivity could be valuable in the context of increasing publication pressure [14], and, to the authors' knowledge, this has not been done before. Furthermore, such research could underline publication practices and differences, highlighting higher education issues and, thus, could provide other aspects that need improvement. This study's aim was to evaluate publication rates and particularities of original scientific thesis-related articles published or accepted for publication during PhD candidature in Romania and to compare them with those in France and the United Kingdom (UK).

## Material and Method

### *Data collection*

Online repositories were used to identify and download free full-text PhD theses in the medical domain from France and United Kingdom (UK). The French medical PhD theses were downloaded from the open archive HAL (Open Archive HAL website, an online free scientific repository developed by Centre Informatique National de l'Enseignement Supérieur [15]), where authors can deposit scholarly documents from all academic fields. The UK medical PhD theses were downloaded from the Manchester eScholar Services (Manchester eScholar Services website, online free scientific repository supported by the University of Manchester Library [16]), which offered free access to a collection of full-text theses awarded at UK institutions.

The search strategy used on the online repositories was:

Content Type = 'Theses'-France

Content Type = 'Thesis' - UK

Filtering by

Criterion 1: Discipline = 'Life Sciences' AND (Structure = 'Centre d'infection et d'immunité de Lille' OR 'Centre de recherche Jean-Pierre Aubert [Lille]' OR 'Centre de Neurosciences Paris-Sud' OR 'Institut Galien Paris-Sud' OR 'Institut de Génomique Fonctionnelle de Lyon' OR 'Centre de Recherche en Cancérologie de Lyon' OR 'Centre de recherche en neurosciences de Lyon' OR 'Centre de recherche en applications et traitement de l'image pour la santé' OR 'Centre de Recherches du Service de Santé des Armées' OR 'Grenoble Institut des Neurosciences' OR 'Techniques de l'Ingénierie Médicale et de la Complexité - Informatique, Mathématiques et Applications [Grenoble]')-France Academic Department = 'Faculty of Medical and Human Sciences'-UK

AND

Criterion 2: Publication Year = from 2009 to 2013

All Romanian medical defended PhD theses were browsed and downloaded using university intranet networks since no online repository exists.

The search started in January 2014, so PhD theses defended until the 31 December 2013 were included in the analysis.

### Methods

For each thesis the following were collected: author initials (for management of collected data), thesis title, completion date (as mm/yyyy), acknowledged financial support, the number of articles published or accepted for publication during PhD candidature, number of contributors (sum of supervisor, co-supervisor, and advisor) and thesis length in pages (with/without References and Appendix sections). The number of thesis' contributors was used to evaluate the scientific help that a PhD candidate received during candidature. The number of articles belonging to each thesis was established based on the author's statement regarding thesis-related published papers (presented in a list or in the thesis' text or appended at the end of the thesis or in the Reference section of the thesis), and there were no article searches beyond the date of thesis completion.

Two researchers with the same expertise and experience in medical research methods browsed each thesis and all thesis-related articles and, with the full consensus, those articles with topics not related to the subject of the PhD thesis were excluded from the analysis and those which were not published or accepted for publication during PhD candidature.

The variables collected for all eligible thesis-related articles (ISI or IIDB included in the analysis) were presented in Table 1.

**Table 1.** Thesis-related article's particularities and their data source

Variable	Collected from ...
number of authors (no.)	full text thesis a
graduate is the first author (yes/no)	thesis title page & article a
journal name (text ...)	full text thesis a
national journal (yes/no)	journal's official web-sites or NLM Catalog b
if article was indexed in Web of Science (yes/no)	Web of Science a
Impact Factor in the year of publication (computed on a 2-year span, no. with 2 decimals)	Journal Citation Reports a
journal rank (as Q1, Q2, Q3, and Q4)	InCites™ Journal Citation Reports c

a France: February-June, 2015; Romania: February-April, 2015; UK: January-June, 2014;

b June, 2015; c October 20, 2015

The number of thesis-related ISI articles (published or accepted for publication during PhD candidature) was collected for each thesis included in the analysis, as well as how many of those also had an impact factor.

The difference in months between the two consecutive articles published or accepted for publication was computed and assigned to the chronologically newer article whenever at least two articles were published or accepted for publication from the same thesis (abbreviated as TS = time span between two consecutive articles from the same thesis). This indicator was used to quantify the scientific articles productivity and allow comparison between different countries.

*Statistics.* The medical PhD theses included in the study were compared according to the country with regard to the thesis' length, article counts, whether awarded financial support and the number of contributors. Furthermore, the articles included in the analysis were compared in each country regarding: the number of authors, if the graduate was the first author, if the article was published in a national journal, the Impact Factor and TS indicator. For qualitative data, counts and percentages were used. Quantitative data was summarized as mean±standard deviation, median and inter-quartile range (as (Q1–Q3), where Q1 is the 25th percentile and Q3

is the 75th percentile. Comparison of qualitative data groups was performed using Z-test for proportions. Mann-Whitney-U test was used to compare quantitative data, whenever these proved not normally distributed. Statistica software, version 8.0., was used to perform all statistical tests. Two-tailed p-values of less than 0.05 were considered to indicate statistical significance.

## Results

According to the country of the institution awarding the PhD, the data was classified into three groups: Romanian (425 theses with 1021 thesis-related articles), French (69 theses with 159 thesis-related articles), and UK (63 theses with 80 thesis-related articles).

Financial support has been acknowledged in 11.76% (50/425) of the Romanian medical theses, in 76.81% (53/69) of the French medical theses and in 65.08% (41/63) of the UK medical theses. With regard to the theses' authors, 63.29% (269/425) of the Romanian authors, 46.38% (32/69) of the French authors and respectively 49.21% (31/63) of the UK authors were females. The percentage of female authors proved significantly higher in Romania than in France (Z-test for proportions:  $p = 0.0112$ ).

No significant differences were found between the article productivity of female and male authors for each country (Romanian:  $p=0.7030$ , France:  $p=0.8610$ , UK:  $p=0.7690$ ).

### Comparison of Romanian and French Medical Theses

A significantly smaller percentage of theses from Romania acknowledged financial support compared with those from France ( $p<0.0001$ ). The results of the comparison between Romania and France regarding theses and scientific thesis-related articles were presented in Table 2.

**Table 2.** Theses related aspects and article productivity in Romania and France

Item	Romania		France		p-value*
	m±SD	Median (Q1-Q3)	m±SD	Median (Q1-Q3)	
PhD theses (Romanian: n=425; France: n=69)					
1	144±50.33	130 (108-170)	156±58.20	146 (114.5-191)	0.0540
2	161±55.02	147(120.5-190.5)	204±81.43	182 (148-250)	<0.0001
3	1.05±0.22	1(1-1)	1.54±0.60	1(1-2)	<0.0001
4	2.40±1.94	2 (1-3)	2.30±1.64	2 (1-3)	0.5580
5	0.61±1.22	0 (0-1)	2.07±1.49	2 (1-3)	<0.0001
6	0.46±1.04	0 (0-0.5)	2.04±1.47	2 (1-2.5)	<0.0001
Theses-related articles (Romanian: n=1021; France: n=159)					
7	4.54±3.18	4 (3-6)	7.67±4.66	7 (4-10)	<0.0001
8	1.73±1.97	1.25 (0.58-2.39)	4.42±4.17	3.52 (2.35-4.79)	<0.0001
9	11.61±14.58	6 (3-14)	11.19±11.11	8(3-16)	0.6390

1 = Thesis pages without references and appendix; 2 = All thesis pages; 3 = Number of contributors; 4 = All articles published or accepted for publication during PhD candidature; 5 = Number of articles listed in Web of Science (ISI articles); 6 = Number of ISI articles with impact factor; 7 = Number of article authors; 8 = Impact Factor for articles published in journals indexed in Journal Citation Reports; 9 = Time span between 2 consecutive articles from the same medical PhD thesis (months);

m = arithmetic mean; SD = standard deviation; Q1 = 25th percentile; Q3 = 75th percentile;

\* Mann-Whitney-U test

A significantly higher percentage of Romanian PhD students were first authors in the published thesis-related articles compared with those from France (Romania: France = 85.31% (871/1021):62.89% (100/159),  $p<0.0001$ ).

A significantly larger number of thesis-related articles were published in national journals in

Romania compared with France (Romania: France = 85.99% (878/1021):5.66% (9/159);  $p < 0.0001$ ).

In contrast with the number of thesis-related articles (Table 2, item 4), the percentage of articles listed in Thomson Reuters Web of Science (ISI articles) proved significantly smaller in Romania compared with France (Romania: France=25.5% (260/1021):89.93% (143/159),  $p < 0.0001$ ).

The TS indicator was calculated for 63.56% (649/1021) of articles from Romanian theses and 56.6% (90/159) of articles from French theses, with no significant differences between these groups ( $p = 0.0982$ ).

#### Comparison of Romanian and UK Medical Theses

A significantly smaller percentage of theses from Romania acknowledged financial support compared with those from the UK ( $p < 0.0001$ ).

The comparisons regarding PhD theses as well as published thesis-related articles investigated parameters revealed in most of cases significant differences between Romania and the UK (see Table 3). Two exceptions were observed regarding the number of article authors and TS indicator.

**Table 3.** Theses related aspects and article productivity in Romania and the UK.

Item	Romania		UK		p-value*
	m±SD	Median (Q1–Q3)	m±SD	Median (Q1–Q3)	
PhD theses (Romanian: n=425; UK: n=63)					
1	144±50.33	130 (108-170)	206±58.54	202 (178-230)	<0.0001
2	161±55.02	147(120.5-190.5)	263±80.12	260 (204-308)	<0.0001
3	1.05±0.22	1(1-1)	2.49±0.89	3 (2-3)	<0.0001
4	2.40±1.94	2 (1-3)	1.27±1.31	1 (0-2)	<0.0001
5	0.61±1.22	0 (0-1)	1.17±1.26	1 (0-2)	<0.0001
6	0.57±1.20	0 (0-1)	1.05±1.17	1 (0-2)	<0.0001
Theses-related articles (Romanian: n=1021; UK: n=80)					
7	4.54±3.18	4 (3-6)	4.96±2.5	4 (3-6)	0.0570
8	1.73±1.97	1.25 (0.52-2.22)	2.88±1.52	2.7 (1.75-3.52)	<0.0001
9	11.61±14.58	6 (3-14)	14±18.12	9 (4-18)	0.1570

1 = Thesis pages without references or appendix; 2 = All thesis pages; 3 = Number of contributors; 4 = All articles published or accepted for publication during PhD candidature; 5 = Number of articles listed in Web of Science (ISI articles); 6 = Number of ISI articles with impact factor; 7 = Number of article authors; 8 = Impact Factor for articles published in journals indexed in Journal Citation Reports; 9 = Time span between 2 consecutive articles from the same medical PhD thesis (months; m = arithmetic mean; SD = standard deviation; Q1 = 25th percentile; Q3 = 75th percentile;

\* Mann-Whitney-U test

The percentage of Romanian PhD students as first author of thesis-related articles did not prove significantly different to the percentage of UK students as first author of thesis-related articles (Romania:UK = 85.31% (871/1021):80% (64/80),  $p = 0.2491$ ).

Similar to the result obtained from the comparison between Romania and France on publishing in national scientific journals, there was a significantly higher percentage of articles from Romanian PhD theses published in Romanian journals compared with articles from the UK PhD theses published in UK journals (Romania:UK = 85.99% (878/1021):43.75% (35/80),  $p < 0.0001$ ).

A significantly smaller percentage of Romanian thesis-related articles were listed in Thomson Reuters Web of Science (ISI articles) compared with those of the UK thesis-related articles (Romania: UK =25% (260/1021):92.5% (74/80),  $p < 0.0001$ ).

A significantly higher percentage ( $p < 0.0001$ ) of ISI thesis-related articles from the UK

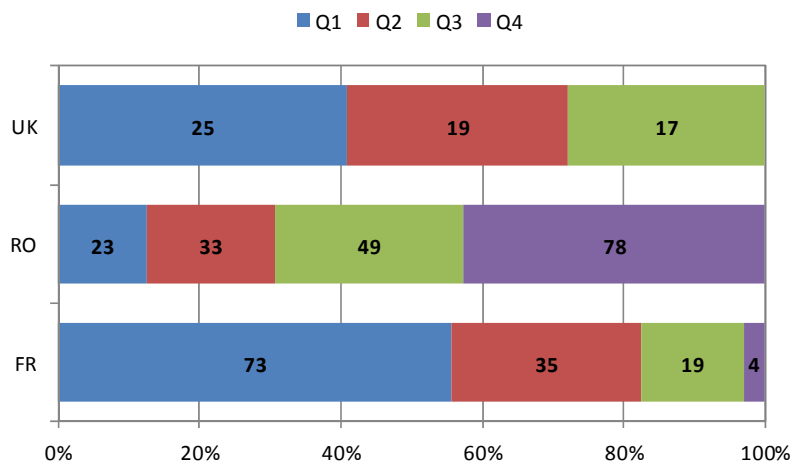
theses had an impact factor 80% (64/80) compared with ISI thesis-related articles from Romanian theses, 17.9% (183/1021).

The TS indicator was calculated for more than 50% of articles included in the analysis with a significantly higher percentage for Romania compared with the UK (Romania:UK=63.56% (648/1021):51.25% (41/80),  $p=0.0415$ ).

#### ISI Thesis-Related Articles and the Rank of Journal

All thesis-related articles published in ISI journals with impact factors (greater than zero) were analyzed included in this analysis, leading to an evaluation of 131 journals for France, 183 for Romania and 61 for the UK. A percentage higher than 50 of the thesis-related articles published by France PhD students were in the top journals (Q1, see Figure 1), this percentage being significantly higher compared to both the UK and Romania ( $p<0.02$ ). A significantly higher percentage of ISI thesis-related articles published by Romanian PhD students are in Q4 ( $p<0.001$ ).

The percentages of thesis-related articles published in Q2 journals were similar in France and the UK (26.72%(35/131):31.15%(19/61),  $p=0.5314$ ), but significantly lower in Romania compared to the UK (Ro: 18.03% (33/183),  $p=0.0460$ ).



**Figure 1.** Distribution of thesis-related articles with impact factor by ranking journal citation reports

The percentage of thesis-related articles published in Q3 journals proved significantly lower in France compared to both Romania and the UK (France: 14.50% (19/131), Romania:26.78% (49/183), UK: 27.87% (17/61),  $p<0.05$ ). No significant differences were obtained with regard to the percentage of thesis-related articles published in Q3 journals when Romania was compared to the UK ( $p=0.8690$ ).

#### Discussion

The evaluation of scientific publications of PhD students from medical PhD theses defended in Romania, France and UK was successful. Based on the obtained results, PhD theses in Romania did not seem to be financially supported by research projects, while in France and UK more than 50% of PhD theses are. However, this result is based only on PhD students acknowledging financial support in their theses and in Romania there is no regulation stipulating that financial support for the thesis must be acknowledged. During the investigation period, at least 50% of the PhD students from Romania had scholarships. Moreover a part of the medical PhD students benefited from financial support through POSDRU grants.

This study identified a significantly higher percentage with regard to female article productivity between Romania and France, contrary to results reported by Puuska [17], which showed that male scholars tend to be more productive than the female ones. The significant differences between Romania and France concerning authors' gender ( $p < 0.02$ ) could be explained by the higher proportion of female medical students in Romania.

No significant differences concerning number of pages in the theses, without counting references and appendix, was observed in Romania compared with France (see Table 2), but such differences were observed when compared with the UK (see Table 3). Note that, starting with 2011 several universities in Romania have changed their requirements regarding the length of the thesis, thus the Romanian theses matched the length of those in France. However, both the French and the UK theses showed a significantly higher number of total pages compared to Romanian theses ( $p < 0.001$ , see Table 2 and 3). In French and UK PhD theses longer reference and/or appendix sections appear.

The number of thesis contributors proved significantly higher in France and the UK compared with Romania; the results are according to the countries' requirements (see Table 2 and 3). In most Romanian medical theses, the PhD student had just one supervisor. However, in 2011 co-supervisors have been introduced in Romania. A study showed that the more supervisors and advisors a thesis has, the bigger the chances for publication [18]. Correspondingly, a study on Spanish doctoral theses completed during 1979 and 2013 found a mean of 1.6 supervisors per thesis [19].

The mean of the number of thesis-related articles from Romania was 2.40, without any significant difference compared with France ( $p > 0.5$ , see Table 2), but there was a significant difference compared with those from the UK ( $p < 0.0001$ , see Table 3).

A significant number of Romanian thesis-related articles were published in national journals compared with those from France ( $p < 0.0001$ ). To some extent, this could be due to a language barrier in the case of Romanian researchers. Being a native English speaker offers a broader range of publishing opportunities in journals from English speaking countries, such as the United States of America [20]. In addition, there was a significantly higher percentage of PhD students as first author in Romanian thesis-related articles compared with France ( $p < 0.0001$ ), but not in comparison with the UK ( $p > 0.2$ ). In Egypt for example, a research on medical doctoral theses completed during 1982 and 2014 found that the graduate student was the first author in 62.2% of the published articles [21].

Not all results presented in medical PhD theses are published in scientific literature. This trend could be explained by an increased workload, insufficient tutor support, publication bias for negative results, insufficient motivation and family burden [6]. This study's results showed a discrepancy on PhD knowledge dissemination between Romanian and France, and the UK respectively. The situation of Romania seems to have improved compared with a result from a report where all medical Web of Knowledge indexed articles published between 1997 and 2006 by Romanian scholars were 907, which was an amount 120 times less than that from France, 6.59 times less than that from Hungary and 1.17 times less than that from Bulgaria [20]. Petkova stated that the Bulgarian PhD student was allowed to defend her/his thesis only after publishing 2 scientific papers in peer-review journals and he/she was the first author in at least one of them [22]. In Căbuz's opinion, poor funding and the brain drain of youth and intelligence have not allowed for high quality and frequency of scientific activity in Romanian universities [23]. Another cause could be the fact that a majority of the faculty members focus on teaching activities rather than on research [23].

A significantly lower number of ISI articles were published in Romania compared with both France ( $p < 0.0001$ , see Table 2) and the UK ( $p < 0.0001$ , see Table 3). The requirements concerning ISI publications are specific for some institutions but there are no national regulations in Romania, nor in France or the UK. A similar result was also obtained when the number of ISI articles with the impact factor was evaluated. The impact factor, denoting journal quality, was introduced to reflect a facet of research performance [24]. The thesis-related articles were elaborated by quantitatively similar research teams in Romania and in the UK

( $p > 0.05$ , see Table 3), while the French research teams had a higher number of members compared to Romania ( $p < 0.001$ , see Table 2). The impact factor of articles published by French, as well as UK PhD students, were significantly higher compared with those published by Romanian PhD students ( $p < 0.001$ , see Table 2 and 3).

No significant differences were observed between Romania, France and the UK respectively, in terms of time span between two consecutive thesis-related articles published by the same PhD student ( $p > 0.1$ , see Table 2 and 3). A research similar to ours has been published recently, not on medical PhD theses, but on a group of 162 of Spanish public health masters theses completed between 2006 and 2010. The study revealed that 60.5% of students had a thesis-related article published or accepted for publication before the thesis defense, and that in 82% of the cases the student was the first author of the article. The median impact factor for the year of publication was 2.37 (IQR 1.39-3.50). The mean time between acceptance of an article and masters completion was 19 months (95%CI 17.1-21). Publication of results was significantly associated with gender, enrollment age, field of undergraduate training, thesis topic area, completion on time of the thesis and thesis score [6].

Starting from the presumption that publications in upper tier journals produce a significantly greater contribution, some assumed that the quality of a publication was a reflection of the quality of the journal it was published in [25]. Different patterns were observed regarding the rank of the journals where the thesis-related articles were published by the Romanian, French and UK PhD students. The rank of the journal was used in this assessment since comparison based on impact factor is not considered appropriate because it significantly differs from discipline to discipline [20,24], differentiations based on the types of publications and their occurrence, and also due to co-authoring practices [17]. Puuska showed that scholars in medical sciences have contributed significantly to more publications than those in other disciplines and have been more productive regarding published articles, probably because of multi-authoring practices [17]. France and the UK share the same pattern, with a higher number of articles published in Q1 or Q2 rank journals. A previous study on the French Medical School of Lille 2 based on 2150 doctoral theses completed during 2001 to 2007, showed that only 11.3% of them had been followed by a scientific publication, while the average impact factor of those publications was 2.23 [26].

In contrast, Romanian PhD students published a higher percentage of their articles in Q3 or Q4 rank journals. Salager-Meyer showed that the quality of the papers published by local or peripheral journals was quite low, in general, and their impact factor was low as well [27]. Furthermore, journals from developed countries try to publish the most important research results in order to reach the widest audience possible and to maximize their profits [26], while top-tier journals' selectiveness could lead to increased rejection rates up to 80-90% of submissions [1].

As stated in previous studies, journal articles and book chapters were considered as a higher importance than conference papers, oral presentations or posters [4,28]. Hence, this study focused on PhD thesis-related articles and, to prevent the inclusion of false-positive results, did not search for articles beyond thesis completion and did not rely on textual analysis.

The present study has several strengths and limitations. There was no missing information regarding thesis details, thesis related article's details and scientometric characteristics of the publishing journal. To obtain valid data, several objective sources of information (full-text PhD theses, the Web of Science and scientific journal's webpages) were used.

Theses from Romania, France and the UK were chosen regardless of the medical domain to which the thesis topic pertained. Since not all medical theses were available online with free full text, it is difficult to appreciate how large this study's sample size is, compared to the total number of medical thesis defended between 2009 and 2013 in each of the above-mentioned countries.

In spite of this study's limited scope, the findings may be valuable to universities and policy makers in Romania and other European countries. Although the overall PhD publication rate, with conference papers and other types of publications, might differ from this study's findings,



the authors believe that the observed associations in this study may be found in future research on other PhD programs. Future studies might assess the strength of these associations and compare the PhD research publications from other European developing countries.

Furthermore, future research could investigate the scientific PhD-related research published after PhD completion and could also assess the citations of those publications.

## **Conclusions**

This research has reported that Romanian medical students, during PhD candidature, have published a small amount of original research articles in highly ranking journals and have received less financial support and collaboration aid than those from western EU countries. Romanian medical students have published most of their articles in national journals or in journals not indexed in Journal Citation Reports (or Web of Science). Universities and policy makers in Romania could make use of these findings and focus their efforts to diminish the principal barriers towards research excellence.

## **List of abbreviations**

PhD – Doctor of Philosophy

UK – United Kingdom

SD – standard deviation

## **Conflict of Interest**

The authors declare no conflict of interest.

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