



School Travel Behavior Research Milestone (1979-2021): A Bibliometric Review Analysis

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Abstract

The expansion of automobiles in the field of transport has fundamentally changed the travel patterns of mankind throughout the world. Disruption in the rhythm likewise impacts school travel, floating concerns of transportation, and child issues. This article aims to map and cluster current knowledge concerning school travel behavior topics by utilizing metadata from prior publications, using The Bibliometrix R-package instrument to perform bibliometric analysis on 513 metadata of scientific documents from Scopus and Web of Science databases between 1979 and 2021. The PRISMA criterion diagram is employed for the metadata searching and validating procedure. The study revealed a plethora of scientific documents and citations, particularly in the recent decade, and the countries from the western hemisphere continue to prime state-of-the-art research on this topic.

Disciplinary: Transportation Engineering (Modelling, Behavior).

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1 Introduction

Since the emergence of the motorized vehicle in the 18th century, transportation has seen dramatic revolutions. The active travel pattern shifted to a more passive one through the escalation of motorized vehicles. Disruption in grown-up travel behavior involved children worldwide, particularly school travel behavior. Currently, children are extra prospective to commute to school using passive mode (motorized vehicles) than active mode (walking and cycling). Meanwhile,

parents have various concerns about authorizing their children to travel independently. This fact raises the issues of transportation (sustainability) and children (health and well-being).

To the author's knowledge, numerous review analyses on travel behavior have been conducted previously. However, there are only a few bibliometric analysis documents explicitly on school travel behavior. The first article (author's claim) performing a bibliometric analysis of this topic presents 343 metadata of scientific documents between 2001 and 2021 from Web of Science and PubMed databases (Jing et al., 2021). This article attempts to map and cluster knowledge from a different perspective. Analyzing the metadata of documents on school travel behavior published between 1979 and 2021 from Scopus and Web of Science databases using the Bibliometrix R-Packages tool to present a comprehensive sight of school travel behavior.

2 Literature Review

Children's travel behavior is distinct from adults' (Lin & Chang, 2010; Mackett, 2013; McMillan, 2005; Milne, 2009; Yarlalagadda & Srinivasan, 2008). Elders make their transport modes, whereas children, particularly on their journey to school, are encouraged by their parents or other elder family members. Adolescents have begun to make transportation choices independently, while parents typically provide those for their younger children (He & Giuliano, 2017; Johansson et al., 2012; Singh & Vasudevan, 2018).

School travel significantly impacts overall urban travel patterns (Müller et al., 2020; Singh & Vasudevan, 2018; Xiong et al., 2019). The total traffic volume will increase during the hours of entering or leaving school. The expanding use of private vehicles for school travel in both developed and developing countries, as well as the decline in active mode use, contribute to urban traffic concerns (Ermagun & Samimi, 2018; He & Giuliano, 2018; Mehdizadeh et al., 2017; Nordfjrn & Zavareh, 2017). Worldwide, parents are increasingly escorting their children to school due to concerns regarding travel safety and a hostile travel environment (Muller et al., 2020; Zhang et al., 2017). Children's mobility independence has a consequence on their level of physical activity. Physical activity is critical for the health and well-being of children (Wilson et al., 2018). School travels are performed by individuals with fragile and complicated traits, which piques the curiosity of policymakers, planners, traffic engineers, researchers, parents, and school authorities interested in studying them (Agyeman & Cheng, 2020; Distefano et al., 2019; Hao et al., 2019). Adult travel behavior is the subject of most research on travel behavior, while children's travel behavior receives insufficient attention (Jing et al., 2018).

3 Method

For comprehensive performance, the author applied a five-stage standard of science mapping (bibliometrics) approach (Zupic & Cater, 2014): 1. Study Design; 2. Data Collection; 3. Data Analysis; 4. Data Visualization; and the last, 5. Interpretation.

3.1 Study Design

The authors generate the following research questions for this analysis: 1. What basic details

are available (annual production; document type; most prominent countries, authors, sources, affiliated institutions, and most cited documents)? 2. How is this topic's conceptual framework and research paradigm analyzed?.

The Bibliometrix R-Package is used to conduct the analysis, following a systematic procedure based on Aria and Cuccurullo's paradigm (Aria & Cuccurullo, 2017). Aria and Cuccurullo created Bibliometrix as an open-source application for comprehensive science mapping analysis.

3.2 Data Collection

This research was conducted using the Scopus database (<http://www.scopus.com>) and the Web of Science Core Collection (<http://www.webofknowledge.com>). Authors collected, filtered, and evaluated the feasibility of metadata of publications using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria table, as seen in Figure 1. Table 1 illustrates an advanced search with numerous criteria for inclusion and exclusion. The search timeframe is 1979-2021, with database access beginning on December 7, 2021, to obtain a complete picture of this study issue. Additionally, authors collect English-language publications primarily for the sake of readability. Authors perform advanced-level searches by categorizing phrases into four categories: population, behavior, travel destination, and mode of transportation (see Table 2). The metadata search uses standard Boolean operators ("OR" and "AND") to connect each term into a search string. The database's search function uses the title, keywords, and abstract fields for each page (Savoy, 2005).

Table 1: Inclusion and exclusion criterion

Criterion	Inclusion	Exclusion
Source	database in Scopus and Web of Science Core Collection	all other databases
Types of Literature	the phenomenon's relevant studies/literature	-
Subjects' Characteristics	student, pupil, child, teen, youth, young adolescence, juvenile, kid, parent	university, college, and academy students
Year of Publishing	1979 until 7 December 2021	all after 7 December 2021
Language of Literature	English	all other languages
Intriguing Phenomenon	mode choice for school a travel activity	all other activities

Table 2: Search string for data collection

Database	Search String
Scopus and Web of Science Core Collection	<p>Population : (student* OR pupil* OR child* OR teen* OR youth* OR young* OR adolescen* OR juvenile* OR kid* OR parent*) AND</p> <p>Behavior : ("mod* choice*" OR "choice* of mod*" OR "transport* mod*" OR "mod* of transport" OR "trip mod*" OR "mod* of trip" OR "travel mod*" OR "mod* of travel" OR "commut* mod*" OR "mod* of commut*" OR "mobility mod*" OR "mod* of mobility" OR "journey mod*" OR "mod* of journey") AND</p> <p>Travel Destination : ("school transport*" OR "school trip" OR "school travel" OR "school commut*" OR "school mobility" OR "school journey" OR "transport* to school" OR "trip to school" OR "travel to school" OR "commut* to school" OR "mobility to school" OR "journey to school") AND</p> <p>Mode of Travel : (walk* OR cycl* OR bik* OR cycl* OR bicycl* OR bus* OR train* OR car* OR motorcyl* OR scooter* OR taxi* OR rapid* OR transit* OR "ride-hailing transport*" OR "ride-sharing transport*" OR "car* pool*" OR "on-demand transport*" OR "transport* app*" OR escort* OR accompan* OR chauffeur* OR independent OR unaccompan* OR "self-determine*")</p>

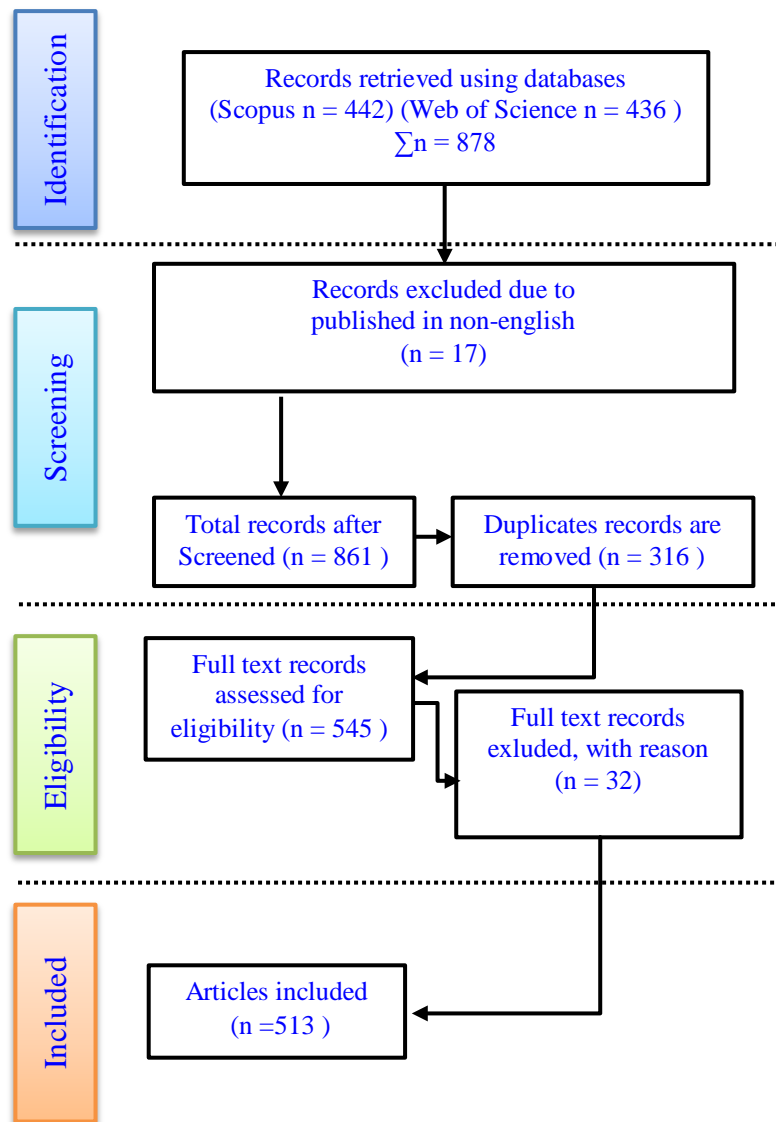


Figure 1: PRISMA flowchart for bibliometric analysis of school travel behavior research

The first phase is identification; a database search generates 878 metadata, containing 442 from Scopus and 436 from Web of Science. The screening process (second phase) deleted 17 metadata in non-English and 316 duplicate metadata, the remaining 545 for the next phase. The third phase is an assessment of the metadata's feasibility. Thirty-two sets of metadata linked to students at the university level and equivalent were discarded due to their incompatibility with the criteria. After this stage, 513 metadata are generated for inclusion in the bibliometric analysis.

3.3 Data Analysis and Interpretation

Data analysis involves descriptive statistical analysis and network analysis. Bibliometrix R-Packages (<http://www.bibliometrix.org>) were employed to analyze the data attained in the previous step. This application provides a tool for quantitative analysis in bibliometrics and scientometrics. In Figure 2, the systematic working order of Bibliometrix is described. After the metadata collection process from the database is complete, the following process is to load and combine the metadata collection into bibliometrix and convert it into a file extension supported by the application for analysis.

The Bibliometrix R-Package provides nonprogrammers with data analysis capabilities. The procedure begins automatically once the metadata file is loaded into the application without being knowledgeable in programming languages. The primary operations are descriptive statistical analysis and network extraction. As a result, a descriptive data matrix and network visualization are produced.

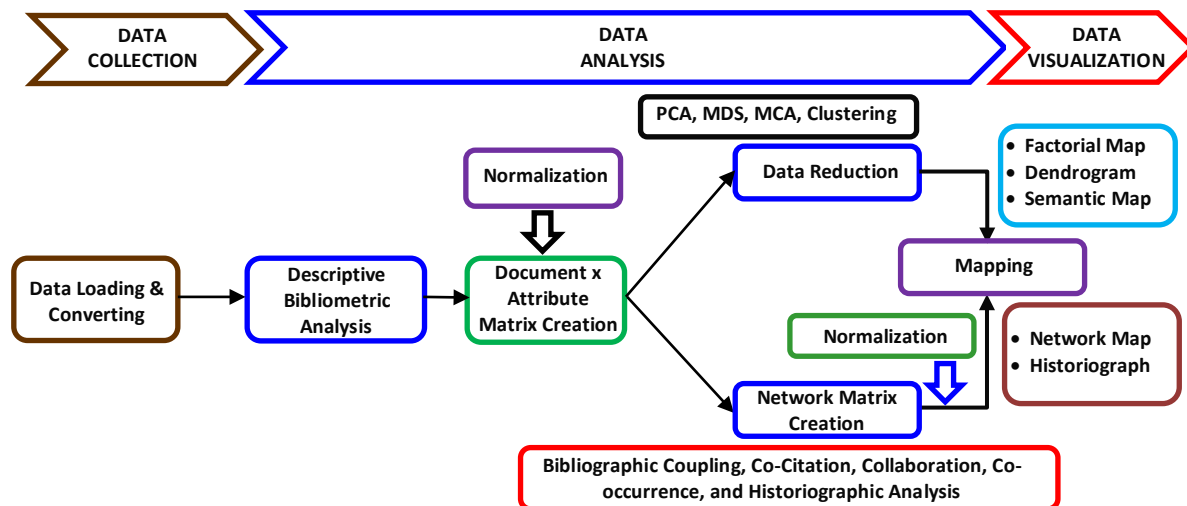


Figure 2: Bibliometrix workflow diagram (Aria & Cuccurullo, 2017)

4 Result and Discussion

4.1 Overview Main Attributes

Table 3 shows general information about the attributes in the metadata collection. After the documents were combined and duplicate titles were eliminated, there were 513 metadata from 172 sources from 1979 to 2021. See Figure 3; these documents are divided into eight types, namely, articles 445 or 87.74%; proceedings 37 or 7.21%; reviews 20 or 3.90%; book chapter 7 or 1.36%; note, erratum, correction, and early access each amounted to 1 or 0.19%. Authors related to these documents are 1324 authors with an average number of 2.58 and 0.387 documents per author

Table 3: Descriptive analysis: Primary attributes of the collection

Description	
Interval	1979 - 2021
Sources	172
Records	513
Average years from publication	5.94
Average citations per records	28.24
Authors	1324
Author Appearances	2103
Authors of single-authored records	29
Authors of multi-authored records	1295
Records per Author	0.387
Authors per Records	2.58
Co-Authors per Records	4.1
Collaboration Index	2.7

4.2 Publication and Citation Trend of School Travel Behavior Research

Since the first article (Rigby, 1979) was cataloged in the search database, additional articles were cataloged in 1999 or two decades later. The school travel behavior research publishing trend began to increase progressively after that. Between 2001 and 2010, a total of 83 documents were published.

The analysis of school travel behavior over the next decade (2011 - 2021) reveals a rising tendency in the following decade. That period saw the publication of 427 documents. Annual growth rates of 18.64% are shown in Figure 4 for the annual publications on school travel behavior.

Figure 5 shows the total number of citations per year (TCPY) for 42-year-old documents. The total number of citations ranges from 14,488 to 513 documents, with a trend toward increasing total citations per year (TCPY), an average of 28,24 citations per document. These two graphs demonstrate an upward tendency in the mode of school travel study.

The study's exploration is still in its infancy, particularly in geography, where developed countries in the western hemisphere dominate. Understanding the factors that influence school travel behavior in developing countries remains a challenge.

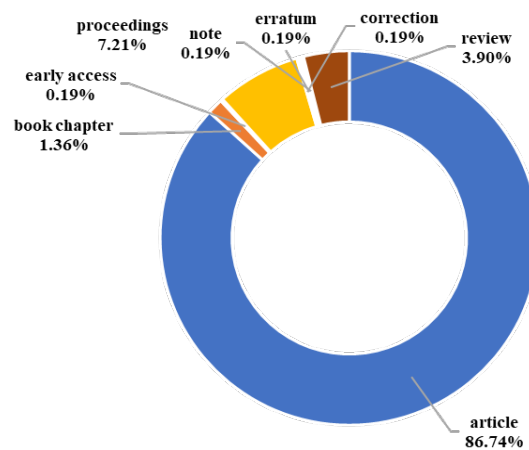


Figure 3: Record type in school travel behavior (1979-2021)

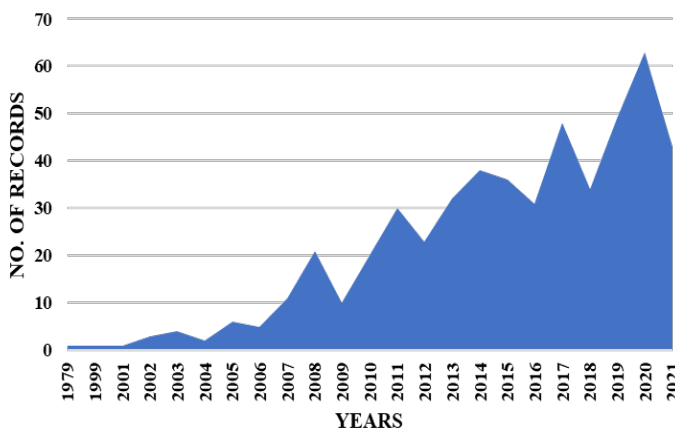


Figure 4: Publications per year on school travel behavior (1979 - 2021).

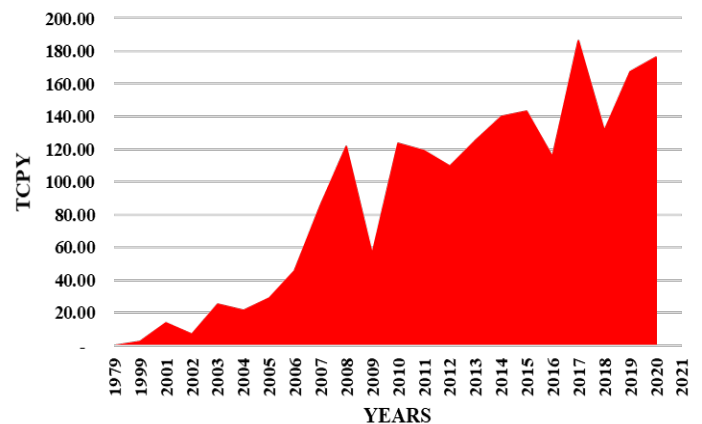


Figure 5: Citations per year in school travel behavior (1979-2020).

4.3 Prominent Authors, Institutions, and Countries

This section assesses the most prominent authors, institutions, and countries in school travel behavior research based on publication production. In Figure 6, Ron Buliung from the University of Toronto, Canada, is the most prominent author with 25 documents on this topic. These documents were cited 1331 times during 2009 - 2021. The document entitled "Active school transportation in the Greater Toronto Area, Canada: An exploration of trends in space and time (1986-2006)" was the most cited, namely 209 times, in 2021. The point of the study is to examine spatially and temporally changes in mobility for school trips in the Greater Toronto Area, Canada's populous city region. Buliung discovered a decline in active modes of transport to and from schools between 1986 and 2006. The order of the ten most prominent authors based on publication production after Ron Buliung is Guy Faulkner (University of British Columbia, Canada) with 23 documents, Palma Chillón (University of Granada, Spain) with 19 documents, Ashley R Cooper (University of Bristol, UK), Sandra Mandic (University of Otago, New Zealand), Raktim Mitra (Ryerson University, Canada), Esther van Sluijs (University of Cambridge School of Clinical Medicine) with 12 documents each, Alireza Ermagun (Mississippi State University, US), Richard Larouche (University of Lethbridge, Canada), Emilio Villa-González (University of Granada, Spain) each with 11 documents. All authors on the theme of school travel behavior come from developed countries in Europe, North America, and Oceania. Their studies mainly highlight active school transportation due to the declining use of this mode of transportation locally and globally.

Records by Author

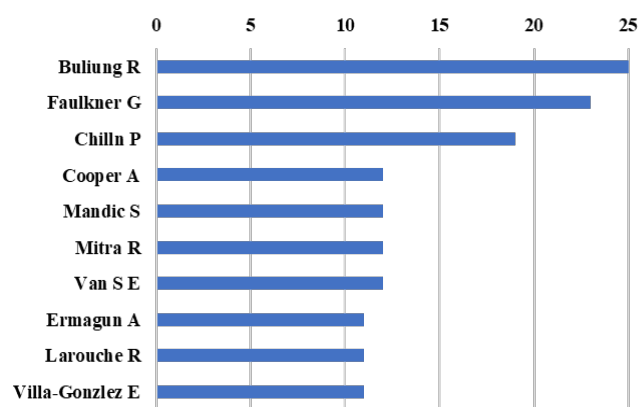


Figure 6: Descriptive analysis: The list of top 10 most prominent authors

Records by Country

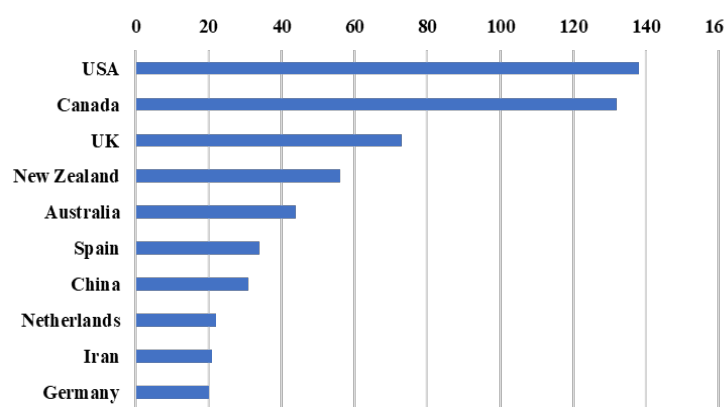


Figure 7: Descriptive analysis: The list of the top 10 most prominent countries.

Following that, a list of countries that contribute the most to document production in school travel behavior research is provided in Figure 7. Eight of the ten countries named are developed countries (the United States, Canada, England, New Zealand, Australia, Spain, Netherlands, and Germany). Additionally, two emerging economies (China and Iran) (United Nations, 2016). The United States, with 138 documents or 17.6% of the total number of documents, is the most prominent country in producing school travel behavior documents. Canada is next with 132 documents or 16.8%, Next is United Kingdom with 73 documents or 9.3%, New Zealand 56

documents or 7.1%, Australia 44 documents or 5.6%, Spain 34 documents or 4.3%, China 31 documents or 4.0%, Netherlands 22 documents or 2.8%, Iran 21 documents or 2.7%, and Germany 20 documents or 2.6%. Of the total number of school travel behavior documents, two countries from North America (the US and Canada) contributed 34.4%, four countries from Europe (UK, Spain, Netherlands, and Germany) 19%, two countries from Oceania (Australia and New Zealand) 12.7%, and two countries from Asia (China and Iran) 6.7%. Most school travel behavior documents are produced from the western hemisphere. Based on the metadata collected, the first article on this study came from the United Kingdom titled “A Review Of Research On School Travel Patterns And Problems” (Rigby, 1979).

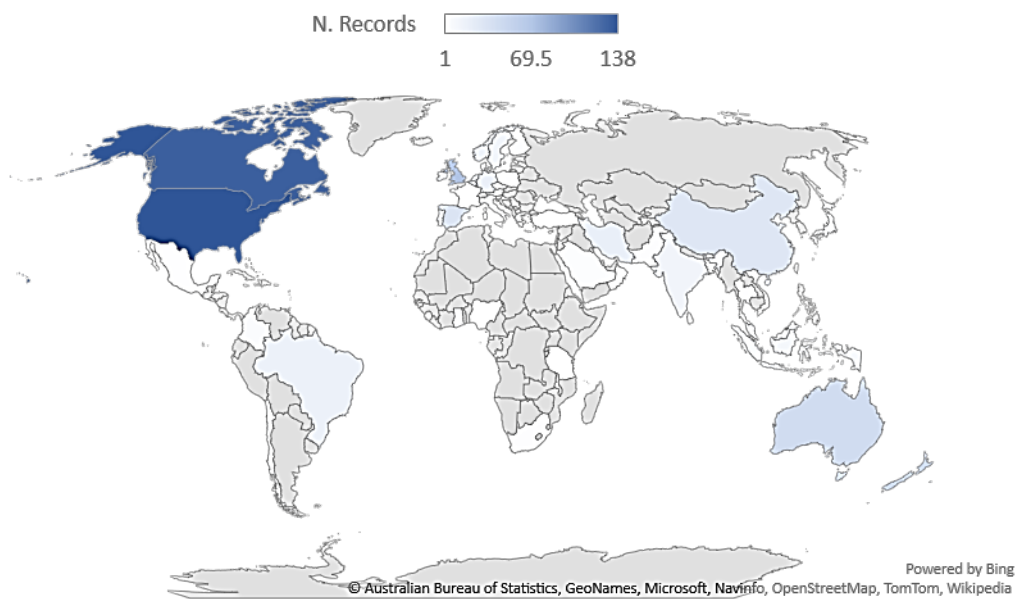


Figure 8: Worldwide records distribution in school travel behavior (1979-2021).

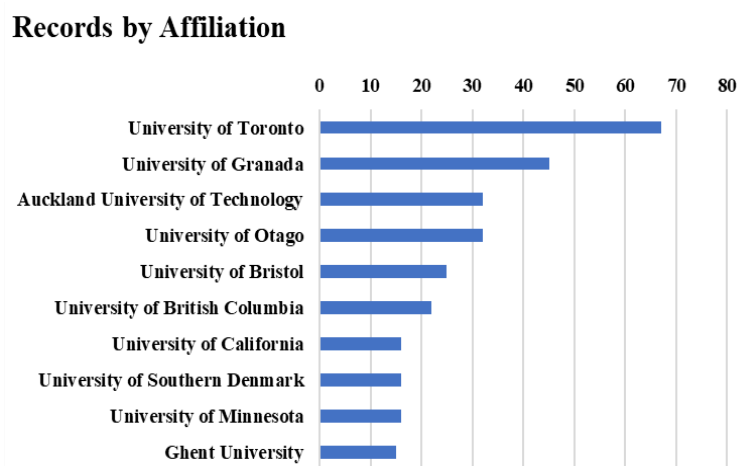


Figure 9: Descriptive analysis: The list of the top 10 most prominent institution

In a scientific article, the institution is the author's affiliation. school travel behavior is a field of study to which numerous developed countries have made significant contributions. The ten most prominent institutions that contributed to the study are listed in Figure 9. To begin with 67 contributing documents, the University of Toronto in Canada became the most notable institution.

The University of Granada in Spain 45 documents; Auckland University of Technology in New Zealand and the University of Otago in New Zealand 32 documents each; the University of Bristol in the United Kingdom 25 documents; the University of British Columbia in Canada 22 documents; the University of California in the United States, the University of Southern Denmark in Denmark, and the University of Minnesota in the United States 16 documents each; Ghent University in Belgium 15 documents.

4.4 Influential Articles and Sources

Table 4 shows the ten most influential articles in the School travel behavior research. The article cited the most was working (McDonald, 2007), with 461 citations in 2021. The work discussed trends in active transportation use among students in the United States. Next is the work (McMillan, 2007) on the factors of urban structure in the United States on the mode of children's travel to school, cited 384 times. (Cooper et al., 2003) analyzing the relationship between walking to school and the level of physical activity in children in the UK has been cited 324 times. Still (Cooper et al., 2005) compared the level of physical activity in Danish children who walked, cycled, and were sent by car to a school that had been cited 297 times. (Schlossberg et al., 2006) revealed that urban structure and distance to the choice of transportation to school in the United States were cited 295 times. (Tudor-Locke et al., 2001) identified sources of physical activity in American children, one of which was active trips to school citations 275 times. Still, in the United States (Ewing et al., 2004), the focus on school location as a determinant of the choice of mode of transportation to school has been cited 273 times. A similar work (McDonald, 2008) also discussed the influence of school location and distance in the United States as determinants of 214 citations. The article from Buliung et al. (2009) highlighting the trend of active travel in Canada over a while, was cited 209 times. Moreover, finally, from the UK (Panter et al., 2010) attitudes, social support, and perceptions of the environment as predictors of school trips have been cited 183 times.

Table 4: Descriptive analysis: The list of top 10 most prominent records

Author	Source	TC	TC per Year
McDonald (2007)	American Journal of Preventive Medicine	461	30.73
McMillan (2007)	Transportation Research Part A: Policy and Practice	384	25.60
Cooper et al. (2003)	American Journal of Preventive Medicine	324	17.05
Cooper et al. (2005)	American Journal of Preventive Medicine	297	17.47
Schlossberg et al. (2006)	Journal of The American Planning Association	295	18.44
Tudor-Locke et al. (2001)	Sports Medicine	275	13.10
Ewing et al. (2004)	Transportation Research Record	273	15.17
McDonald (2008)	Transportation	214	15.29
Buliung et al. (2009)	Preventive Medicine	209	16.08
Panter et al. (2010)	Journal of Epidemiology and Community Health	183	15.25

From 172 sources containing school travel behavior documents, Table 5 lists the ten most prominent sources based on the number of documents on that topic. The first order, the Journal of Transport and Health (JIF = 2.80), published 53 articles or 10.3% of 513 documents. Then the Journal of Transport Geography (JIF = 4.99) with 28 articles or 5.5%. The International Journal of

Behavioral Nutrition and Physical Activity (JIF = 6.46) and the International Journal of Environmental Research and Public Health (JIF = 3.39) each had 24 articles or 4.7%. Transportation Research Record (JIF = 1.56), 20 articles or 3.9%. Preventive Medicine (JIF = 4.02) with 18 documents or 3.5%. Transportation (JIF = 5.19) 17 documents or 3.3%. BMC Public Health (JIF = 3.30) and Transport Policy (JIF = 4.67) each had 16 documents or 3.1%. Finally, Transportation Research Part A: Policy and Practice (JIF = 5.59) with 12 documents or 2.3%.

Table 5: Descriptive analysis: The list of top 10 most prominent sources

Sources	No. of Records	% of records	JIF
Journal of Transport and Health	53	10.3	2.80
Journal of Transport Geography	28	5.5	4.99
IJBNPA	24	4.7	6.46
IJERPH	24	4.7	3.39
Transportation Research Record	20	3.9	1.56
Preventive Medicine	18	3.5	4.02
Transportation	17	3.3	5.19
BMC Public Health	16	3.1	3.30
Transport Policy	16	3.1	4.67
Transportation Research Part A	12	2.3	5.59

4.5 Cluster Analysis and Thematic Mapping

This section describes concepts often used in school travel behavior studies from 1979 to 2001. The concept analysis was carried out using 973 keywords from 513 records. Bibliometrix R-package provides analysis output in the form of a co-occurrence network, such as the visualization of Figure 10. The network describes the clustering of concepts most frequently discussed in school travel behavior research throughout the search period. The larger the circle in the image, the more often the concept appears in the document. The lines in the figure show the relationships between concepts. Colors indicate the division of concepts in the cluster. Table 6 shows the division of clusters and the items contained in them. This cluster can help researchers, especially novice researchers, determine their research position within the more extensive research network. Researchers can also see items related to the research topic. Cluster 1 relates to school travel behavior, namely the choice of school travel mode and its determinants. Cluster 2 emphasizes walking and cycling as an active modes of schooling. Cluster 3 discusses children and adolescents' physical activity and health-related to active school trips. Cluster 4 discusses the factors that support and hinder an active school journey.

Table 6: Cluster and concept items

Cluster	Concept items	No.items	color
1	Children; school travel; mode choice; active transportation; bicycling; school trips; neighborhood; travel behavior; gender; attitudes; school transportation; travel	12	Red
2	Walking; cycling; built environment; active travel; active school travel; safety; walkability; safe routes to school; gis; students; commuting; school children; active school transportation	13	Blue
3	Physical activity; active commuting; transportation; child; youth; schools; adolescent; active; commuting to school; environment; health; obesity; exercise; adolescence; fitness; public health; accelerometer	16	Green
4	Active transport; school; adolescents; transport; distance; parents; barriers; independent mobility	8	Purple

relates to other concepts, such as "environment", "gender", "perceptions", "active travel to school", "walk", "bike", "car choice", "built", and "children independent mobility". . In addition, there is the theme of "neighborhood" which is connected to the concepts of "public health", "risk perception", "behavior change", "community", "parent attitudes", "spatial behavior", and "urban design". Furthermore, the theme of "school transportation" is connected with the concepts of "space syntax", "global positioning system", "multinomial logit model", "school choice", and "weather".

The upper left quadrant is the niche theme. This quadrant shows high density but with low centrality. The significance of the field is low compared to the previous theme. The theme with the closest significance is the theme of "public transport," which is connected with the concepts of "travel behavior", "urbanization", "theory", "mode share", "models", and "lifecycles", and "cohort". Next is the "active" theme, which is connected to the concept of "travel modes". "primary school" and "escorting" are themes with lower significance in this quadrant.

The lower left quadrant is emerging or declining themes with low density and centrality. There are two possibilities, whether the theme is emerging or, on the contrary, declining. The theme of "evaluation" is in this quadrant. Evaluation of school travel behavior metadata includes the evaluation of programs or policies (Baslington, 2010; Hinckson & Badland, 2011; Hoelscher et al., 2016; Johnston et al., 2006; Kipping et al., 2008; Levantis, 2010; Perez-Martin et al., 2018; Rodriguez et al., 2019), measurement tools or instruments (Pocock et al., 2020; Sersli et al., 2019; Stewart et al., 2015), group of population (Mendoza et al., 2014), effects on children non-physical health (Ramanathan et al., 2014), school status (Yan et al., 2019), routes (Spallek et al., 2006) (Woods & Nelson, 2014), barriers (Fallah Zavareh et al., 2020), data reliability and validity (McDonald et al., 2011).

The lower right quadrant is the basic theme - fundamental, and interdisciplinary subjects. These themes span several research areas and include a broad range of subjects. Some basic concepts related to the theme of "school travel" include the concepts of "children", "walking", "mode choice", "active transport", synonyms "active commuting to school", "walkability", and "safety".

5 Conclusion

School travel behavior research has increased in the last decade. This trend is shown by the increasing annual production and citation of scientific documents. The western hemisphere still dominates the state-of--of-the--the-art contribution in this field, from productions, authors, institutions, and cited documents.

The limitations of this review are a challenge for future researchers. This bibliometric analysis only reveals general information about descriptive attributes in metadata and conceptual structures (co-occurrence network and thematic map) in the school travel behavior research. Future research can analyze intellectual structures (co-citation networks and historiography) and social structures (collaboration networks and maps).

6 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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