The impact of physical activity to the child’s quality of life: a bibliometric study [version 1; peer review: 1 approved, 2 approved with reservations]

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Abstract
Background: The application of bibliometrics in healthcare research is becoming popular, however at present it is still an under-researched area.
Methods: In our study we used a bibliometric technique called bibliometric mapping to visualize the published research regarding the influence of physical activity to children’s quality of life. The research was visualized in the form of both chronological and cluster science landscapes. Science landscapes, contrary to conventional reviews, capture the relationships between multiple topics and concepts, enabling the generation of “synthetic reviews”.
Results: Evolutionarily, three distinct research phases appeared, namely research on influence of physical activity on various chronic non-communicable diseases; research on quality of life and childhood diseases related to physical activity; and outcome-related research. The research consists of six main topics: asthmatic child and exercising, blood diseases, health-related quality of life, obesity and chronic diseases, childhood obesity and behaviour, and depression and health outcomes.
Conclusions: The study identified some research that may be helpful to general paediatricians whose everyday practice or research is not focused on physical activity and child’s quality of life, but wants to learn about the taxonomy of the topics, the most interesting discoveries, guidelines and practices and the state of the art in the field. It also revealed some hidden association, otherwise not easily identified, even by informed researchers and clinicians.

Keywords
Physical activity, Health related quality of life, Bibliometric mapping, Scientific landscape

Open Peer Review
Invited Reviewers

1. Zachi Grossman, Maccabi Healthcare Services, Tel Aviv, Israel
2. Manuel Jesus Cobo, University of Cádiz, Cádiz, Spain
3. Julije Mestrovic, University Hospital of Split, Split, Croatia

Any reports and responses or comments on the article can be found at the end of the article.
Introduction
The role of bibliometrics in healthcare research has been excellently described by Lewison and Devey: “Bibliometrics is to scientific papers as epidemiology is to patients.” Indeed, in 1990 bibliometrics first became a medical subject heading. Consequently, the application of bibliometrics by health professionals to analytical, clinical, informational and academic areas of interest is becoming more extensive; however, at present it is an unexploited area of a fruitful research.
Interdisciplinary research concerning the influence of physical activity and sport on children’s quality of life is increasingly becoming more and more important. In their review paper Buttitta et al. reported that several factors are associated with children’s quality of life; among them physical activity is one of the most important, especially in in those with pre-existing diseases. Various malignant diseases and anticancer therapy in children both drastically affect daily life activities, including high-performance sports. However, both random and non-random feasibility studies show positive effects of physical activity on clinical and psychosocial outcomes. Consequently, every effort should be made to maintain physical activity during paediatric cancer therapy. Comparable findings for congenital heart diseases, were reported by Dufier et al.
Since our research area interest is multidisciplinary, we had an opportunity to employ a bibliometric technique called bibliometric mapping. Bibliometric mapping visualizes academic research in the form of scientific landscapes. Science landscapes, contrary to conventional reviews, which focus on particular research questions, extract information at various levels and capture the relationship between multiple topics and concepts, creating “synthetic reviews”. Scientific landscapes are still relatively rarely used; however, those published have been well received by the scientific community.
Methods
Bibliometrics could be defined as the application of mathematical, statistical and heuristic methods to scientific publications. Bibliometric mapping is a recent addition to techniques already used in bibliometrics in medicine. Bibliometric mapping aims to visualize different facets of literature production based on different co-occurrences (i.e. words, authors, organisations, journals), co-citations and bibliographical coupling. Bibliometric mapping can be automated using various software tools. Among open licence software tools, VOSviewer is very versatile and easy to use. Both bibliometric mapping and VOSViewer have been successfully used in health related fields.
Bibliographical dataset and corpus
The corpus was extracted from the Scopus bibliographical dataset, because of Scopus broad coverage of various journals, book chapters and conference proceedings on one hand and on the other hand because of Scopus’ extensive and easy to use search and analytical functions. The search was made on 12th January 2019 using the search keyword string child AND (“physical activity” or “sport”) AND “quality of life” in information source titles, abstracts and keywords for the whole period covered by Scopus.

Data extraction and analysis
Publication year, source title and author’s country of affiliation were extracted by Scopus services. Abstracts were exported as comma separated values (CSV) files to enable further analysis by the VOSviewer (V1.6.9) and Excel software (Version 2016). Cluster and chronological scientific landscapes were generated for all terms with an occurrence frequency larger than 30. Common words such as report, significance, trial, study and baseline were ignored using a customised thesaurus file (see Underlying data). Similarly, synonyms like body mass index and BMI were integrated into one term. The Attraction was set to 4, Min. Cluster size to 8, Resolution to 1.25; all other VOSViewer parameters were set to default values.

Meta-synthesis
The popularity of a term (size of the term font and associated square) and relatedness between terms (terms located near each other are more related than those further apart) in both cluster and chronological scientific landscapes were analysed using meta-synthesis. An appropriate topic was determined for each cluster based on the analysis of most popular terms belonging to the cluster.

Results
The search resulted in 2334 publications (1637 articles, 419 reviews, 66 conference papers, 50 editorials, 35 notes, 29 book chapters, 19 letters, 19 short communications and 24 other types of publications; see Underlying data). The most popular journals in which the above publications appeared are shown in Table 1. The most prolific journal was BMC Public Health with 31 publications. The highest ranked journal in the selected field was Pediatrics, with 21 publications (621 place according to SCImago Journal Rank - SJR, which ranks within the top 2%.

<table>
<thead>
<tr>
<th>Source title</th>
<th>Number of publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC Public Health</td>
<td>42</td>
</tr>
<tr>
<td>Quality of Life Research</td>
<td>39</td>
</tr>
<tr>
<td>Haemophilia</td>
<td>36</td>
</tr>
<tr>
<td>Pediatric Blood and Cancer</td>
<td>32</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>27</td>
</tr>
<tr>
<td>Cochrane Database of Systemic Reviews</td>
<td>24</td>
</tr>
<tr>
<td>PloS One</td>
<td>20</td>
</tr>
<tr>
<td>BMC Pediatrics</td>
<td>19</td>
</tr>
<tr>
<td>Developmental Medicine and Child Neurology</td>
<td>17</td>
</tr>
<tr>
<td>Epilepsy and Behaviour</td>
<td>17</td>
</tr>
<tr>
<td>Health and Quality Of Life Outcomes</td>
<td>17</td>
</tr>
<tr>
<td>Σ = 290 (12.4%)</td>
<td></td>
</tr>
</tbody>
</table>
of all source titles indexed by Scimago. Interestingly, all of the most prolific source titles are ranked in the top quarter of all journals. Their contribution to the total literature production on our topic of interest accounts for 12.4%. As expected most of the most prolific source titles are from the field of paediatrics, others relate to quality of life or from general areas. Surprisingly no source titles related to sport or physical activity were ranked among the most prolific source titles – the first (American Journal of Sports Medicine) is in 15th place with 11 publications.

The most productive countries are presented in Table 2. All of them have advanced health, industrial and economic systems, high BDP and are also leading countries in research and development. The top 10 countries produced more than 83% of all publications, indicating that literature production is regionally centred.

**The trends in research literature production and evolution of research topics**

Shen et al. proposed a model of science discipline development based on literature production dynamics. Following their example, a graph was constructed (Figure 1) which reveals three distinguished phases in the production of publications regarding influence of physical activity to children’s quality of life, namely:

- initial phase in the period 1975–1989 when publications were scarce, most three publications per year;
- initiation phase in the period 1990–1999 when number of publications linearly increased from 6 to 23; and

Figure 2 presents the term map on the topic of research, the influence of physical activity to children’s quality of life.

Table 2. The 10 most productive countries on the topic of research, the influence of physical activity to children’s quality of life.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>688</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>240</td>
</tr>
<tr>
<td>Canada</td>
<td>223</td>
</tr>
<tr>
<td>Australia</td>
<td>204</td>
</tr>
<tr>
<td>Germany</td>
<td>166</td>
</tr>
<tr>
<td>Netherlands</td>
<td>125</td>
</tr>
<tr>
<td>Spain</td>
<td>113</td>
</tr>
<tr>
<td>France</td>
<td>97</td>
</tr>
<tr>
<td>Italy</td>
<td>95</td>
</tr>
<tr>
<td>Sweden</td>
<td>81</td>
</tr>
<tr>
<td><strong>Σ = 1951 (83.6%)</strong></td>
<td></td>
</tr>
</tbody>
</table>

According to the figure the research development went through three main phases, namely:

1. **Research on the influence of physical activity on non-communicable diseases** (approx. period from 1975 to 2011 – violet and blue colours). The associations between (1) hypertension, diabetes, cardiovascular diseases, mortality, exercise and positive/beneficial effects, and (2) asthma, cystic fibrosis, medication, illness, sport and daily activity, were the main stream of research in the first phase.

2. **Research on frequent childhood diseases and physical activity** (green and light blue colours – approx. period from 2012 to 2013). The research was focused on associations between (1) chronic diseases, society, pregnancy, birth, sedentary life style, prevention strategies, and risk increase, (2) nutrition, promotion, blood pressure, obesity, physical activity and, fitness and (3) anxiety, depression, stress, juvenile idiopathic arthritis, haemophilia, injury and health status.

3. **Measuring quality of life** (light green and yellow colours – state-of-the-art research). The research in the most recent period is concerned with association between (1) inclusion, adherence, protocol, cancer and health outcomes, (2) sedentary behaviour, weight status, physical activity level and physical activity interventions and (4) quality of life indicators, physical functioning and physical health.

The cluster science landscape (Figure 3) consists of six clusters. Meta-synthesis revealed six topics, as shown in Table 3.

**Discussion**

It is interesting to note some details evident from the derived topics above and associations between terms:

- **The quantity of research concerning physical activity in relation to asthma, but not only as a single disease, but also in combination with obesity and diabetes.** Di Genova et al. claim that growing evidence shows the existence of an “obese asthma” phenotype characterised by difficult-to-manage asthma. Additionally, Atay and Berket show that obesity results in various co-morbidities in children and adolescent.

- **The increasing incidence of psychosomatic diseases and the beneficial effects of physical activity.** Hrafnsdottir et al. reports that less screen time and more intense physical activity lowers the risk of mental health problems.

- **The broadness of the spectrum of diseases related to child’s quality of life and physical activity.** Studies highlighted that children with overweight/obesity and related co-morbidities and lifestyle behavioural risk factors, had significantly lower healthy-related quality of life.
Figure 1. The dynamics of literature production on the topic of research, the influence of physical activity to children's quality of life.

Figure 2. The chronological science landscape of the influence of physical activity to children's quality of life.
Figure 3. The cluster science landscape on the topic of research, the influence of physical activity to children's quality of life.

Table 3. Topics derived from the cluster science landscape.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Cluster colour</th>
<th>Popular terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood obesity and behaviour</td>
<td>Green</td>
<td>Childhood obesity, BMI, behaviour, community, obesity, weight</td>
</tr>
<tr>
<td>Chronic diseases and lifestyle</td>
<td>Blue</td>
<td>Diabetes, cardiovascular diseases, hypertension, chronic diseases, risk, life style, morbidity</td>
</tr>
<tr>
<td>Asthmatic child and exercising</td>
<td>Yellow</td>
<td>Asthma, asthmatic child, exercise, physical fitness, positive effect, awareness, medication</td>
</tr>
<tr>
<td>Health-related quality of life and physical and social functioning</td>
<td>Red</td>
<td>Health-related quality of life (HRQOL), paediatric quality of life (PEDSOSQ, social functioning, physical functioning, physical health, life inventory, Kidscreen, pain</td>
</tr>
<tr>
<td>Illness and sport</td>
<td>Light blue</td>
<td>Illness, daily activity, sport, friend</td>
</tr>
<tr>
<td>Depression and regular physical activity</td>
<td>Violet</td>
<td>Depression, anxiety, stress, fatigue, physical activity intervention, health outcome, social support</td>
</tr>
</tbody>
</table>


• The introduction of modern technology such as various sensors in both research and practice supporting the empirical research in areas that were previously very subjective. Traffic-related air pollution and noise may lead to adverse health outcomes, including increased blood pressure, myocardial infarction, and respiratory health in paediatric population. Measuring the physical activity and environmental factors revealed that such measurements can lead to better understanding of the relation between above factors. Another study investigated the use of a carbohydrate intake based on continuous glucose monitoring trends during physical activity of children with diabetes to objectively assess the association between these two variables.

• The state-of-the-art efforts in the development of specific child’s quality of life indices and instruments to measure their relatedness to other paediatric indices. Moghaddasazadeh et al. measured the paediatric quality of life indicators and their relations to enjoyment levels and physical attractiveness.

• The relationship between acute lymphoblastic leukaemia and haemophilia, and physical activity. Acute lymphoblastic leukaemia treatment in children can result in muscle weakness and motion limitations. A study showed that active dorsiflexion range of motion combined with physical activity had a positive correlation with strength/agility standard score. Haemophilia management recommends physical activity in children with haemophilia. In a study researchers adapted and validated the adult Haemophilia & Exercise Project-Test-Questionnaire (HEP-Test-Q) for children aged 6–17 years, reformulated questionnaire items to make them understandable to children.

Conclusion
Using bibliometric mapping we created two scientific landscapes on the topic of research, the influence of physical activity to children’s quality of life. To the best of our knowledge, this is the first such attempt in the paediatric field. We identified six distinct topics and also visualised the chronological aspect of the research literature production. The study revealed some knowledge that might be helpful to an “outsider” who wants to learn about the taxonomy of the topics, the most interesting discoveries, guidelines and practices and the state of the art in the field. It can also help the “seasoned insiders” better understand more specialised research including that is out of their immediate scope of interest. Additionally, it can reveal hidden facts, not easily identified, even by informed researchers and clinicians.

Data availability
Underlying data
Open Science Framework: Physical activity and quality of life in children. [https://doi.org/10.17605/OSF.IO/WXSQE]

This project contains the following underlying data:

• Map.txt (Map file for VOSViewer software)
• Network.txt (Network file for VOSViewer software)
• Scopus1.csv (Extracted articles from Scopus 2011–2019)
• Scopus2.csv (Extracted articles from Scopus 1975–2010)
• Thesaurus_terms.txt (Customised thesaurus file defining terms to be omitted and synonyms)

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

Grant information
The author(s) declared that no grants were involved in supporting this work.

References

6. Kokol P, Blažun Vožmer H, Železnik D: Clinical Simulation in Nursing: A

8. Bellis ND: Bibliometrics and Citation Analysis: From the Science Citation Index to Cybermetrics. Lanham, Md: Scarecrow Press; 2009: 450. Reference Source


Open Peer Review

The work is interesting for readers and should be indexed. The following should be done first:

1. In the discussion, explain briefly the possible relationships between illness and physical activity. Namely, it is important to note what are the mechanisms of how physical activity can affect disease, but also vice versa, in a wide range of conditions, from asthma to air pollution.

2. In discussion, avoid overlapping conditions (asthma and obesity).

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly
**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Paediatric intensive care and quality of life.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

**Reviewer Report 25 July 2019**

https://doi.org/10.5256/f1000research.20643.r50557

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**Manuel Jesus Cobo**
Department of Computer Science and Engineering, University of Cádiz, Cádiz, Spain

The manuscript develop a science mapping analysis of the physical activity on children and the effect in their quality of life. To do that, VOSViewer software tool is employed.

In general, the paper is well organised and written. Moreover, the software tool is appropriate for this analysis and authors use it properly.

In what follows, some comments and suggestions are listed:

- I miss some references to the origins of co-word analysis, science mapping, or generally, science of science. Authors focus too much on bibliometrics on health, but there are important references out of this field. Moreover, authors should cite some recent bibliometric studies developed in health, for example in cancer, rehabilitations, etc.

- The reference to VOSViewer is incorrect. Author should cite the paper where the software is presented.

- Figure 2 is confusing. Authors should provide other kind of visualisation. Also, authors should describe better the conceptual evolution of this research field.

- Discussion should be better described. At this moments it is just a sequence of itemises. Author should provided a clear speech.

- Conclusions are just a summary of the paper.

**Is the work clearly and accurately presented and does it cite the current literature?**

No

**Is the study design appropriate and is the work technically sound?**

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Manuel Jesus Cobo
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Bibliometric and science mapping analysis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 17 June 2019

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Zachi Grossman
Pediatric clinic, Maccabi Healthcare Services, Tel Aviv, Israel

I find this manuscript interesting since it gives a new perspective on the literature.

I would like to propose the following changes in order to improve the conclusions:

1. Single papers on blood diseases - haemophilia and leukaemia - are not enough to draw conclusions from. Therefore, I would tend to disregard these papers both in the discussion and in the abstract.
2. I am not so convinced in the existence of three distinguished time phases. I would prefer a two time phases division: before and after 1995.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** General paediatrics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.