Physical Activity in the Face of the COVID-19 Pandemic: Changes in Physical Activity Prevalence in Germany

Körperliche Aktivität während der COVID-19-Pandemie: Veränderungen in der Prävalenz körperlicher Aktivität in Deutschland

Summary

Problem: Physical activity (PA) is a vital component for promoting physical and mental health and for preventing disease. The COVID-19 pandemic has challenged populations from around the world on various levels to maintain and increase overall PA and subsequently led to a shift in physical activity and its health outcomes. This paper synthesizes the current literature on PA during the COVID-19 pandemic in the German population.

Methods: In a rapid review we identified 31 studies that examined PA behavior in children, adolescents, young adults and adults from Germany during the COVID-19 pandemic.

Results: Findings indicate predominantly a decline in PA among all age groups. PA levels in children and adolescents increased in a few studies predominantly during the first lockdown. Types of sports and intensities changed within the German population during the pandemic. Quality assessment of the included studies revealed a lack of adequately reported PA measures as well as a lack of sufficiently reported study results.

Conclusion: The COVID-19 pandemic led to lower PA levels overall in the German population. Furthermore, the PA inequality has been exacerbated. With the uncertainty of the duration of the pandemic, the continuous and cross-agency efforts of PA promotion across all population groups is key.

KEY WORDS: Exercise, Sport, Lockdown, SARS-CoV-2

Introduction

Regular physical activity (PA) is associated with numerous health benefits, including the prevention and control of physical, mental and social health issues: Strong evidence shows that, par example, regular PA lowers the risk for cardiovascular diseases, diabetes, as well as breast and colon cancer (18). Besides, it has been suggested that an active lifestyle across the lifespan lowers all-cause mortality risk, independent of geographical location, socioeconomic status, and genetic predisposition (31). PA is further associated with improved mental health (49) and increased life expectancy (30).

However, in 2012 researchers called out the pandemic of physical inactivity (25), which is responsible for 5.3 million deaths per year worldwide (31) and is threatening the global economy. Despite multi-

Zusammenfassung

Problem: Körperliche Aktivität ist eine wichtige Komponente zur Förderung der körperlichen und geistigen Gesundheit und zur Prävention von Krankheiten. Die COVID-19-Pandemie und die damit einhergehenden Eindämmungsmaßnahmen führten zu entscheidenden Veränderungen im täglichen Leben der Bevölkerung und veränderten damit auch das Bewegungsverhalten. Diese Arbeit fasst die aktuelle Literatur über die Veränderung der körperlichen Aktivität während der COVID-19-Pandemie in der deutschen Bevölkerung zusammen.

Methoden: In einem Rapid Review wurden insgesamt 31 Studien identifiziert, die das körperliche Aktivitätsverhalten von Kindern, Jugendlichen, jungen Erwachsenen und Erwachsenen aus Deutschland während der COVID-19-Pandemie (März 2020-Juli 2021) untersuchten.

Ergebnisse: Die Ergebnisse deuten überwiegend auf einen Rückgang der körperlichen Aktivität in allen Altersgruppen hin. Allerdings zeigte sich auch während des ersten Lockdowns eine Zunahme des Aktivitätsverhaltens insbesondere bei Kindern und Jugendlichen in einigen wenigen Studien an. Sportarten und Intensitäten versahen sich innerhalb der deutschen Bevölkerung während der Pandemie. Die Qualitätsbewertung der eingeschlossenen Studien ergab einen Mangel an adäquat berichteten gesicherter körperlicher Aktivität sowie unzureichender Berichterstattung der Studienergebnisse.

Schlussfolgerung: Die COVID-19 Pandemie hat zu einer Abnahme im Bewegungsverhalten in der deutschen Bevölkerung geführt. Angesichts der Unwissenheit über die Dauer der Pandemie sind anhaltende und behörden- und sektorenübergreifende Handlungen zur Förderung der körperlichen Aktivität in allen Bevölkerungsgruppen von entscheidender Bedeutung.

SCHLÜSSELWÖRTER: Trainieren, Sport, Lockdown, SARS-CoV-2

Regular physical activity (PA) is associated with numerous health benefits, including the prevention and control of physical, mental and social health issues: Strong evidence shows that, par example, regular PA lowers the risk for cardiovascular diseases, diabetes, as well as breast and colon cancer (18). Besides, it has been suggested that an active lifestyle across the lifespan lowers all-cause mortality risk, independent of geographical location, socioeconomic status, and genetic predisposition (31). PA is further associated with improved mental health (49) and increased life expectancy (30).

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Since January 2020, the outbreak of COVID-19 was declared a public health emergency and in March 2020, the outbreak of the virus was characterized as a pandemic (56). Many governments' immediate protective measurements aimed to halt, or at least slow down, the spread of the COVID-19 disease, which brought full or partial lockdowns of cities, travel bans and closed borders, social restrictions etc. (23). This drastic change in public and personal life brought changes to the population's lifestyle behavior. On many levels, the world population’s daily PA has been impaired for months, affecting the health of a significant portion of the global society. Understanding how the COVID-19 pandemic impacted PA and related non-communicable diseases (NCDs) is to be completely understood, but we now know that the inactivity pandemic is key in the global explosion of NCD’s that have tragically collided with the COVID-19 pandemic (21). Therefore, fighting the silent pandemic of physical inactivity and its health consequences is arguably one of the most pressing global public health challenges of the current and post-COVID-19 era.

Thus, the objective of this rapid review is to set the scene for PA changes of the German population in face of the COVID-19 pandemic. This review synthesizes empirical studies conducted in Germany.

### Methods

#### Study Design

This research includes a rapid review strategy based on the standardized procedure proposed by Seidler, Nußbaumer-Streit (50). A rapid review approach has been conducted as it is an appropriate way to address health-related questions that require rapid answers during the COVID-19 pandemic (50).

#### Eligibility Criteria

Studies were included in the current review if they met various inclusion criteria regarding outcome, population, and publication type and if exclusion criteria did not apply (table 1).

#### Search Strategy

The database search was performed on 19 May 2022 using the electronic databases Pubmed and Web of Science (with all the databases included in this platform). The search strategy was

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Table 1: Inclusion and exclusion criteria for the rapid review.

| INCLUSION CRITERIA | EXCLUSION CRITERIA |
|--------------------|--------------------|
| Study only focuses on physical activity behaviors during the pandemic without considering pre-pandemic behaviors (either prospective or retrospective) | Study focusing on sport club or fitness center membership rather than on physical activity behavior |
| Only participants with chronic diseases were included | Studies among competitive/professional athletes |
| In case of international studies: no separate data analyses/presentation of German participants is available | Commentaries/discussion papers not presenting original data |
| Empirical studies published in English or German language | Publication language other than German or English |

Table 2: Study characteristics.

| CHARACTERISTIC | INCLUDED STUDIES, N(%) | SOURCES |
|----------------|------------------------|---------|
| **PARTICIPANTS** | | |
| Children and adolescents | 8 (25.8%) | (20, 26, 29, 33, 46, 47, 48, 58) |
| Young adults | 6 (19.4%) | (8, 16, 19, 22, 40, 42) |
| Adults | 17 (54.8%) | (3, 5, 10, 12, 13, 27, 28, 32, 34, 35, 37, 38, 39, 45, 51, 53, 55) |
| **STUDY DESIGN** | | |
| Longitudinal study | 12 (38.7%) | (5, 10, 28, 29, 34, 37, 38, 46, 47, 48, 58) |
| Cross-sectional study | 19 (61.3%) | (3, 8, 12, 13, 16, 19, 20, 22, 26, 27, 32, 33, 35, 40, 42, 45, 51, 53, 54) |
| **PA INDICATOR** | | |
| WHO Guideline | 10 (32.3%) | (12, 13, 19, 32, 33, 46, 47, 48, 58) |
| Types of Sports | 4 (12.9%) | (16, 42, 51, 54) |
| Types of PA | 12 (38.7%) | (10, 12, 13, 28, 37, 38, 39, 45, 46, 47, 48, 58) |
| General PA | 10 (32.3%) | (3, 5, 8, 16, 19, 20, 27, 29, 33, 40) |
| Step counts | 1 (3.2%) | (22) |
| Reduction of PA | 1 (3.2%) | (26) |
| Duration and Quantity of PA | 3 (9.7%) | (22, 35, 51) |
| Inactivity | 2 (6.4%) | (29, 33) |
| PA intensity | 2 (6.4%) | (42, 53) |
| **MEASUREMENT METHOD** | | |
| Questionnaire | 31 (100%) | (2, 5, 8, 10, 12, 13, 16, 19, 20, 22, 26, 27, 28, 29, 32, 33, 34, 35, 37, 38, 39, 40, 42, 45, 46, 47, 48, 51, 53, 54, 58) |
| Smartphones | 1 (3.2%) | (22) |
| **SAMPLE SIZE** | | |
| <500 | 12 (38.7%) | (3, 16, 19, 20, 28, 29, 35, 42, 45, 51, 53, 54) |
| 500-999 | 4 (12.9%) | (12, 13, 32, 40) |
| 1000+ | 15 (48.4%) | (5, 8, 10, 22, 26, 27, 33, 34, 37, 38, 39, 46, 47, 48, 58) |
| **REGIONAL CONTEXT** | | |
| National representative | 11 (35.5%) | (10, 26, 32, 37, 38, 39, 42, 46, 47, 48, 58) |
| National | 8 (25.8%) | (8, 12, 13, 19, 27, 51, 53, 54) |
| Regional | 12 (38.7%) | (3, 5, 8, 16, 20, 22, 28, 29, 33, 34, 35, 40, 45) |
Results
A total of 335 potentially relevant articles were identified through database searches. After screening for titles and abstracts, full texts of 48 articles were retrieved for in-depth screening, 19 articles were excluded due to trivial aim of either the article, the statistical analysis, participants or other reasons, thus a total of 29 articles were identified as eligible and were included in this rapid review. Subsequently two additional publications were identified through hand search, yielding a total of 31 articles reporting on 23 unique studies included in this review (figure 1).

Characteristics of Included Studies
Overall, 23 projects, including 31 studies, were identified that investigated PA during the COVID-19 pandemic (March 2020-July 2021) in children and adolescents, young adults or adults from Germany (table 2) (table 3, 4, 5, see supplemental material online). Eight studies investigated PA changes in children and adolescents, six in young adults and thirteen in adults. PA indicators varied along the included studies, but the majority assessed WHO guideline compliance (N=10), types of PA (e.g., walking, gardening, outdoor play, unorganized PA) (N=12) or overall PA which was not described in greater detail (N=12).

Related to the study design, twelve studies assessed longitudinal data (5, 10, 28, 29, 34, 37, 39, 46, 47, 48, 58) whereas the majority of identified studies (N=19) were cross-sectional in nature and 17 studies used retrospective data for reference. The remaining two studies (32, 53) compared the assessed data during the pandemic with existing data from similar studies (pre-pandemic). The sample size ranged from 106 (28) to 5,021 (8). In 11 studies, the sample was rep-
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Evidence on Changes in PA Prevalence

Children and Adolescents

PA levels in children and adolescents increased during the first lockdown in Germany in the MoMo-Study (46, 48, 58) whereas the remaining 20 studies took place either across Germany (N=8) (8, 12, 13, 19, 27, 51, 53, 54) or in a regional context within Germany (N=12) (3, 5, 8, 16, 20, 22, 28, 29, 33, 34, 35, 40, 45).

Table 6

Quality assessment of the included studies (based on JBI Checklist for analytical cross sectional and prevalence studies (34)).

| SOURCE | AIMS/OBJECTIVES OF THE STUDY CLEARLY STATED? | MEASURE OUTCOMES (PA) CLEARLY DEFINED? | STATISTICAL RESULTS ADEQUATELY DOCUMENTED? | METHODS ADEQUATELY DOCUMENTED? | SCORE (YES=2; SOME CONCERNS=1; NO=0) |
|--------|------------------------------------------|--------------------------------------|------------------------------------------|-------------------------------|--------------------------------------|
| Brailovskaia, Truskauskaite-Kuneviciene (3) | Yes | Some concern | Some concerns | Yes | 8/10 |
| Brandl, Zimmermann (5) | Yes | Some concerns | Some concerns | Some concerns | 7/10 |
| Busse, Buck (8) | Yes | Yes | Some concerns | Yes | 8/10 |
| Engels, Mutz (10) | Yes | Yes | Yes | Yes | 9/10 |
| Fuezeki, Schroeder (12) | Some concerns | Some concerns | Yes | Yes | 6/10 |
| Fuezeki, Schroeder (13) | Some concerns | Some concerns | Yes | Yes | 7/10 |
| Giessing, Kannen (16) | Yes | Yes | Some concerns | Yes | 8/10 |
| Helbach and Stahlmann (19) | Yes | Yes | Some concerns | Yes | 9/10 |
| Hommes, van Loon (20) | Yes | No | No | Some concerns | 4/10 |
| Huber, Steffen (22) | Some concerns | No | Some concerns | Some concerns | 3/10 |
| Koletzko, Holzapfel (26) | Some concerns | No | No | Some concerns | 3/10 |
| Koopmann, Mueller (27) | Some concerns | No | Some concerns | Some concerns | 4/10 |
| Krist, Dornquast (28) | Yes | Some concerns | Some concerns | Yes | 8/10 |
| Kurz, Braig (29) | Yes | No | Some concerns | Yes | 7/10 |
| Maertl, De Bock (32) | Yes | Yes | Some concerns | Yes | 9/10 |
| Marchkoff, Siebald (33) | Yes | Yes | Some concerns | Some concerns | 8/10 |
| Mata, Wenz (34) | Yes | Yes | Some concerns | Yes | 9/10 |
| Mohtahedzadeh, Neumann (35) | Yes | Some concerns | Some concerns | Yes | 8/10 |
| Mutz and Gerke (37) | Yes | Yes | Yes | Yes | 9/10 |
| Mutz, Müller (38) | Yes | Yes | Yes | Yes | 10/10 |
| Mutz and Reimers (39) | Yes | Some concerns | Yes | Yes | 9/10 |
| Palmer, Schaden (40) | Yes | Some concerns | Some concerns | Yes | 7/10 |
| Pietsch, Linder (42) | Yes | Some concerns | Yes | Yes | 8/10 |
| Schlichtiger, Steffen (45) | Some concerns | Yes | Yes | Some concerns | 7/10 |
| Schmidt, Anedda (46) | Yes | Yes | Yes | Yes | 10/10 |
| Schmidt, Burchartz (47) | No | Yes | Some concerns | Yes | 5/10 |
| Schmidt, Burchartz (48) | Yes | Yes | Yes | Yes | 10/10 |
| Sonza, da Cunha de Sá-Caputo (51) | Some concerns | No | Some concerns | Some concerns | 5/10 |
| Tschuschke and Schröder (53) | Yes | Some concerns | Some concerns | Some concerns | 6/10 |
| Wendtland and Wicker (54) | Yes | Yes | Some concerns | Yes | 7/10 |
| Wunsch, Nigg (58) | Yes | Yes | Some concerns | Yes | 8/10 |

Evidence on Changes in PA Prevalence

Young adults

The change of compliance with the WHO guideline was assessed in one study for young adults and indicated a small decrease (37.4% to 36.8%) (19). A change in the types of sports has been observed, which is associated with a change towards types of sports that can be done without others (e.g., jogging, gymnastic and strength training at home, unorganized sports) (16, 42). Regarding PA intensities, the amount of PA with low and moderate intensities increased in this age group during the first and second lockdown (8, 42) (table 4, see supplemental material online).

Adults

Percentage of adults meeting the WHO guideline decreased since the onset of the pandemic (12, 13, 34). However, Maertl, De Bock (32) indicated an increase from 29.4% to 32.1% of adults achieving the PA recommendations. Overall, PA as well as the amount of PA in some types (e.g. walking, active travel, gardening...) decreased (10, 12, 13, 27, 28, 37, 38, 39, 45). Similar to trends observed in young adults, PA with lower intensities increased or did not change while PA with higher intensities decreased during pandemic in adults (5, 53). There was also a change in the types of...
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In addition to the quantitative changes in PA that occurred during the pandemic, one further aspect has been observed: there were changes regarding the way how people exercised during the pandemic. For example, Mutz, Muller (38) examined the use of digital media for home-based activities during the COVID-19 pandemic and found that 23% of adults in Germany having used digital media for sports activities at least once during the pandemic while public and private sports infrastructure were closed. A variety of digital exercise options were used, especially in younger, higher educated and financially better situated participants. People using digital tools to engage in exercise reported 30min/week more time in exercise activities during the pandemic compared to individuals who solely exercised without digital media.

Quality Assessment
The results of the standardized assessment of the methodological study quality using two standardized instruments is summarized and can be found in figure 2. The results of this evaluation show that 70.9% of the included studies (N=22 studies on PA behavior change) are lacking quality in two or more domains. Many studies had no clear description of the assessed PA (51.6%). In particular, it was not clear, what type or domain of PA (e.g. structured vs. unstructured) was investigated. Furthermore, studies lacked related to sufficient reported results by missing key statistical analysis such effect sizes, p-values or test-results. In 10/31 of the included studies statistical results were documented adequately and sufficiently. Overall, the sum score of the included studies reached a mean value of 7.1/10 points with the lowest quality in Huber, Steffen (22) and Koletzko, Holzapfel (26) with only 3 of 10 points. On the other hand, three studies had the highest possible sum score of 10 points (38, 46, 48) (table 6) (table 3, 4, 5, see supplemental material online).

Discussion
Since the onset of the COVID-19 pandemic, PA opportunities have been restricted for the majority of the population due to lockdown measures, including closures of sport grounds, sport clubs and schools, and the quarantine and social distancing measures implemented by many countries worldwide. Several reviews summarized the changes of PA from pre to during the lockdown in countries all over the world (4, 41, 52, 57). As restrictions to slow down the spread of the virus varied across the countries, it is challenging to compare the changes in PA levels (2). Thus, the aim of the present rapid review was to summarize the PA changes from pre to during the pandemic in the German population. This rapid review identified 31 suitable studies. The majority of these studies reported that PA declined during the first and second COVID-19 pandemic lockdown, regardless of the target population or the methodology used. Nevertheless, half of the studies with children and adolescents revealed increases in PA levels during the first lockdown (29, 46, 48, 58). This could be explained by the closure of kindergartens and schools resulting in more recreational time to engage in unorganized PA (43). Additionally, the first lockdown took place during spring in Germany. Coming from winter, rising temperature levels invited many to be physically active outdoors (14, 15). On the other hand, decreases of PA in children and adolescents can be explained by the closure of sports clubs and thus restricting one important opportunity to engage in PA (44). These contradictory findings could be transferred to different PA indicators that were measured as well as different time points of the COVID-19 pandemic. In (young) adults, data indicated predominantly a decrease of PA levels during the pandemic. This reduction of PA in (young) adults could be explained by the closure of sports club and other social restrictions.

Furthermore, data indicated a change in the types of sports people engaging in. In particular, an increase was seen in aero-bics, jogging, and strength training (16, 42, 51) with a shift from strengthening in a gym/sports club to strengthening on their own or with digital media (38, 42). Lockdown measures (especially the closure of sports clubs (44)) may be the reason for this change in types of sports. It seems that those types of sports flourished where no kind of equipment is needed and which can be done at home. For future pandemics, it would be helpful to advance the levels of digital exercise opportunities and make it accessible to all age groups.

Lastly, besides the change in the types of sports, included studies indicated a shift from high intensity to lower intensity, especially in young adults and adults (5, 8, 42, 53). This could be explained by the types of PA people engaged during the lockdown. Activities such as walking, bicycling and other light intensity activities tend to substitute high-intensity sport (37).

Taken together, included studies revealed predominantly a decline in PA from pre to during the COVID-19 pandemic in the German population with shifts in types of sports and intensities. Nevertheless, as our data extraction showed, PA indicators as well as the measured units or categories are quite...
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heterogeneous (e.g. WHO guideline, type of PA, type of sports, reduction/change of PA, intensity/frequency...). This heterogeneity makes it difficult to synthesize and compare the different findings. Despite this strong regional and methodological heterogeneity, our results seem to be in line with similar reviews including studies from around the world (4, 41, 52, 57).

Besides the methodological heterogeneity, included studies also differ vastly in quality assessment. This can also be seen in other reviews summarizing the changes of PA levels during the pandemic (4, 57). Especially, only one-third of included studies defined PA measure outcomes clearly, which could be responsible for the great heterogeneity in the used PA indicators in this rapid review. A clearer definition would help to narrow down few PA indicators.

Strengths and Limitations

The first strength of the present rapid review is the inclusion of studies investigating changes of PA levels from pre to during COVID-19 among all age groups (children, adolescents, young adults, as well as adults). A further strength of the study is that only data from Germany was included, which enables an analysis of changes in the German population that might be different to other populations. In addition, our rapid review included 12 longitudinal studies, which are more reliable to assess changes from pre to during the pandemic in Germany compared to retrospective data.

Nevertheless, this review has some limitations. First, the methodology used to measure PA were highly heterogeneous, making direct comparison of respective results difficult. Moreover, many studies used retrospective data for the pre COVID-19 data and thus, the accuracy of the reported data may be questionable. Another limitation is the representativeness of the included studies. Many of the studies were conducted in one region and thus are not representative for the German population. Lastly, we only included healthy participants and did not focus on vulnerable groups that might be particularly affected by the pandemic.

Conclusion

This rapid review aims to provide an overarching and holistic picture of PA prevalence changes in Germany during the COVID-19 pandemic from 2020-2021. The included studies revealed that PA levels predominantly decreased within the German population, even if few studies indicated an increase of PA levels in children and adolescents during the first lockdown. Overall, the COVID-19 pandemic seems to reinforce the existing PA inactivity among the population, also referred to as the pandemic of physical inactivity (24). Despite the lack of some quality criteria in the included studies, our conclusion is clear: for future pandemics, restriction policies need to be adapted. In particular, children as well as adults need to be provided sophisticated information about the importance of sufficiently PA especially in specific times of lockdowns. We now know that in times of self-isolation, physical and social restrictions, PA must receive higher priority by decisive stakeholders (e.g. policy makers, school teachers, employers etc.) so that further reductions in PA levels can be avoided and optimal health can be maintain or even enhanced. We suggest that a combination of the provision of PA opportunities for all, mass media campaigns on the health benefits of PA and multisectoral work is key in assisting the population maintain PA levels during future pandemics. Further research should focus on the influence of COVID-19 on PA levels among vulnerable groups, as these groups are neglected so far in existing reviews.

Conflict of Interest

The authors have no conflict of interest.

Acknowledgement

We acknowledge financial support by Deutsche Forschungsgemeinschaft and Friedrich-Alexander-Universität Erlangen-Nürnberg within the funding programme “Open Access Publication Funding”.

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Körperliche Aktivität während der COVID-19-Pandemie: Veränderungen in der Prävalenz körperlicher Aktivität in Deutschland

Physical Activity in the Face of the COVID-19 Pandemic: Changes in Physical Activity Prevalence in Germany

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Aufbau des Papers

Körperliche Aktivität ist eine wichtige Komponente zur Förderung der körperlichen und geistigen Gesundheit und zur Prävention von Krankheiten. Die COVID-19-Pandemie und die damit einhergehenden Maßnahmen führten zu entscheidenden Veränderungen im täglichen Leben der Bevölkerung und damit auch im Bewegungsverhalten. Diese Arbeit fasst die aktuelle Literatur über die Veränderung der körperlichen Aktivität während der COVID-19-Pandemie in der deutschen Bevölkerung zusammen.

Methodische Einschränkungen

Die verwendete Methodologie in den eingeschlossenen Studien war sehr heterogen, was einen direkten Vergleich der einzelnen Studien schwierig macht. Außerdem haben viele Studien retrospektiv die Pre-COVID-19 Aktivitätslevel erfasst, was die Genauigkeit der berichteten Daten etwas in Frage stellt. Viele eingeschlossene Studien sind außerdem eher regional und damit nicht repräsentativ für Deutschland.

Ergebnisse und Diskussion

Die Ergebnisse deuten überwiegend auf einen Rückgang der körperlichen Aktivität in allen Altersgruppen hin. Dieser Rückgang könnte durch die Schließung von Sportvereinen und anderen sozialen Einschränkungen erklärt werden. Allerdings zeigte sich auch während des ersten Lockdowns in wenigen Studien eine Zunahme des Aktivitätsverhaltens, insbesondere bei Kindern und Jugendlichen. Dies könnte auf die vermehrte Freizeit aufgrund von Schul- und Kindergartenschließungen zurückzuführen sein. Außerdem veränderten sich Sportarten und Intensitäten während der Pandemie. Die Qualitätsbewertung der eingeschlossenen Studien ergab einen Mangel an adäquat berichteter gemesener körperlicher Aktivität sowie unzureichende Berichterstattung der Studienergebnisse.

Was ist neu und relevant?

Die Übersichtsarbeit zeigt die Veränderungen der körperlichen Aktivität bei Kindern, Jugendlichen und (jungen) Erwachsenen in Deutschland im Verlauf der COVID-19 Pandemie auf.

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