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Protocol

Becoming more active: A protocol for assessing and supporting physical activity in special schools for students with intellectual disabilities

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Abstract: The goal of this study is to support and evaluate the process of developing a school into becoming a more active school, particularly for children with intellectual disabilities (ID). This study protocol outlines the first phase of a broader school development project aimed at promoting physical activity (PA) and health among students with ID. The intervention, conducted at one school, uses a structured action cycle facilitated by a coordination group consisting of school staff, university consultants and students. Over a three-year period (2023-2026), various strategies are participatively elaborated and implemented to increase daily physical activity. To measure the impact, motor skills are assessed using the German-Motor-Test, while physical activity is monitored with Move-4 Accelerometers, capturing steps per minute during school hours. In the pre-test phase, 240 students participated in motor skill assessments, and 137 wore accelerometers for a day. Findings showed that 57% of students were overweight, highlighting the need for targeted interventions. Data analysis includes Z-scores and comparisons of activity levels during different school periods. Despite challenges, such as staff shortages and logistical difficulties, the intervention aims to create a sustainable model for increasing activity. This research will culminate in recommendations and guidelines to help other schools implement similar processes, with final results published in 2026 to contribute to evidence-based practices for promoting active school environments. While the current protocol emphasizes in-school activity, future phases will expand to include structured observation, stakeholder participation, and community-based interventions. This protocol provides a scientifically grounded foundation for assessing needs and guiding sustainable PA promotion in special education settings.

Keywords: school development; action research; motor skills

Introduction

Regular physical activity is crucial for children with intellectual and developmental disabilities (ID) to maintain good health, acquire motor skills, and enhance overall well-being (Franssen et al., 2018; Murphy & Carbone, 2008; Wouters et al., 2018; Wouters et al., 2019). Despite these benefits, children with ID often have lower fitness levels and higher obesity rates than their typically developing peers (Murphy & Carbone, 2008). There is a broad number of studies that measured physical activity of children during school (Brusseau & Hannon, 2013). While people with ID are often neglected in such research regarding

activity and health some studies show that only 19-47% of children with ID meet recommended physical activity guidelines (Fox et al., 2019; Wouters et al., 2018). To improve overall health, participation in structured physical activity programs can significantly improve aerobic capacity, muscular strength, and endurance in children with ID (Collins & Staples, 2017). Factors such as low motor development, age, functionality and ID are associated with lower physical activity levels (Fox et al., 2019; Wouters et al., 2018). To address these challenges, healthcare professionals, families, schools and caregivers should focus on supporting and motivating children with ID to explore and expand their physical activities (Murphy & Carbone, 2008; Wouters et al., 2018).

To increase their everyday activity as recommended (Kapsal, 2019) it is important to see, where these children spend most of their time. In Bavaria, Germany, where the study took place, 91,94% of students with a diagnosed ID visited a special school in the schoolyear 2022/23 (Bayerisches Staatsministerium für Unterricht und Kultus, 2023). 80,8% of these students with ID in special schools visit school in the morning and stay there till 15:30 in all day cares (Dworschak & Selmayr, 2021). Adding the time of transport to and from school, a lot of the daytime is determined by the institutional circumstances (Kehne, 2011). Data from a randomized, meaningful study collected at special schools in Bavaria showed very different abilities of children with ID regarding the overall motor and movement skills and the ability to move independently which often leads to limitations in reference to the overall physical activity (Baumann et al., 2021; Müller & Dinter, 2020). 75% have no problems regarding their motor skills when walking while 25% of children with ID show limited movement capabilities with 2% using some sort of walking aid and 9% using a wheelchair. But this data was collected via the external assessment of teachers. Their individual needs often require physical care during school and day-care time. Numbers in Bavaria show that only 34% of individuals with ID have no need of physical care from other people. 25% need 0-30 minutes of physical care, 15% 30-90 minutes, 8% 90-180 minutes and 7,5% spend more than 3 hours during a school day in physical care situations (Wagner et al., 2021, p. 175). These numbers indicate that the individual needs in regards of physical health restrict the time spent being physically active and highlight the importance of specific interventions promoting a healthier lifestyle and activity pattern. The motor skills of individuals with ID have not yet been comprehensively assessed in Germany and represent a research desideratum.

However, meta-analyses showed that interventions addressing this subject only led to moderate or no effects regarding to the physical activity of children and young people with ID (McGarty et al., 2018). Also, it was shown that the effects decreased as soon as the interventions stopped (Borland et al., 2022). Borland also defines the often-missing executive functions of children with ID as one of the main reasons for part-time interventions and programs not being effective long term. Thus, it seems more promising to follow a systemic approach to create an environment for these young people which is more conducive to physical activity (Haveman & Stöppler, 2014).

To approach the needs of children with ID in institutions is particularly important, because this group is underrepresented in sports clubs outside of school. Some research show that only 21% of children with ID are part of a leisure club in Germany and Sports clubs also have less connection to special schools compared to regular schools (Hauck, 2020) which marks the importance of developing more cooperation between institutions for children with ID and sports clubs. When asked about how inclusive sports clubs are, only 7% of clubs noted, that they have offers specialized for people with disabilities (Breuer & Feiler, 2022).

These are all arguments in favor of including the individual needs regarding support needs and external help for children with ID to develop a more inclusive health improving environment at schools and the additional all-day cares. Although school is one of the first

settings where all children and young people with an ID can easily be reached, until now a systematic approach in these institutions has rarely been used to increase everyday physical activity in Germany (Walther & Römisch, 2019). A reason could be the lack of scientific research regarding children with ID and the heterogenous requirements that interventions with the goal of better and more physical activity need to meet.

Review of literature

Students with ID

Individuals with ID are a group of people who require special attention in all contexts of life, specifically in the health area. The International Classification of Functioning, Disability and Health (ICF) provides a basis and framework for "understanding and studying health and health-related states, outcomes and determinants" (WHO 2001, p. 5) of people with ID. It also offers an alternative view on disability and ID compared to the more medically and psychologically oriented diagnostic instruments like the ICD-11 or the DSM-5 (Clark et al., 2017; World Health Organization, 2019). According to the ICF, disability must be understood as a consequence of an individual's confrontation of his or her individual conditions with a specific environment rather than an illness or impairment itself. Therefore, it is important to include the strengths of a person when individual support plans are created and implemented. As a result, the responsible people and institutions are faced with the task of meeting individual support needs. This refers to a "pattern and intensity of supports that are necessary for a person when it comes to participating in typical activities" (Verdugo et al., 2020, p. 1).

The support needs for special (health-)care increases with the severity of the ID (Kroschewski & Baumann, 2021), which is reflected in the duration of care and the extent of support required in daily life. The assessment of support needs is unique for every individual with ID. Generally speaking people with severe or profound mental retardation have a lifelong need of support because of "limitations in self-care, continence, communication and mobility" (World Health Organization, 2019). In Bavaria, Germany, a study conducted, that 59% of students have a mild, 23% a moderate and 12,6% a severe or profound kind of ID, according to the classification of the ICD-10 (Wagner, 2021) which showcases the need of planning and assessing individual health-care support.

School system in Bavaria for children with ID

Despite the Convention on the Rights of Persons with Disabilities (UN-CRPD; United Nations, 2006), where the participating nations agreed on implementing a more inclusive school system, the commitment to develop such change in Bavaria has had little success so far for children with ID. This is shown by the number of 91,2% of children with ID still visiting a special school for children with ID. 7,6% visit other special schools and only 1,2% are included in a regular school (Bayerisches Staatsministerium für Unterricht und Kultus, 2023; Dworschak & Selmayr, 2021). The law regarding the school education in Bavaria, BayEUG (Bayerische Staatskanzlei, 2000) also declared in 2011, that the realization of the demands made by the UN-CRPD shall be realized and that all schools are tasked with the implementation. So far, the demands in both documents have not had much effect. Therefore, children with ID are excluded in many areas of daily living, especially regarding the school system. The study conducted in Bavaria by Baumann et al. (2021) also highlighted that the rate of inclusion decreases with the degree of severity.

The Bavarian special schools for children with ID offer the possibility of all day-care where children can stay after school hours. Educated and skilled personal provides care and support for groups and 80% of children and families use this service (Dworschak & Selmayr, 2021). The fact that most of the children with ID spend a large part of their day in school and

the all day-care shows the importance of creating an environment that focuses on health as well as on education. Especially because individuals with ID are more vulnerable when it comes to physical and mental health (Bruland et al., 2023; World Health Organization, 2010), the school system needs to continuously develop and provide a systematic health-care approach to counteract the lower levels of health-related physical fitness of students with ID (Collins & Staples, 2017). Many concepts, guidelines and programs for becoming a more active school already exist (Laging, 2017; Rütten & Pfeifer, 2017; Thiel & Teubert, 2018) with instructions and suggestions for how to promote physical activity. In addition authors like Müller & Dinter worked on the question of adapting existing concepts for students with special needs in general and also specifically for children with ID (Müller & Dinter, 2020).

Physical activity and motor skills in students with ID

Physical activity includes "any bodily movement produced by skeletal muscles that expends energy" (Powell et al., 2011, p. 351) and plays an important part in many areas of life and regarding motor skills (Möller et al., 2021). Furthermore, integrating physical activity in daily-living provides substantial health benefits for every individual, "including reductions in risk for a variety of diseases and improvements in functional ability" (Powell et al., 2011, p. 351). On the other hand sedentary behavior corelates with obesity and health risks (Banzer, 2016; Einarsson et al., 2016). Organizations like the WHO published international guidelines, as well as many nations having national recommendations for physical activity to sustain a healthy lifestyle (Rütten & Pfeifer, 2017; World Health Organization, 2010). Children at the age of 5-17 should therefore include at least 60 minutes of moderate to vigorous physical activity (MVPA) daily and additionally muscle and bone strengthening activities at least 3 times a week (World Health Organization, 2010).

Less and less children meet these guidelines and the amount of sedentary behavior increases (Möller et al., 2021). Children with ID additionally face various risks of being hindered in their daily physical activity. They are also shown to be less active then children and peers without ID during and after school in national and international studies (Bundesministerium für Arbeit und Soziales, 2016; Einarsson et al., 2016). Obstacles and barriers can occur in many areas, one being the need of physical care of many children with ID. In German students with ID, 17,5% spend more than 3 hours in physical care each day during school (Wagner et al., 2021) which limits the amount of time spend being physically active. While most students with ID can move without limitations, 21,5% use either a wheelchair, electronic wheelchair or other kinds of support items (Kroschewski & Baumann, 2021) which can have an effect on the individual physical activity.

Physical activity is important in many areas of a school day and can be found in different ways of transportation to and from school and in between lessons and breaks, in time being active during lessons or in Physical Education. Children with ID also depend more on their schools than children without ID when it comes to increasing the physical activity, one reason being the amount of time spend in school and all day-care (Einarsson et al., 2016). To improve the amount of activity it is therefore important to take all the different aspects of physical activity during school hours into consideration (Laging, 2017; Rütten & Pfeifer, 2017) when creating guidelines or methods.

Motor skills in general are important for many aspects of human development and daily functioning and are closely linked to physical activity and health (Bardid et al., 2019; Logan et al., 2018; Nagy et al., 2023). They "promote mobility, coordination, posture and balance" and include basic skills like walking, running and jumping as well as more complex motor activities (Möller et al., 2021, 2) and greatly determine the individual physical abilities. Studies suggest that the connections between the motor and cognitive development are more

significant in children with ID which highlights the importance of research in this population (Houwen et al., 2016; Westendorp et al., 2011).

Measuring and analyzing physical activity and motor skills

To measure the actual physical activity and enable comparisons between studies, the use of accelerometers has proven to be a valid and objective method (Rosenbaum, 2012) in scientific studies. It became the main method compared to more subjective methods such as questionnaires and/or observations. These devices detect the acceleration of the body and can capture different parameters like intensity, frequence and duration etc. to determine the physical activity and to characterize motor skills of an individual person (Bardid et al., 2019; Leung et al., 2017). To compare and assess levels of physical activity between participants and with the guidelines of health-related physical activity, the amount of time spent doing moderate to vigorous physical activity (MVPA) is an important parameter which can be determined using accelerometers. Another indicator regarding health-related physical activity is the number of steps that are made per day or during specific periods of time, like school lessons, PE or being at home. The WHO recommends at least 11000-11700 steps per day depending on age and sex for children and adolescents (Rütten & Pfeifer, 2017) to meet the minimum amount of daily physical activity and to prevent negative health-outcomes.

To be able to analyse the physical activity pattern of an individual, the person should wear an accelerometer a couple of days continuously to increase the reliability (Rosenbaum, 2012). Otherwise, substantial influential factors can cloud the actual average physical activity of the tested person. When measuring steps, the best place to position the device is the hip and waist (Boerema et al., 2014; Leung et al., 2017) where the accelerometers can either be attached onto the pants or be worn around the waist using a specific belt. To get the results of accelerometers specific software is needed most of the times.

To identify children with motor deficiencies is a big part of educational testing and to measure motor skills and possible delay in the development it is important to use evaluated assessment methods and tests (Bardid et al., 2019; Scheuer et al., 2019). It also allows to identify strengths and weaknesses and to use the information to derive individual support measures (Nagy et al., 2023). The choice of test or instrument depends on factors like target population, the purpose of the study, or circumstances like time and resources, because testing participants with motor tests takes time, dedicated equipment and costs a lot of money (Bardid et al., 2019). Observation methods are one category of test formats used in studies to measure motor skills. These tests "involve an individual systematically viewing and recording a participant's performance in a set of motor skill tasks" (p. 315). They also depend on the theoretical construct of the test (Scheuer et al., 2019). Goals can be "diagnosis, monitoring, development of motor functions and impact research" (p. 1098) and different tests are reviewed by Scheuer et al. It is important to follow the guidelines and procedures of each test to guarantee the tests efficiency.

Systematic inclusive school development with the Index of Inclusion

For this study the Index for Inclusion serves as a template for the development of a more active inclusive school concept. This approach was mainly developed by Booth and Ainscow and consists of 3 dimensions: "creating inclusive cultures, producing inclusive policies, evolving inclusive practices" (Booth & Ainscow, 2002). These dimensions are further divided into different sections that enable to accurately analyse the current status quo. 5 steps then provide a guideline for conducting and promoting more inclusive structures: "1. Getting started with the index 2. Finding out about the school 3. Producing an inclusive school development plan 4. Implementing priorities 5. Reviewing the Index process" (2002, p. 10). Following this approach, an inclusion coordination team should always be implemented and

be responsible for the process and students should be included to conduct participatory research. The introduction of a coordination team guarantees a sustainable future to ensure that the school development keeps on going. This is especially important because studies have found that the success of interventions for the population of people with ID quickly decreases after specific methods and structures are taken away again after successfully being implemented (Borland et al., 2022).Health cycle and implementation of interventions in health-related areas

People with disabilities are more vulnerable in regard to health issues and the number of barriers and therefore more dependent on systematic health structures (Eisenberg et al., 2015). Numerous studies deal with the question of a systematic approach and evaluate methods and strategies, one being the "Public Health Action Cycle" (PHAC) (Habermann-Horstmeier, 2019; Hartung & Rosenbrock, 2022; Egger et al., 2021). This model consists of 4 stages: "1. Defining the problematic areas 2. Developing strategies 3. Carry out the strategies and 4. Evaluate the process and the results". When one cycle is completed the defining of problematic areas starts again. The method typically involves four key domains: epidemiology and surveillance, environmental approaches, health care system interventions, and community programs linked to clinical services (Park et al., 2017). Schools play a viable role in promoting possible health outcomes (Kolbe, 2019) and the PHAC can be used to instruct systematic change. Lacunes in scientific research

Despite the importance of systematic health approaches and the fact that schools provide a suitable basis for interventions, health programs in schools are not widely used (Benzian et al., 2012). Schools are also not commonly used to assess and address physical activity of children, even if students spend a great part of their time in school sedentary. Even less studies are concerned with the question of how physical active children with ID are and why and how they participate in sports and in physical activity (Einarsson et al., 2016). This study can help to explore the school development of special schools in becoming more active, the physical activity of students with ID during schools and wants to close the gap in health-related physical activity in children with ID. Research question and Aims and Objectives

This study aims to evaluate how the school system can develop into an inclusive, active school and what impact this more physical activity-friendly environment has on students. This should ultimately result in recommendations for the development of other schools. The first step is to examine the physical activity and motor skills of students with ID and to compare the results to other studies and scientific findings. The results of the study will also allow to compare the movement and physical activity of children with ID to children and adolescents without ID in other forms of school and fill the gap that can be found in today's research and studies in Germany. Data from this survey can form the basis for the political discussion on the need to improve participation in exercise programs and promote an active lifestyle for people with ID.

In this study, the evaluation of the results includes the measurement of everyday physical activity at school (pre-post-test-design) by means of pedometers (Beets & Pitetti, 2011; Brusseau & Hannon, 2013) and the German Motor Test (Deutscher-Motorik-Test, DMT; Bös, 2017), which is *the* standardized test battery in Germany for measuring the physical fitness of 6 to 18-year-old young people.

The schools will be split with one school undergoing a systematic change by forming a control committee and implementing more activity and one school not developing any specific concepts to promote physical activity. Due to this design comparisons between the development of the level of activity of the children the success of a systematic approach can be determined. Further the activity-profiles of these two schools can be compared to each

other which could allow conclusions regarding similar and/or different influence factors. The following questions and hypothesis shall encompass the goals:

1. Motor skills and daily physical activity:
   How do the overall physical fitness level and general motor skills of the children with ID in comparison to each other and to the sampling group of the DMT (Bös, 2017; Bös & Schlenker, op. 2011)? Are there any differences when split into groups like age, classes, what school they are going to, or the general IQ?
2. Evaluation of the implementation process of an (active) inclusive school program:
   Which processes can be successful for developing a school for children with ID? How can all school members participate during this process? What challenges and facilitators arise during the process of integrating this inclusive program within the existing school infrastructure?
3. Systematizing the process for future programs:
   What are the key components and best practices identified during the implementation process that can be systematized for the development of future inclusive school programs? How can the program's structure be optimized to ensure scalability and adaptability across various school environments for children with ID?
4. Effect evaluation:
   What are the measurable changes in the motor skills of children with ID following the implementation of the inclusive school program (post-test) compared to the pre-test? Does the intervention lead to significant improvements in motor skills and improve the amount of daily physical activity?
5. Impact on school climate and community:
   What are the effects of the interventions on the overall school climate, including the interactions between pupils and teachers, as well as the perception of inclusivity among the school community? How does the inclusive school program impact the wellbeing, engagement, and social dynamics of both students with mental ID and educators? Are there changes in how lessons are organized, and does it affect the effectiveness of teaching?

These research questions are designed to assess both the process and outcomes of implementing a systematic inclusive school program, with a focus on physical health, school climate, and the potential for future replication and scaling of the intervention.

Materials and Methods

The study in general initiated and supported the development of a school in Bavaria, Germany to an ‘active school’ by means of a community-based participatory research design. This research protocol presents Phase 1 of a long-term, participatory school development project. The current phase focused on the assessment of baseline physical activity and motor skills among students with ID and the overarching aim was to support special schools in becoming more conducive to physical activity and health promotion.

This means working out and implementing a school concept in best case with *all* members of the school family (including students). But there is a lack of science reports about participatory research with children or youths with ID. With reference to Habermann-Horstmeier`s Public Health Action Cycle (Habermann-Horstmeier, 2019) the participatory development of schools continuously addresses the working steps of (1) defining the problem, (2) formulating goal(s) and strategies and (3) implementing and evaluating processes and results. Because of the participatory method this is an open and not predictable process. To monitor and supervise the systematic process we use audio recordings and notes of the project meetings, a project diary and to involve the students e.g.

adapted questionnaires. The data will be evaluated by using content analysis (Kuckartz & Rädiker, 2022). This can provide guidance and help for other schools wanting to integrate more physical activity into their everyday school culture.

Population and participants

All the children going to the two schools in this study have an ID, diagnosed with psychological and medical tests and measurements, and described in an expert report. These are necessary steps before children are assigned to a special needs school in Bavaria, Germany. Because both schools are in Bavaria, Germany the overall population of both schools can be described using the SFGE-II study (Baumann et al., 2021), where teachers filled in questionaries regarding various characteristics of their students such as categories of different diagnosis and forms of ID, communicative and motor skills, or practical abilities etc. Whilst the measurement of any form of IQ can be criticized, possible connections could be discovered by correlating the IQ with different results of the study. For the study, the students do not have to be subjected to a separate IQ test; instead, the IQ data available in the pupils' files can be used. The authorization of the school supervisory board has been obtained for the study. Only pupils whose parents have given their consent for the tests are included in the study. All student data is documented, stored and published in pseudonymized form. The individuals that took part in the pre-test would not necessarily be the same to those participating in the post-test, but the results can be used to compare the average motor skills and physical activity of the children at both times.

Schools

For anonymous reasons, the schools were pseudonymized. Both schools have a main building, a gym, a swimming pool and an outdoor area with sports facilities and various playgrounds. Two classes of school A (5 and 6) are permanently outsourced to a nearby secondary school with 850 individuals. The classes there use the rooms and sports halls of the secondary school, but commute to the school's main building by subway for certain occasions. Four elementary classes of school A are in the building of a regular elementary school, and these 6 classes are schooled using a so-called partner-class-system. This is a form of inclusive cooperation with another school (Heimlich et al., 2016). The classes 10-12 of both schools are also located in a building complex near the main building. The schools are in two different Bavarian cities (with at least 130,000 residents) and the individuals can therefore be described using the findings of the SFGE-II study (Baumann et al., 2021) when referring to the diagnosis, the ID, or the care requirements. Both schools also have nearby facilities, that are specialized for children with motor disabilities, which also impacts the characteristics of the students at both schools regarding time of care, the quantity of children with severe or profound ID and the needs and requirements of the schools.

Process evaluation of the school development

For the evaluation of the systematic school development the “Public Health Action Cycle” (Habermann-Horstmeier, 2023) is used to guide, determine and describe the progress. This method helps to structure the procedure and guarantees a valid basis for the scientific analysis of the systematic approach. It also helps to define the needs and goals of the school and to weigh the different aims and objectives against each other. It is a well-known and used method in the scientific health-sector (Egger et al., 2018).

Effect evaluation using German motor test

In this study, the evaluation of the results includes the measurement of everyday physical activity at school (pre-post-test-design) by means of accelerometers and the German Motor Test DMT (Bös, 2017). The DMT, developed in response to concerns about

declining motor skills in children and adolescents, is a standardized battery designed to assess physical fitness in individuals aged 6 to 18 years. The DMT measures key motor abilities: endurance, strength, speed, coordination, and flexibility. The test consists of eight tasks: 1. 6-Minute Endurance Run 2. 20-Meter Sprint 3. Standing Long Jump (leg strength) 4. Backward Balancing 5. Push-Ups (40 seconds) 6. Side-to-Side Jumping 7. Sit-Ups (40 seconds) 8. Forward Bend (flexibility). Several tasks required to be adapted because of the specific needs of some children. The balancing-task, push-up task and the sit-up task could be done using an easier form from the Test Battery for Measuring Motor Performance of Preschool Children MoTB 3-7 (Krombholz, 2010). Body measurements such as height and weight were also recorded. Using these measurements the DMT software automatically calculated the BMI of every individual using the juvenile percentiles as a basis. The DMT is validated for use in schools and sports clubs and is suitable for evaluating current motor abilities, identifying strengths and weaknesses, tracking changes over time, and assessing the impact of interventions. The test is easy to conduct, requiring one trained supervisor and several assistants, and can evaluate up to 28 participants in 90 minutes. Normative data is available for boys and girls aged 6 to 17 (n = 4529), ensuring reliable comparisons. The DMT's objective and valid results are crucial for screening motor competence and evaluating physical activity interventions (Bös, 2017). The test results also allow differentiating the overall motoric skills into categories of speed, strength, endurance, and mobility and analysing eventual correlations can give further insights.

Because of the preconditions of some children, four teams of two supervisors tested smaller groups of children at once in the gymnastics halls of the schools. 3 slots of 90 minutes are available each day of the test weeks and a schedule should be released beforehand to ensure that the classes are ready for testing at the right time slots.

Before the pre-test was conducted, one class of school A took part in a pilot-study in March 2021, where a team of students from the University of Wuerzburg tested the execution of the DMT and the adaptations of specific tasks on 12 individuals. Because of these experiences three exercises had to be adapted because of their complexity. Otherwise, a lot of children would not have been able to perform the tasks. The sheets were adapted accordingly for the additional tasks and rules were set for when to perform them. The original task always must be tried first and only when zero reps are possible the participant is shown the adapted version. If the original push-up-task with the additional hand and body movements isn't possible to carry out, the children could do plain push-ups while being on their knees. In case of not being able to complete the sit-up-task the alternative is to lay on the back, put the hands on the thighs and push the body up from the ground until the hands reach the knee.

Effect evaluation using Accelerometers

The Move-4 Accelerometers, developed by Movisens (https://www.movisens.com/de/produkte/aktivitaetssensor/), are advanced motion sensors designed for precise measurement of physical activity and movement patterns. It measures acceleration across three planes (x, y, z), enabling a comprehensive analysis of movement in all directions. This allows for the detection of various activities and movements such as walking, running, standing, and sitting. These devices are widely used in research and clinical settings due to their high accuracy and flexibility in data collection, particularly in monitoring activity levels in children, adults, and special populations, such as individuals with disabilities (Rosenbaum, 2012). In school-based or intervention studies, such as those involving children with mental disabilities, the Move-4 accelerometers can accurately capture daily movement patterns and correlate these with health outcomes, such as improvements in physical fitness or motor skills.

Test-Process

The process of school development, using the action cycle as a template, started in the summer of 2023 at school B (intervention-school) after the pre-tests took place in February. A set timeline for the school development does not exist on purpose and the duration is not fixed and will depend on the progress and the goals of the school and the coordination team. This group consists of the principal, teachers, other staff from the day-care of the school, people from the university and students.

The pre-testing took place in the school year 2022-23 and the post-test will take place in school year 2025-26. The distance between both test dates will be similar. The process for testing all participants that were authorized to be tested lasts one week for each school. The supervisors who lead the children through the DMT are trained beforehand in carrying out the tasks with the participants and collecting the data. The DMT is set up in the gymnastics of the respective schools. The supervisors note the results on individual sheets specified for the DMT. When the adapted tasks are used, the number of reps on the original tasks are noted as 0 while the number of the adaptions could be noted on the sheet as well (Bös, 2016).

To also measure everyday physical activity, an activity sensor is attached to the individuals with a hip belt. This makes it comfortable to wear and keeps the sensors in the right place (Boerema, van Velsen, Schaake, Tönis & Hermens, 2014). Most important for this study were the measurements of the number of steps the children took between 8:30 and 12:00 o`clock, the timespan of the school day. This way physical activity can be measured and compared to other studies, scientific recommendations and between different groups and classes of this study. To be able to make accurate claims, the total amount of steps was used to get the average steps per minute for different time periods (lessons 1, break, lessons 2). Therefore, assumptions are possible when using the results to describe the change in physical activity throughout the school day and on how different contributing factors influence the children´s movement.

Collecting and Analyzing the Data

The coordination-group meets irregularly in school B to discuss the state of the process and plan further steps. The meetings are planned by the school. The university has more of a consulting role. To evaluate and further analyse the school development in becoming a more active school, the meetings of the coordination-group are recorded. Furthermore, questionaries are used to collect data from variant groups, such as teachers, other schools and day-care staff and students. The student administration group is also involved in the process. This group of elected students meets regularly to discuss relevant topics, such as their role in becoming a more active school. To assess the impact on school life, the atmosphere and the satisfaction of teachers and individuals, school staff are surveyed both during and after the project period using online questionnaires.

To analyse the test with the DMT, the raw values from the protocol sheets are entered into the software available on the DMT (Bös, 2016) website. The results can then be sampled into different classes and groups and be compared. Z-scores show the overall motoric and fitness level compared to the official sampling group while T-scores allow to differentiate between the different tasks and fitness and motoric-categories. The minimum and maximum possible test-scores are 70 and 130. Everything under or above these scores will be cut off there. This means that it is not possible to precisely differentiate the scores of participants having a Z-score of less than 70 using only the official program of the DMT. It is therefore necessary to calculate the value of the individual scores of these participants by hand using the following formula: $z = (x-\mu)/\sigma$. This way it will be possible to make exact conclusions and comparisons including all final scores of the participants, which is especially

important for this population, because many of the students had results of Z=70 or less. Resulting extremely below-average values below 55 are set to the value of 55, as no differentiation of the test is expected after the third standard deviation.

The processed data of the DMT is further collected and processed using the programs Excel and IBM SPSS Statistics (Version 28.0.1.1). Several questionnaires, as described within the research questions, are set to specify the needs of sampling the data accordingly. This way it will be possible to compare the results of different age groups and classes, the schools as a whole or to differentiate between the sexes or the kind of Intellectual disability. Standardized methods of analysing the data are used to ensure scientific accuracy (Arithmetic mean, standard deviation, maximum and minimum results, t-test) and the effect of the size of different groups are always considered regarding the significance of the results (Rasch et al., 2021). The processed data of the DMT is further collected and processed using the programs Excel and the statistical program SPSS.

The results of the accelerometers were processed similarly. Creating charts helps visualize the comparison of the individual number of steps made throughout the school day. An important step is to note the exact time of the breaks of all the classes. Only this way can the distinction between physical activity during lessons and breaks be analysed precisely. The number of steps per minute can then be summed up to an average steps per minute for the following categories: lesson 1, break 1, lesson 2, break 2 (if relevant), lessons overall, breaks overall and overall steps per minute for the entire period. This allowed for the comparison between the physical activity of children during lessons and breaks that were not the same length.

The pre-and post-tests of this study are laid out in a cross-section design, but because of the analyzation and the comparison of the development of motor skills, the physical activity and progress and process of the school development, it is also a longitudinal study. The findings of the pre-test can be compared to results of the post-test multiple ways. First, the results of both tests allowed us to generate statements of the development of both schools separately and in comparison, with each other using the DMT and the accelerometers. This way possible changes of motor skills and physical activity can be found and analysed. Second the Codes that are generated to anonymize the students can be used to compare the individual progress of students who took part in both the pre- and the post-test. Data of the BMI can give further information about the impact of the interventions on possible health-factors.

The testing of the samples with the DMT lasted one week and the issuing of the activity sensors lasted two weeks, whereby both could be carried out simultaneously in the first week. The period in which the physical activity of the individuals was recorded was 8:30-12:00 AM (210 minutes) and roughly corresponded to the teaching time in the morning including the break at both schools and the respective external sites. To this end, activity sensors were distributed to at least one and a maximum of four individuals each class before the start of lessons. The information about the allocation of the sensors to the individuals was noted on prepared lists. In the following 3 ½ hours, the individuals followed their regular school routine while the devices recorded their steps and physical activity (Move 4 sensors). At the end of the measurement period, the devices were collected. The 'DataAnalyzer' software provided by Movisens (Movisens, https://docs.movisens.com/DataAnalyzer/) is required for analysing the date of the accelerometers. This software can be used to record and analyse test subject's data stored in the sensor. The data to be analysed can be specified in advance (e.g. steps, type of activity, acceleration). In addition, the program requires height, weight and exact age of the test person for evaluation. The results can then be viewed in another software, 'UnisenseViewer', and the corresponding data records can be exported for further processing programs. For this research project, the steps per minute were required. This

measured value also enables statements to be made about the everyday activity of the individuals based on a correlation with the extent of their movement potential.

Results

Out of the children of both schools, N=240 were then tested with the DMT in the pre-test and n = 137 took part in wearing an accelerometer throughout one school day. All the participants were between 6 and 19 years old. Most of the students were in classes 1-4 (n = 106), second most in the classes 5-9 (n = 92) and the least number of children that took part in the testing were in classes 10-12 (n = 42). Regarding the accelerometers the ratios were the same with n = 53, n = 50 and n = 34. More children were male (n = 158) than female (n = 82) which represents the numbers evaluated in the SFGE-II study. The acquired IQ's ranged from 42 to 85.

While many parameters are neglectable regarding the research questions, it is important to state that 57% of students were overweight at the time of the pre-test (measured by using the weight and the height to calculate the BMI). This number is way beyond the norm of 21.4% of German children being overweight (14.4%) or obese (6.0%) (Krug et al., 2018, S. 4).

At first school A was meant to be the intervention school and school B the control group. One initial meeting was held online during the COVID-19 pandemic, where the planned coordination group met. In the period that followed, it became clear that the school was overstretched in terms of implementing the project and the associated school development due to generally difficult circumstances and a shortage of staff and teachers. School B was then selected to be the intervention school, and school A became the control group. This was possible, because no progress of any kind was made at school A regarding interventions and starting the action cycle.

The process of the school development at school B already completed one full run of the action cycle. The coordination group met multiple times over the past 18 months to plan and guide the steps of progress. Because of similar problems that occurred at school A in the beginning, the number of teachers and school staff taking part in the meetings varied greatly and remained low. Another issue is the fact, that the school and the employed teachers and the staff of the day-care are separated regarding the employing institution and the Specifications of their contracts. This makes it difficult to find suitable dates and times for all participants. The current state at the beginning was established using questionnaires and structured observations, goals were identified and sorted regarding their priority and first implementations were realized with help of the University of Wuerzburg. University students created material manuals and guides for the school for reference and with the aim of helping increase the everyday physical activity during lessons and the rest of the day spent in school and day care. The intervention school recommended March 2026 as a suitable period for the post test.

Ethical considerations

The tests and methods (DMT and Accelerometers) that are used in this study should not have any negative effects on the students that are tested. Because of the individual needs that some of the students have, precautions are taken regarding specific elements of both methods. Teachers or other professionals can accompany the children when needed during the DMT. The instructors work in pairs and are all skilled in working with children with ID. If it is not possible for students to complete a specific task, alternative options are prepared and no proband is forced to do or complete a task. No child who did not want to wear one had to. Sensible data of the children, including weight, height, age and IQ, are conducted and labelled with an individual generated code for all the participants. Therefore, it would

be possible to pair the data with the results of the DMT and the Accelerometers of the probands but not leading back to the identity of the children.

Discussion

For this study it is important that adequate methods are chosen to determine the motor skills and daily physical activity of children with ID during the school day. The DMT makes it possible to measure specific characteristics regarding motor skills such as strength, endurance, speed, coordination and flexibility independently from sex and age (Bös et al., 2016). More precisely the DMT gives further information about the five dimensions endurance, strength, coordination under a time limit, coordination during tasks focusing on preciseness and mobility. These areas represent the motor skills and allow comparisons to the random sample captured by Bös et al. (2016). Because of the prerequisites of this study´s sample group of children with ID, it was necessary to adapt certain tasks. Otherwise, many participants would have a test result of 0 doing the more complex tasks and the motor skills could not be assessed. The DMT enables cross-section testing, and the results represent the motor skills validly.

The number of accelerometers that were available during pre-testing limited the overall quantity of individuals that could be tested, but the quality of the devices increased the validity and allowed precise results about the physical activity being measured in steps per minute. It is important to note that because of the relatively short period of time that the participants wore the accelerometers (one school day, 3.5 hours), the significance of the individual results is limited. To get accurate results individuals would need to wear the devices for several consecutive days. Only then can the physical activity of individuals be determined and interpreted (Rosenbaum, 2017). Also, because the students were not observed during the time they wear the accelerometers, there is no possibility of linking individual physical activity to either internal or external factors. This means that this study does not allow to analyse the physical activity of individual children. Instead, it is possible and relevant to describe the average physical activity of groups of children such as classes, children of different age groups, or to compare the overall results of groups and schools with existing studies and guidelines.

The process of school development was first planned to be primarily maintained by the school itself with the university having a more advisory role. Because of a lasting shortage of teachers and the school-staff being overloaded in general, the concept of the school self-sustaining the process proved to not be possible easy. The school mentioned several times that they would need help from the university to be able to take the necessary steps in becoming a more active school. To address this, the university took a more active role in supporting the school, providing material manuals and guides to facilitate the increase in daily physical activity. Some of these experiences contradict the results of research. Many studies have shown increased satisfaction after a period of time, caused by the consequences of the systematic development process (Ghenghesh & Abdelmageed, 2018).

The study finds that less than two thirds of students were overweight, and underscores the critical need for systematic health approaches in schools for children with ID. This aligns with previous research indicating that children with ID often do not meet the WHO recommendations guidelines (Fox et al., 2019; Wouters et al., 2019). The fact that targeted interventions can significantly improve health outcomes for children with ID also underlines the choosing of a systematic approach with the goal of extensive change in the physical activity habits of children with ID during school hours. The high percentage of overweight students also indicates a pressing need for ongoing interventions. Future research should focus on long-term strategies to sustain physical activity levels post-intervention.

Additionally, exploring the impact of these interventions on other health outcomes, such as mental health and academic performance, would be valuable.

Perspectives

Future timetable: In the current school year, the intervention school would like to implement the measures developed so far in everyday school life. The post tests for both schools are planned for October 2025 (school A) and March 2026 (school B). So), so three years will separate the pre-test from the post-test which is enough time for implementing interventions with the goal to increase the overall physical activity of the students in school B. School A does not implement any specific methods and strategies to increase the physical activity of the children and serves as the comparison group to the interventions-group. The results and analysis of the process, also focused on the inclusion of children with ID in the coordination-group, will be published in 2026. These results contribute to the literature by providing specific data on the physical activity levels of children with ID in Bavaria, Germany. Another goal is to also provide other schools and institutions with the knowledge and advice gained in this study, to include and start the systematic process of becoming a more active school or institution on their own. This will be realized using the insights of this study to develop guidelines and recommendations for realizing the development. Future phases of this project may include structured observations of school environments (e.g., corridors, recess, transport routines) and expanded stakeholder engagement, including families, politics and external partners.

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