

FİZYOTERAPİ VE REHABİLİTASYONDA YAYINLANAN ÇİFT GÖREV ÇALIŞMALARININ BİBLİYOMETRİK ANALİZİ

BIBLIOMETRIC ANALYSIS OF DUAL-TASK STUDIES PUBLISHED IN PHYSIOTHERAPY AND REHABILITATION

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ÖZET

AMAÇ: Çift görev, farklı amaçlarla motor, davranışsal veya bilişsel görevlerden aynı anda ikisini gerçekleştirme yeteneğidir. Günlük yaşam aktivitelerinin çoğu çift görevlerden oluşur. Çift görev eğitimi, fizyoterapi ve rehabilitasyonda yaygın olarak kullanılmaktadır. Bu çalışmanın amacı, fizyoterapi ve rehabilitasyondaki çift görev çalışmalarının gelişim ve eğilimlerini tanımlamak için bibliyometrik bir analiz yapmaktır.

GEREÇ VE YÖNTEM: Bibliyometrik analiz için veriler Web of Science'dan toplandı. Konu arama sorguları TS=("dual-task" AND "physiotherapy" OR "dual task" AND "physiotherapy" OR "dual-task" AND "physical therapy" OR "dual task" AND "physical therapy") idi.

BULGULAR: Tarama sonucunda 98 yayına ulaşıldı. Her yayın için ortalama atıf sayısı 27.29'du. Amerika Birleşik Devletleri işbirlikçi ağ (n=36) ve yayınlar (n=28) açısından ilk sırada yer aldı. Nieuwboer (n=57) çift görev araştırmasına en çok katkıda bulunan yazardı (n=5). Oluşum oranı (OR) ve toplam bağlantı gücü (TLS) en yüksek olan anahtar kelime "yürüyüş" tü (OR: 32, TLS: 75). Çift görev çalışmaları arasında en sık atıf alan döküman, Folstein ve ark.'nın (n=21) çalışmasıydı. En yüksek TLS'si olan döküman Silsupadol ve ark. (n=22) tarafından yapılan çalışmaydı.

SONUÇ: Fizyoterapi ve rehabilitasyonda ikili görev çalışmaları açısından literatürde ciddi boşluklar olduğu görüldü. İkili görev eğitiminin çeşitlendirilmesi ve farklı popülasyonlarda uygulanması önerilmektedir.

ANAHTAR KELİMELER: Bibliyometrikler, Çoklu görev davranışı, Fizyoterapi, Rehabilitasyon

ABSTRACT

OBJECTIVE: Dual-task is the ability to simultaneously perform two motor, behavioral, or cognitive tasks with different objectives at the same time. Most of daily life activities consist of dual-tasks. Dual-task training is commonly used in physiotherapy and rehabilitation. This study aimed to conduct a bibliometric analysis of dual-task studies in physiotherapy and rehabilitation to describe their progress and trends.

MATERIAL AND METHODS: Data for bibliometric analysis were collected from the Web of Science. The topic search queries were TS=("dual-task" AND "physiotherapy" OR "dual task" AND "physiotherapy" OR "dual-task" AND "physical therapy" OR "dual task" AND "physical therapy")

RESULTS: As a result of the search, 98 publications were found. Mean number of citations for each publication was 27.29. The United States of America ranked first in terms of collaborative network (n=36) and publications (n=28). Nieuwboer (n=57) was the author who contributed the most to dual-task research (n=5). The keyword with the highest occurrence rate (OR) and total link strength (TLS) was "gait" (OR: 32, TLS: 75). The most commonly referred document among dual-task studies was the study of Folstein et al. (n=21). The document with the highest TLS was the study performed by Silsupadol et al. (n=22).

CONCLUSIONS: It was observed that there are severe gaps in the literature in terms of dual-task studies in physiotherapy and rehabilitation. It is suggested that dual-task training should be diversified and applied in different populations.

KEYWORDS: Bibliometrics, Multi-tasking behavior, Physical therapy, Rehabilitation

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INTRODUCTION

Dual-task is the ability to simultaneously perform two motor, behavioral, or cognitive tasks with different objectives at the same time (1). Dual-task differs from serial multitasking in which switching between the tasks is involved and in which the individual focuses on a different task each time. However, in literature, it is sometimes referred to as "concurrent multitasking" in which multiple tasks are performed simultaneously (2). Dual-task, which has been the subject of research in several studies on psychology, has recently been a topic in physiotherapy and rehabilitation (3, 4).

Dual-task interference or cost is the loss of performance occurring in one or both of the tasks as the attention is divided between the two tasks while the two tasks are performed simultaneously (5). Most of the daily life activities consist of dual-tasks. The ability to perform two tasks simultaneously plays an important role in performing daily life activities independently (3). In older adults (6), individuals with a neurologic deficit (stroke, Parkinson's disease, multiple sclerosis, etc.), and individuals with a cognitive problem such as dementia (7), taking on an additional cognitive task while walking or during several activities that require balance and postural stability can result in falling. Nowadays, dual-task training programs are developed for different objectives such as preventing the risk of falling (8), improving gait (9) and balance (10) and increasing mobility (11). Therefore, dual-task training is used as a reliable method in several physiotherapy and rehabilitation areas and differently diagnosed populations (12 - 14). According to several studies, becoming aware that gait or balance was not only a motor task but also affected by complicated cognitive processes and that executive function could increase the dual-task performance with dual-task training (15, 16) resulted in the increasing number of dual-task studies.

Bibliometric analyses summarize the cumulative information by mapping and, visualizing the content, characteristics and, state of literature that published and indexed in a scientific field (17, 18). The main objective of these researches is to give a general idea about a specific

research area and provide information about the relationships between the number of studies in this area, number of citations, terminology maps, and concepts in a specific area (19). Therefore, well-structured bibliometric studies can form a sound basis to develop an area in unique and significant ways and guide the researchers for future studies (18). There are a few bibliometric analyses on multitasking in psychology (20, 21). However, there is no bibliometric analysis of dual-task studies the popularity of which is gradually increasing in physiotherapy and rehabilitation today. Therefore, this study aimed to carry out a bibliometric analysis of the dual-task studies in physiotherapy and rehabilitation to summarize their progress and tendencies from the beginning.

MATERIALS AND METHODS

This study was retrospectively performed and presented the results of bibliometric analysis of dual-task studies in physiotherapy and rehabilitation. Dual-task was a focus of interest in several disciplines, especially psychology. However, the number of dual-task studies in physiotherapy and rehabilitation has increased and they have become a part of the assessment and treatment of individuals with need rehabilitation recently. Considering all these, this bibliometric analysis involved all studies including assessments and treatments related to dual-task in physiotherapy and rehabilitation.

In this study, the distribution, growth trend and, citations of dual-task studies, countries with the highest number of publications, citations and collaborations of countries, the author contributing to literature most with his or her publications and co-authorships, keywords that have been used most, publications that have been cited most, and co-citations of these publications identified and a reference that form a basis for future studies obtained.

Data Collection

Data for bibliometric analysis were collected from the Web of Science (WoS) including SCI-EXPANDED, SSCI and, A&HCI. Data collection was completed on November 17, 2021. The term of dual-task is stated in two different ways in literature ("dual-task" and "dual task").

Therefore, the research strategy in WoS was established accordingly. The topic search queries for this study were TS=("dual-task" AND "physiotherapy" OR "dual task" AND "physiotherapy" OR "dual-task" AND "physical therapy" OR "dual task" AND "physical therapy"). It was observed that all the documents were published between 1992 and 2021. The documents of 2021 were not included in the study as they have not been completed yet and could mislead the results of the study. All types of documents apart from Articles and Reviews were excluded from the study. Only the studies published in English were included. As a result of this query, a total of 98 documents were obtained (<https://www.webofscience.com/wos/woscc/summary/51094b48-ea19-4664-ac61-054f001f-b89e-15ed9497/relevance/1>).

Study Protocol

The bibliometric analysis was carried out using the VOSviewer software (version 1.6.17 of VOSviewer). VOSviewer, a software tool to construct maps based on network data and visualize these maps, was developed by van Eck and Waltman (22). Each item is represented by a circle in bibliometric analysis. The size of the circle shows the weight of the item. The items in the same cluster are symbolized with the same color. The number of lines between the items shows the total link strength; the stronger the link, the greater the relationship between the items (22, 23).

RESULTS

In this part, the results obtained from the dual-task studies in physiotherapy and rehabilitation were presented in numerical data, tables, and figures by the objectives of the study.

Status of The Documents Published on Dual-task In Physiotherapy and Rehabilitation:

In this part, the yearly distribution, growth trend and, citations of the dual-task studies in physiotherapy and rehabilitation were assessed.

The distribution of the numbers of publications on dual-task in physiotherapy and rehabilitation according to years was shown in **Figure 1**. The first article on dual-task in physiotherapy and rehabilitation was published in 1992. There were a total of 98 publications including 89

articles and 9 review articles between 1992 and 2020. The highest number of articles were published in 2016 and 2020 (n=15). Although the number of publications decreased after 2016 until 2020 it increased again in 2020.

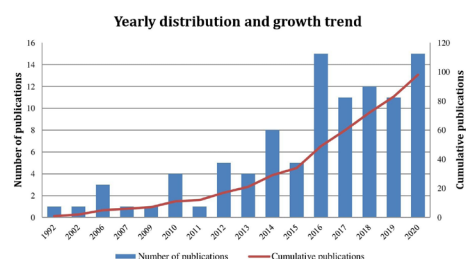


Figure 1: The number of publications and cumulative publications on a year-on-year basis

The total number of citations between 1992 and 2020 was 1674. The average number of citations for each publication was 27.29. The number of citations for the publications was the highest in 2016 (n=488). The number of citations according to the number of publications was the highest in 2002 when the years were compared (n=256) (**Figure 2**).

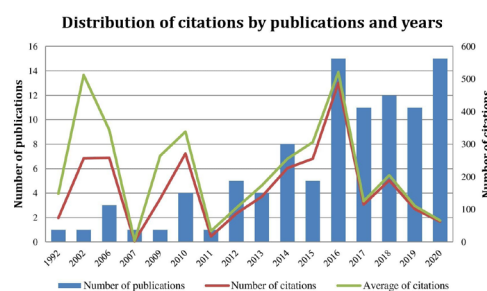


Figure 2: Distribution of citations by publications and years

Collaborative Countries Network Analysis:

Total link strength provides a prediction of a country's collaborative studies with the other countries (24). The documents on dual-task were downloaded from a total of 27 countries and regions via VOSviewer software. Since 7 countries had no collaborative research network they were not included in the figure. The size of the circle in **Figure 3** showed the number of publications in two countries or regions. The thickness of the line linking the two countries or regions represented the strength of the relationship between them. The thicker the line was the stronger the collaborative relationship was. As a result of the analysis, the United States of America (USA) was the top country in terms of the collaborative network.

The countries that published 3 documents and more on dual-task in physiotherapy and rehabilitation were listed in **Table 1**. According to the table, the USA with the highest number of publications (n=28) had the highest number of citations. Following the USA, Australia (n=11) and Denmark (n=9) were listed as the countries with the highest number of publications. Following the USA (n=36), Australia (n=32) and Belgium (n=20) had the strongest collaboration with the other countries. When the percentages of citations per publication were compared the USA (37.86%) fell behind Canada (69.20%) and Australia (60.64%). Turkey was among the countries with the lowest number of citations (n=5) and the lowest link strength according to the number of publications.

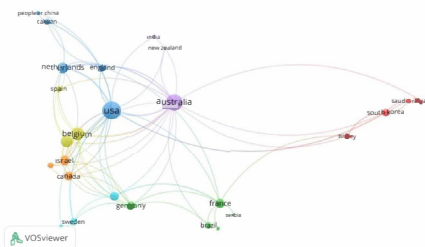


Figure 3: Collaborative networks of collaborative countries/regions of dual-task studies in physiotherapy and rehabilitation

Table 1: Top countries that published more than three documents

Countries/Regions	Documents	Percentage of documents	CN	Average citations per document	TLS
1 USA	28	28.57	1060	37.86	36
2 AUSTRALIA	11	11.22	667	60.64	32
3 NETHERLANDS	9	9.18	124	13.78	14
4 BRAZIL	7	7.14	146	20.86	4
5 ENGLAND	7	7.14	149	21.29	7
6 BELGIUM	6	6.12	157	26.17	20
7 ITALY	6	6.12	161	26.83	16
8 CANADA	5	5.10	346	69.20	9
9 GERMANY	5	5.10	136	27.20	9
10 ISRAEL	5	5.10	185	37.00	11
11 SWEDEN	5	5.10	175	35.00	6
12 TURKEY	5	5.10	13	2.60	4
13 SLOVENIA	3	3.06	16	5.33	9
14 SOUTH KOREA	3	3.06	32	10.67	7
15 SPAIN	3	3.06	56	18.67	5
16 TAIWAN	3	3.06	57	19.00	5

CN=Citation number; TLS=Total Link Strength

Co-Authors Network Analysis:

Collaborative network analysis helps to understand the dynamics and updates of the researchers about the subject (24). **Figure 4** presented the visualization of author collaborations. The authors were imaged with various colors and classified into different clusters. The obtained size of the circle was related to the number of documents published by co-authors. The larger the circle was the higher the number of documents was. Moreover, the lines linking the authors revealed that there was a collaborative

relationship between the authors. As a result of the bibliometric analysis, 10 clusters were obtained. The author who contributed the greatest to dual-task studies in physiotherapy was Nieuwboer (n=5). The studies of the author generally focused on the dual-task training she provided for the older individuals and individuals diagnosed with neurological diseases (25, 26). All dual-task studies of the author cited a total of 153 times and she was the author who had the strongest collaboration with the other authors (n=57).

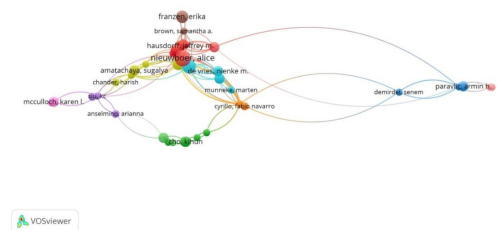


Figure 4: Co-authors network analysis

Keyword Co-Occurrence Analysis:

Keywords are important as the related terms in an article give the opportunity to quickly scan the objective, target, and method of the article (27). The co-occurrence of keywords can indicate semantic relationships in the scientific literature (28). Keyword co-occurrence occurs when two or more keywords appear in the same article at the same time (24). The keyword co-occurrence analysis aims to reveal the research subjects of a specific academic discipline and give an opinion to the reader about current theoretical tendencies and new subjects (29). The keywords with the same meaning were revised to increase the quality of analysis before performing the visualization for Keyword Co-Occurrence Analysis. The minimum occurrence number for a keyword was 5. The size of the circle in visualization revealed the total occurrence frequency of keywords in studies on dual-task in physiotherapy and rehabilitation. The larger size of the circle revealed that the subject of that research represented the related area more (30). The lines between the items showed the strength of the relationship between the keywords. The dual-task studies in Physiotherapy and Rehabilitation were classified into 3 different categories. The green group consisted of Multiple Sclerosis

and Parkinson's disease and the subjects of balance, falling, and exercise-related to these diseases; the red group consisted of aging and gait, physiotherapy, cognition, and accidental falling related to aging; and the blue group consisted of stroke and the subjects of dual-task, walking speed and rehabilitation related to stroke. The first 5 keywords with the highest occurrence rate (OR) and total link strength (TLS) were "gait" (OR: 32, TLS: 75), "physiotherapy" (OR: 29, TLS: 60), "Parkinson's disease" (OR: 21, TLS: 47), "rehabilitation" (OR: 19, TLS: 45), and "dual-task" (OR: 17, TLS: 44) respectively (**Figure 5**).

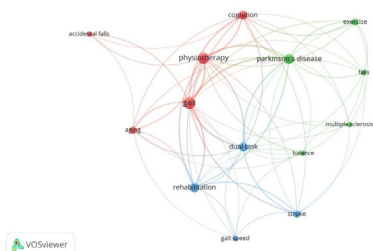


Figure 5: Keywords Co-occurrence of dual-task documents in physiotherapy

Analysis of Highly Cited Documents and Co-Citation:

Co-citation is defined as the citation of two documents by another document (31). Co-citation analysis involves tracking pair of articles that are cited together in the source articles and thus, research clusters of the studies on a specific subject start to form and can entirely map the structure of specialized research areas (31). This informs the researchers about the development tendencies of the subject (32). There are 9 documents cited by dual-task studies more than 10 times among 3757 cited resources. The size of the circles represented the frequency of documents that were co-cited and the links between the circles represented the relationship of the references. The most commonly referred document among the dual-task studies was the study of Folstein, Folstein, and McHugh (1975) on the Mini-Mental Test (33). The document with the highest link strength was the study performed by Silsupadol et al. on the effect of single and dual-task training on the balance performance in older adults (**Figure 6**) (34). The information about the ot-

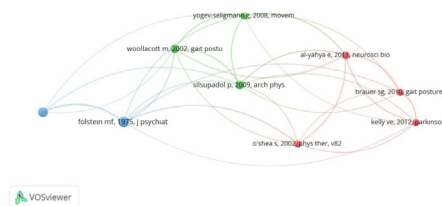


Figure 6: Highly Cited Documents and Co-citation

Table 2: Reference co-citation and total link strength of documents

Rank	Author/Year	Title	Source Title	CN	TLS
1	Folstein et al./1975 (33)	"Mini-mental state". A practical method for grading the cognitive state of patients for the clinician	Journal of psychiatric research	21	20
2	Podsiadlo and Richardson/1991 (35)	The timed "Up & Go": a test of basic functional mobility for frail elderly persons	Journal of the American Geriatrics Society	19	11
3	Silsupadol et al./2009 (34)	Effects of single-task versus dual-task training on balance performance in older adults: a double-blind, randomized controlled trial	Archives of Physical Medicine and Rehabilitation	14	22
4	Woollacott and Shumway-Cook/2002 (36)	Attention and the control of posture and gait: a review of an emerging area of research	Gait&Posture	14	17
5	Al-Yahya et al./2011 (37)	Cognitive motor interference while walking: a systematic review and meta-analysis	Neuroscience and Biobehavioral Reviews	12	20
6	Brauer and Morris/2010 (38)	Can people with Parkinson's disease improve dual tasking when walking?	Gait&Posture	10	15
7	Kelly, Eusterbrock, and Shumway-Cook/2012 (39)	A review of dual-task walking deficits in people with Parkinson's disease: motor and cognitive contributions, mechanisms, and clinical implications	Parkinson's Disease	10	14
8	O'Shea, Morris, and Iansek/2002 (40)	Dual Task Interference During Gait in People With Parkinson Disease: Effects of Motor Versus Cognitive Secondary Tasks	Physical Therapy	10	13
9	Yogev-Seligmann, Hausdorff, and Giladi/2008 (41)	The role of executive function and attention in gait	Movement Disorders	10	18

CN=Citation number; TLS=Total Link Strength

DISCUSSION

As a result of the study, it was observed that dual-task studies started to develop in the 20th century. Although they did not lose their popularity dual-task studies could not reach a sufficient number in the literature. The treatment options in physiotherapy and rehabilitation such as virtual reality, robotic rehabilitation, and telerehabilitation increased in the 21st century may reason this. Also, dual-task studies in literature methodologically differ and, the choice of two different tasks require conceptual planning and the experience to establish dual-task assessment or training (42, 43).

In the study, the USA is the country contributing to literature with the highest number of publications. Since most of the dual-task studies are performed on the older individuals, individuals diagnosed with neurological disease (stroke, Parkinson's disease, CP, MS, etc.) and in-

dividuals with cognitive disorders the increase in the older population density or incidence of cognitive and neurologic disorders may have directed the area of research to dual-task in countries publishing a high number of studies. Moreover, it is an expected condition that the USA has the leading role in scientific research due to its great financial resources and level of research efforts (24, 44). The USA hosts several national research institutes and these institutes create resources for scientific research (24). The greatest contribution as an author to the dual-task studies in physiotherapy and rehabilitation was by Nieuwboer. In addition, the studies of the author cited a considerable amount and her collaboration with the other authors was strong. The studies of the author focused on the dual-task training generally for older individuals and individuals diagnosed with neurological disease (25, 26).

Physiotherapy and Rehabilitation are the services provided by physiotherapists to improve, maintain and restore maximum mobility and functional ability for a lifetime in individuals (45). Therefore, cognition, gait and, balance that are effective in maintaining the daily life activities independently have often attracted the attention of physiotherapists as an area of research to increase the individuals' optimal function and quality of life (46, 47). In physiotherapy and rehabilitation, dual-task training is based on performing a cognitive task simultaneously with motor tasks such as balance or walking to improve gait and, balance and decrease the number of falling generally in Parkinson's disease, MS, and stroke in older individuals (48 - 50). According to the analysis, the keywords; 'gait', 'walking speed', 'falling', 'balance', 'cognition', 'aging', 'multiple sclerosis', 'Parkinson's disease, and 'stroke' were not surprising. The obtained result is a brief of trend areas used for the studies on dual-task literature.

The most commonly referred document among dual-task studies was the first study of Folstein et al. (1975) on the Standardized Mini-Mental Test (33). The Standardized Mini-Mental Test is commonly used in dual-task studies in physiotherapy and rehabilitation to assess general cognitive ability, practically.

The document with the highest link strength was the randomized controlled study by Silsupadol et al. (2009) who investigated the effect of single and dual-task training on balance performance in older adults (34). In this randomized controlled study, Silsupadol et al. (2009) directed the focused attention of the individuals to a task by adding fixed-priority and variable-priority instructions into the dual-task training and gave a different point of view to the researchers by providing a shift between the tasks. Therefore, most of the researchers were considered to refer to this study in their studies.

In conclusion, this study provided a bibliometric analysis of dual-task studies in physiotherapy and rehabilitation to guide researchers in future research. It is believed that there are severe gaps in the literature in terms of dual-task studies in physiotherapy and rehabilitation. The recommendation for researchers in future studies is to combine the dual-task training with different physiotherapy and rehabilitation methods (virtual reality, telerehabilitation, etc.) and perform the dual-task studies with different population groups.

Using only the WoS database for analysis and one software package for visualization were limitations of the study. Another limitation was that the classification of the studies assessed may have been affected by subjective comments although they were comprehensively classified.

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