

Alfred Rütten & Klaus Pfeifer (Eds.)

National Recommendations for Physical Activity and Physical Activity Promotion



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Recommendations for physical activity

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Recommendations for physical activity promotion

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Supported by:



Federal Ministry
of Health

on the basis of a decision
by the German Bundestag

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Erlangen

FAU University Press

2016

ISBN: 978-3-944057-96-5

eISBN: 978-3-944057-97-2

**Supported by the Federal Ministry of Health
on the basis of a decision by the German Bundestag**

The present scientifically based recommendations will give orientation for measures of physical activity promotion and their future implementation. The working group "Bewegungsförderung im Alltag" (physical activity promotion in daily living) appointed by the Federal Ministry of Health will support their dissemination.

**Members of the working group "Bewegungsförderung im Alltag"
(physical activity promotion in daily living):**

German University Sports Federation
BAG Umbrella Organization of Patient Organizations
Association of the German Sporting Goods Industry
Federal Association for Prevention and Health Promotion
Federal Centre for Health Education
German Federation of Sportsmedicine and Prevention
German Society of Sport Science
National Paralympic Committee Germany
German Olympic Sports Confederation
German Association for Health Related Fitness and Sport Therapy
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Foreword



Image source: BMG/Jochen Zick

Always and at any age, regular physical activity can act as a powerful elixir with a beneficial effect on health and well-being. The wide variety of health effects that physical activity can have, for example on our cardiovascular system, back and joints, is scientifically well proven. At the same time, we spend most of our time sitting – at school, at the office or in the car. Our bodies, however, want to be on the move! This fundamental instinct is deeply rooted in human nature and this basic urge to move does not really suit our modern sedentary lifestyle. That is why it is important to know what kind of, and how much, physical activity is most effective in improving the

health of which sectors of the population. However, we also need to know the specific ways in which we can most effectively motivate people to become physically active.

For the very first time, this publication sets out National Recommendations for Physical Activity and Physical Activity Promotion for the Federal Republic of Germany. The recommendations apply to children and adolescents, adults and older persons as well as to adults with chronic diseases. In their present form, they are geared particularly to experts in different areas and institutions.

The recommendations are characterized by their solid scientific grounding. Highly respected scientists from the fields of sports science, sports medicine and public health were involved in drawing them up. As with their creation, the recommendations' further development and implementation will be accompanied closely by the working group on physical activity promotion in everyday life ("Bewegungsförderung im Alltag") at the Federal Ministry of Health. This platform provides a forum for numerous organizations involved in health promotion, physical activity and sport in Germany and is part of the National Action Plan "IN FORM – German national initiative to promote healthy diets and physical activity".

These recommendations are also in line with current international projects by the European Union and the World Health Organization, where they can likewise provide impetus for new ideas.

What is important, however, is that the recommendations are not just discussed by groups of experts. Instead, the general public needs to be made aware of them. Consequently, the next step will be a project funded by the Federal Ministry of Health in which scientists will work together with representatives from different settings and institutions to develop materials that are easily understood, are target group oriented and can serve to disseminate the recommendations more widely among the general public.

I would like to thank all of those who contributed to this publication. I hope that it allows us to get moving on physical activity and enables us to anchor the latter as a cross-sectional topic in various different settings. This is one of the important aims also pursued by the German Act to Strengthen Health Promotion and Disease Prevention ("Präventionsgesetz").

A handwritten signature in black ink, appearing to read 'Hermann Gröhe', with a stylized flourish at the end.

Hermann Gröhe
Federal Minister
Member of the German Bundestag

Acknowledgements

These National Recommendations for Physical Activity and Physical Activity Promotion have been developed in a collaboration involving various different stakeholders. The foundations were laid by a research project funded by the Federal Ministry for Health that included chapters on the scientific basis of recommendations for physical activity and recommendations for physical activity promotion and a separate chapter on examples of good practice. The editors wish to extend their special thanks to Alexander Woll, who coordinated the work on that important part of the overall project. That part was not integrated in these recommendations, but instead could support the process of implementing the physical activity recommendations as a possible independent publication.

In addition, the work of all of the academic authors who contributed their expertise and time to preparing the recommendations is also worthy of special mention. For the recommendations for physical activity we would like to thank Winfried Banzer, Nina Ferrari, Eszter Füzéki, Wolfgang Geidl, Christine Graf, Verena Hartung, Sarah Klamroth, Klaus Völker and Lutz Vogt. Our thanks go to Karim Abu-Omar, Ionut Burlacu, Günther Gediga, Sven Messing and Ulrike Ungerer-Röhrich for the recommendations for physical activity promotion.

We would also like to thank the international Scientific Advisory Committee comprising Klaus Bös, Sonja Kahlmeier and Willem van Mechelen, whose feedback was very important to us in designing and developing the recommendations.

Last but not least, special thanks are due to all of the members in the working group "Bewegungsförderung im Alltag" (physical activity promotion in daily living) and the staff members responsible at the Federal Ministry for Health, who made a valuable contribution to the recommendations through their constructive suggestions and feedback.

Alfred Rütten & Klaus Pfeifer
Erlangen, August 2016

Introduction

These recommendations for physical activity and physical activity promotion are aimed on the whole at professional stakeholders and organizations in the field of physical activity promotion. This includes all experts and organizations that in the context of physical activity and health in the areas of sport (e.g. sport clubs), education (e.g. child care facilities or schools), the health system (e.g. health insurers), local authorities (e.g. in urban development and spatial planning), politics (e.g. health or education policy) or in other relevant areas of society directly or indirectly influence the development and implementation of measures to promote physical activity or physical activity-related health promotion. These recommendations should serve as a scientific guide for those stakeholders and organizations in their daily work and in developing strategies for future activities in the area of physical activity promotion.

In these recommendations, "physical activity" is seen from a health perspective. Physical activity thus includes all "health-enhancing physical activity" [1].¹ This includes leisure-time and sport activities, provided that they are useful to health and prevent health risks, as well as everyday activities, e.g. cycling and walking as active transport.

"Recommendations for physical activity" have a long tradition internationally. For many years, US recommendations [e.g. 2] also served as a guide internationally, until in 2010 the World Health Organization (WHO) used them as a basis to issue its own recommendations [3], which are nowadays used by many countries as a reference point for national recommendations, e.g. by Austria [4] and Switzerland [5].

¹ The term "health-enhancing physical activity" common in an international context is defined as "any form of physical activity that benefits health and functional capacity without undue harm and risk" [1]. Based on that definition, health-enhancing physical activity includes leisure activities (e.g. sport) and active transport as well as physical work in the workplace or at home. Recommendations for physical activity and physical activity promotion generally focus on physical activity behavior during leisure time and active transport. The health-enhancing effects in these areas are also better substantiated.

Although there are also "recommendations for physical activity promotion" from international organizations [6, 7], these have found scarcely any systematic consideration in national physical activity recommendations thus far.

These "National Recommendations for Physical Activity and Physical Activity Promotion" thus constitute a novelty at two levels: firstly at national level, by providing the first scientifically proven and developed recommendations for the Federal Republic of Germany, and secondly at an international level, by systematically linking recommendations for physical activity and physical activity promotion in such a form.

In view of current studies and data, this link seems to us to be urgently necessary: Although the benefits of physical activity for health have now been proven by extensive scientific literature [8] and enough studies show that physical activity can be effective from a health economical perspective [9-11], the prevalence of individuals with physically inactive lifestyles in Europe in the past decade has remained more or less constant [12]. The insights gained into the links between physical activity and health have obviously failed to adequately reach the relevant target groups in the population in their everyday actions. Against this backdrop, "recommendations for physical activity" may constitute a first step in providing the relevant knowledge for individual target groups. However, it is at least equally as important to systematically analyze how inactive individuals can be encouraged to change their physical activity behavior most effectively.

To this end, the European Commission in its "EU Physical Activity Guidelines" [7] already referred specifically to the WHO [13] as the frame of reference for "recommendations for physical activity" and – practically as a supplement – focused in its recommendations on "measures to support health-enhancing physical activity". This approach was once again highlighted in a recommendation by the European Council from 2013, in which the EU member states were encouraged to adopt a differentiated implementation of the EU Guidelines from 2010 and "national recommendations on physical activity for health" were defined as an indicator in this context [14].

Germany too has recently seen political calls for physical activity recommendations come from various different political institutions. For example, recently a joint resolution by Germany's Standing Conference of Ministers of Health ("Gesundheitsministerkonferenz", GMK) and Germany's Standing Conference of Ministers of Sport ("Sportministerkonferenz", SMK) was passed to examine the "development of natio-

nal physical activity recommendations" [15]. Previously there had already been a call at an expert conference of the SMK, which was also attended by the German Olympic Sports Confederation (DOSB) among others, for the development of "recommendations for physical activity promotion". Alongside these activities by the German federal states, these "National Recommendations for Physical Activity and Physical Activity Promotion" were initiated in 2014 within the context of an intersectoral working group at the Federal Ministry for Health (BMG) for physical activity promotion in daily living and were made possible by project funding from the BMG. At the same time a process of exchange and agreement was initiated between the various different approaches. This means that a broad alliance of stakeholders at national and federal state level could support the potential implementation of the recommendations in practice for physical activity and health promotion.

National recommendations in an international context

"Recommendations for physical activity" were issued by the American College of Sports Medicine as far back as 1978 [16]. These were based on early studies on the health benefits of endurance and strength training and were focused on the area of sport. The guidelines recommended endurance and strength training at as high an intensity as possible several days a week.

At the beginning of the 1990s, various epidemiological studies then substantiated the health benefits of moderate physical activity also. Corresponding moderate types of physical activity (e.g. walking) could be part of everyday living, e.g. for transport or when working in the workplace or at home. These findings led to a paradigm shift in the physical activity recommendations, reducing the narrow-to-exclusive concentration on sport and focusing more on health-enhancing physical activity in everyday life [17]. For America, Pate et al published corresponding recommendations in 1995 [2]. Those recommendations advised adults to engage in moderate-intensity physical activity for at least 30 minutes most days in the week. „Moderate intensity" describes activities where adults experience slightly accelerated breathing and heart rate, for example equivalent to a brisk walk. In principle, these recommendations are still valid today.

In 2010 the World Health Organization published its own recommendations for physical activity. Those recommendations were the result of a very extensive analysis of the scientific findings available on the health effects of physical activity on children and adolescents, adults and older adults [8]. The recommendations are also based on the concept of health-enhancing physical activity. They are broken down into recommendations for the age groups 5 to 17, 18 to 64 and 65 and older. For children and adolescents, those guidelines recommend physical activity of at least 60 minutes per day at moderate to vigorous intensity. In a slight modification to earlier recommendations, e.g. from Pate et al (1995), adults are recommended health-enhancing physical activity with a duration of at least 150 minutes a week (moderate intensity) or 75 minutes a week (vigorous intensity) as well as muscle-strengthening physical activity on at least two days a week. Furthermore, the recommendations advise older adults to carry out exercises to maintain their balance and prevent falls.

There are now a whole range of countries that have published national physical activity recommendations. The content of almost all of these is based on the WHO recommendations for physical activity. In the German-speaking world, for example, Austrian recommendations for health-effective physical activity were published in 2012 [4]. Corresponding recommendations for Switzerland were issued in 2013 [5]. Going beyond the scope of the WHO recommendations, some countries have also addressed the topic of prolonged sitting times in their recommendations. Examples include the recommendations from the UK (2011), Australia (2013) and Canada (2013) [18-20]. As already indicated, the topic of "physical activity promotion" does not yet play any role in most of the existing national recommendations, or merely plays a minor role in that individual examples of physical activity promotion are listed in a cursory fashion [4].

Structure of the recommendations

In their current form, these recommendations provide a scientific analysis of two related work areas: (A) Recommendations for physical activity and (B) Recommendations for physical activity promotion. In each case, the basic work steps involved (1) reviewing national and international literature, (2) developing relevant quality criteria and (3) wording recommendations.

Physical activity and physical activity promotion

Recommendations for physical activity relate to the nature, duration, intensity and volume of physical activity, with newer recommendations also taking into account the avoidance of sedentary behavior. The challenges in this work area related to preparing a synthesis of the existing international recommendations, comparing these with the quality criteria derived from current research and delivering the content in a condensed form.

Recommendations for physical activity promotion are addressed in particular to political decision makers, political institutions as well as stakeholders and organizations involved in prevention and health promotion. In recent years, such recommendations have been issued e.g. by the European Union, the WHO, CDC (USA) and NICE (GB) [6, 7, 21-28]. These recommendations are generally broken down into intervention type, setting and target group or a relatively unsystematic mix of those categories. The main challenges in this field concerned the systematization of the extensive findings on the effects of different interventions on physical activity promotion. It had to be considered in this context that the effects of interventions depend not least on taking into account quality criteria in health promotion and on particular contextual aspects.

This document contains the specific recommendations for the selected target groups in each of the highlighted boxes. These are followed by a detailed description of the scientific grounds for the recommendations. .

Recommendations for different target groups

In line with international practice, these recommendations take a life-course perspective and comprise the target groups of children and adolescents, adults and older adults. Due to the increasing significance of chronic diseases, adults with pre-existing conditions were also included in the recommendations as a separate target

group. This is a special feature even in an international comparison² Additionally, recommendations for physical activity promotion were also formulated for the community and population level.

Physical activity promotion in different settings

Within the different sections on children and adolescents, adults, older adults and adults with pre-existing conditions, the recommendations for physical activity promotion were structured by setting in order to support later dissemination. By contrast, the recommendations for the community and population level were structured by intervention type and include population-based information approaches, community-based interventions and policy and environmental approaches.

Dissemination and implementation of the recommendations

As a foundation document, these recommendations can provide important impetus for the further development of physical activity-related health promotion in Germany. Active involvement on the part of stakeholders and organizations from the respective context appears to be of fundamental importance for dissemination and for directly reaching the target groups and settings listed in the recommendations. For

² The development of special recommendations for further target groups was discussed by the project group but ultimately was not pursued for various reasons. For example, people with disabilities constitute a significant target group. However, this target group is very heterogeneous in connection with physical activity and physical activity promotion in particular. As a result, the development of special recommendations for certain disabilities would only have been possible with considerable additional resources. For comparable reasons, socially disadvantaged individuals – an especially relevant group from a health promotion perspective – were not treated as a special target group. Other potential target groups considered included special recommendations for pregnant women and a distinction between children and adolescents. The preparation of gender-specific recommendations was also considered. Such recommendations for special target groups are necessary for the future. However, for the reasons indicated, they do not appear to be realizable within the current framework. Representatives of these special target groups should, however, be actively included in as far as possible in disseminating and implementing the recommendations.

example, the scientists involved should work together with representatives from child care facilities and schools to develop information materials suitable for the target groups on the topics of physical activity and physical activity promotion for children and adolescents. The same procedure can be adopted for the other selected target groups and their settings. For example, products could include traditional materials such as flyers and brochures, but also websites, apps, video clips or the integration of social media.

For the Federal Ministry for Health and other political institutions, e.g. at state or municipal level, these recommendations can act as an important foundation stone for incorporating the topics of physical activity and physical activity promotion with a scientific grounding into existing or future political activities. For example, they may provide impetus for wording the national German Act to Strengthen Health Promotion and Disease Prevention ("Präventionsgesetz") or for possible resolutions by the SMK and GMK on the topics of physical activity and physical activity promotion.

Physically inactive lifestyles are nowadays seen as a "chronic" policy problem. This means that there are no fast or even definite solutions in sight. The only way to develop long-term solutions is by means of concerted action and the continuous involvement of various policy sectors and policy levels as well as of other relevant stakeholders (e.g. sport clubs). These recommendations aim to make a scientifically founded contribution for this purpose.

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Recommendations for physical activity

Klaus Pfeifer, Winfried Banzer, Nina Ferrari,
Eszter Füzéki, Wolfgang Geidl, Christine Graf,
Verena Hartung, Sarah Klamroth, Klaus Völker, Lutz Vogt

Objectives of the recommendations

An active lifestyle improves the health of individuals of all ages. In addition to healthy people, adults with chronic diseases also benefit from the positive effects of regular physical activity. Together with the recommendations for physical activity promotion described in the second section, recommendations for physical activity are a significant component of a comprehensive strategy for increasing the physical activity of the population and safeguarding the health benefits that can be achieved through such physical activity.

Target groups for these recommendations

These recommendations for physical activity are aimed at:

- all groups of people for whom respective specific recommendations are issued: children and adolescents, adults and older adults as well as adults with chronic diseases
- all stakeholders involved with the topic of physical activity promotion in the areas of health promotion, prevention and rehabilitation as well as;
- all stakeholders who develop strategies for physical activity promotion and for avoiding long sitting times.

Definitions

Physical activity is defined as any bodily movement produced by skeletal muscles that requires substantial energy expenditure above and beyond resting energy expenditure (one metabolic equivalent = 1 MET). The classification presented in Figure 1 [cf. 19, 117] with the respective intensities (light, moderate, vigorous) shows energy expenditure when resting and during physical activity. The volume of physical activity can be stated in MET minutes or MET hours accordingly. Everyday

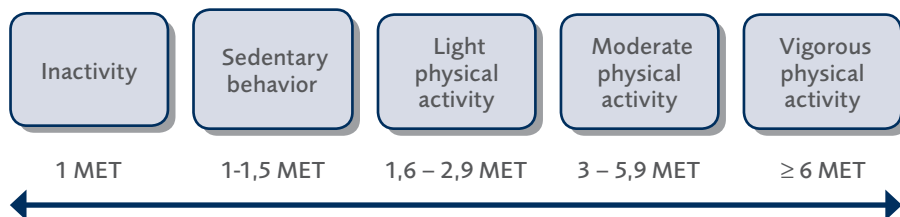


Figure 1. Energy expenditure in the unit of metabolic equivalents (MET) for various physical activity (PA) intensity levels.

activities up to 2.9 MET are also described as basic activity. Physical inactivity is used to describe a state where this basic activity is not accompanied by any moderate or vigorous physical activity.

Table 1 below includes explanations for important terms used.

Table 1: Terms to describe physical activity

Terms to describe physical activity	
Physical activity	Any bodily movement produced by skeletal muscles that requires increased energy expenditure above and beyond resting energy expenditure
Basic activity	Low-intensity physical activity (up to 2.9 MET) for performing everyday activities (household chores, standing, walking slowly etc.)
Aerobic physical activity	Physical activity over periods of more than a few minutes that uses large muscle groups, ensuring they are adequately supplied with oxygen. Examples include walking, power walking, jogging, cycling, swimming and corresponding ball sports etc.
Recreational physical activity	Physical activity during recreational pursuits or sport

Physical activity as a means of transport	Physical activity such as walking or cycling in order to cover distances e.g. to school, work or to go shopping
Physical activity at home or at work	Physical activity when carrying out household tasks or work-related activities
Muscle-strengthening physical activity	Physical activity that creates higher muscle tension through weight loading, leading to a strengthening of the muscles, e.g. functional gymnastic exercises or moving loads
Sedentary behavior	Physical inactivity with long periods sitting at a workstation and/or during leisure time and energy expenditure of less than 1.5 MET
Physical activity duration	Duration of the physical activity in minutes
Unit of physical activity	A physical activity carried out over a certain period
Physical activity frequency	Frequency of a unit of physical activity per day or per week

Physical inactivity	A state where basic activity is not accompanied by any moderate or vigorous physical activity.
Physical activity volume	The entire volume of physical activity as a product of physical activity duration, intensity and frequency.
Terms to describe the intensity of physical activity	
Absolute intensity of physical activity	Effort measured in metabolic equivalents (MET, see Fig. 1) or in relation to the maximum heart rate or oxygen uptake capacity achievable .
Relative intensity of physical activity	Effort in relation to the physical capacity or perceived level of exertion during physical activity.
High-intensity physical activity	Physical activity perceived as tiring where it is no longer possible to speak continuously; breathing rate rises moderately to somewhat more sharply. Examples include: running, fast cycling or swimming.
Moderate-intensity physical activity	Physical activity perceived as somewhat tiring where it is still possible to speak but not to sing; breathing rate rises slightly to moderately. Examples include: power walking, jogging.
Low-intensity physical activity	Physical activity scarcely perceived as tiring and that requires 1.5 to 2.9 times resting energy expenditure (1.5 to 2.9 MET), see Basic activity.
Resting energy expenditure, metabolic equivalent	The energy consumed when physically resting is described over the equivalent quantity of approximately 3.5 ml of oxygen taken up per minute and kilo of body weight; metabolic equivalent (= 1 MET).

Methodology used in developing the physical activity recommendations

The recommendations for health-enhancing physical activity were developed in a three-phase process with recourse to existing high-quality international recommendations. The basic outline of the methodology is set out in Table 2.¹

The recommendations for health-enhancing physical activity were developed in a three-phase process with recourse to existing high-quality international recommendations. The basic outline of the methodology is set out in Table 2 .

In Phase 1, existing physical activity recommendations for each of the groups children and adolescents, adults, older adults, and adults with chronic diseases were researched systematically (Work step 1A in Table 2). At the same time, an assessment model with quality criteria was developed to assess the quality of existing physical activity recommendations (expert survey, Work step 1B).

An expert survey was carried out to create the quality criteria (Work step 1B). The resulting list of quality criteria was agreed upon and signed off by all of those involved in preparing the physical activity recommendations. This resulted in a total of 28 quality criteria for Domain A "Scope of application and purpose", B "Methodological precision of the development of the recommendation", C "Clear content and differentiation" and D "Structure".²

In Phase 2, the quality of the physical activity recommendations researched was assessed based on the quality criteria (2A). High-quality physical activity recommendations were identified for each target group as 'source recommendations' (2B).

¹ A detailed description of the methodology is contained in individual articles in a special edition of the medical journal "Das Gesundheitswesen"

² A detailed description is found in Geidl et al. in a special edition of the medical journal "Das Gesundheitswesen"

After assessment using the quality criteria, the source recommendations identified in Phase 1 were subject to a systematic content analysis (2C). This was used as a basis for preparing a content summary in relation to existing physical activity recommendations, reported health effects of physical activity, dose-response relationships and risk-benefit considerations. Furthermore it was used to formulate recommendations for health-enhancing physical activity for each target group (children and adolescents, adults, older adults and adults with chronic diseases). For the target group "Adults with chronic diseases", source recommendations for seven diseases were reviewed and a higher-level chapter "Generic physical activity recommendations for chronic diseases" was prepared.

Table 2. Methodology for preparing the National Physical Activity Recommendations

Phase 1	<ul style="list-style-type: none"> • 1A: Systematic literature review based on current physical activity recommendations for a) Children and adolescents, b) Adults and older adults as well as c) Individuals with chronic diseases • 1B: Development and implementation of an expert survey for the preparation of quality criteria
Phase 2	<ul style="list-style-type: none"> • 2A: Assessment of the physical activity recommendations researched using quality criteria • 2B: Selection of high-quality physical activity recommendations as source recommendations • 2C: Content analysis of the source recommendations
Phase 3	<ul style="list-style-type: none"> • 3A: Synthesis of the content analyses and derivation of the recommendations for health-enhancing physical activity (2C)

Physical activity recommendations for children and adolescents

Target group

The recommendations apply to children and adolescents, broken down into the respective age groups between birth and 18 years. The recommendations are based primarily on the following source recommendations: UK [85], USA [78] and Canadian recommendations [129, 132, 147], supplemented with information from current reviews [48, 57, 133] on the topic.

Recommendations

Infants and toddlers (0 to 3 years)

- Infants and toddlers should get as much physical activity as possible and be prevented as little as possible from following their natural instinct to move; a safe environment must be ensured

Pre-school children (4 to 6 years)

- For pre-school children, physical activity should amount to a total of 180 minutes/day and more, which can comprise instructed and non-instructed physical activity

Primary school children (6 to 11 years)

- Children of primary school age should be moderately-to-vigorously physically active for 90 minutes or more each day. 60 minutes of that time can be spent on everyday activities, e.g. at least 12,000 steps/day

Adolescents (12 to 18 years)

- Adolescents should be moderately-to-vigorously physically active for 90 minutes or more each day. 60 minutes of that time can be spent on everyday activities, e.g. at least 12,000 steps/day

Sitting and using screen media (TV, computer/tablet, smartphone etc.)

- Avoidable sitting times should be reduced to a minimum. In addition to (motorized) transport, e.g. in a baby carrier or child seat, or periods spent inside unnecessarily, this relates in particular to reducing consumption of screen media to a minimum:
 - Infants and toddlers: 0 minutes
 - Pre-school children: as little as possible, maximum of 30 minutes/day
 - Primary school children: as little as possible, maximum of 60 minutes/day
 - Adolescents: as little as possible, maximum of 120 minutes/day

Specific aspects

- For primary school aged children, the large muscle groups should be subject to higher-intensity loading on two to three days a week in order to improve strength and endurance, taking into account respective developmental stages
- Special aspects as well as interests, needs and possible barriers of the respective target group should be taken into consideration, e.g. age, gender, sociocultural factors
- Physically inactive children and adolescents should be introduced gradually to the target, e.g. initially 30 minutes of physical activity on one to two days per week. The duration is then increased first, after which the intensity is increased

Reasons for the recommendations

General health benefits of physical activity³

The role of physical activity and the reduction of sitting times for the healthy physical, psychosocial and intellectual development of children and adolescents is undisputed [47, 127]. Physical activity has positive effects on the cardiovascular and metabolic risk profile, motor abilities and skills, cognitive performance, musculoskeletal health and the prevalence of overweight/obesity. There is strong evidence to suggest a link between muscular fitness as a result of physical activity and the reduction of (central) obesity, cardiometabolic risk factors such as insulin resistance, blood pressure, bone health and feelings of self-esteem [116]; the greater the volume of physical activity, the larger the assumed health benefit. There are also indications that the extent of physical activity at pre-school age has a positive influence on time devoted to physical activity as an adult [124].

Based on the recommendations of the World Health Organization (WHO) [46], most recommendations across all age groups are for at least 60 minutes of moderate-to-vigorous physical activity per day. Such recommendations are generally accompanied by a reference to the fact that this is a minimum figure and that more physical activity also leads to greater health benefits.

For infants and toddlers, there is very little data available on possible links between physical activity and health. It mainly comes from the UK and North American working groups that have made specific recommendations [78, 85, 129 132]. For example, the guidelines state that infants should be restricted as little as possible in the time they spend physically active. Toddlers and pre-school children should have 180 minutes of physical activity per day – instructed and non-instructed. The Canadian recommendations for the 0-to-4 age group are based on a systematic review by Timmons et al. [127] on the following indicators: incidence of overweight and obesity, cardiovascular factors (including blood pressure, lipids, glucose and insulin as well as inflammation parameters), skeletal system, motor skill development, psychosocial health (self-concept, self-esteem, aggression, behavior etc.) and cognitive

³ The health effects and reasons for the physical activity recommendations reported here are based on the selected source recommendations (for the methodology, see Geidl et al., Füzeki et al., Pfeifer et al. in a special edition of the medical journal "Das Gesundheitswesen"). For other comprehensive current reviews, see e.g. Pedersen & Saltin 2016 [95]

development (including speech development). While the level of evidence ranged from low to high, overall it was shown that a higher extent of physical activity is linked to a lower prevalence of obesity, fewer cardiometabolic risk factors, better motor skills, superior bone health, favorable psychosocial adjustment and improved cognitive development. However, it is not yet possible to make unequivocal statements regarding the specific dose of physical activity, i.e. intensity, frequency and/or type of physical activity/sport. The consensus in all recommendations available to date for this age group is to offer as much physical activity as possible, not to limit the natural need for physical activity, and to raise the awareness of the parents or guardians in relation to the importance of physical activity [127, 129]. No risks or side effects from increased physical activity were described [127]. The environment should be safe for children accordingly.

The data available for the other age groups are much better, particularly from primary school age upwards. As a basis for the Canadian physical activity recommendations, Janssen and LeBlanc [55] assessed the health benefits of physical activity for schoolchildren: Nine studies dealt with the impact on cholesterol and blood lipids. In an observational study, it was demonstrated that less physically active 12 to 19-year old girls and boys have a 1.9 to 3.7-times higher risk of high cholesterol. The other experimental studies were focused on higher plasma lipid concentrations and/or obesity. The findings were inconsistent. Aerobic exercise led to an improvement, particularly in levels of triglycerides. The effects of strength exercise were minimal. Eleven studies dealt with the influence on blood pressure. However, the effects were low for aerobic exercise (1.39 mmHg reduction in systolic and 0.39 mmHg reduction in diastolic blood pressure) and not really possible to assess for strength exercise. The links to overweight and obesity were examined far more frequently. In 31 studies, the impact for aerobic exercise was -0.40 for percentage body fat and -0.07 for BMI, while for strength exercise the impact was -0.19 for percentage body fat. In studies on links to metabolic syndrome and fasting insulin levels, the impact was -0.60 for aerobic exercise and -0.31 for strength exercise. Positive findings were also reported for bone density, the incidence of injuries, depression and corresponding symptoms. Nevertheless a lot of questions remain unanswered here too, e.g. in terms of types of physical activity/sport, intensity, social and cultural prerequisites as well as adequate age and gender-based differentiation.

In a more recent review, the link was examined between muscular fitness as a result of physical activity and a reduction in (central) obesity, cardiometabolic risk factors such as insulin resistance, blood pressure, bone health as well as feelings of self-

esteem [116]. The greater the volume of physical activity, the larger the assumed health benefits. For Germany, the MOMO collective (MOMO: Motoric Module as a sub-group of the representative KiGGS cohort) showed a weekly period of physical activity of around 480 minutes on average for boys and around 400 minutes for girls (n=4401) [142]. This means that the target of more than 60 minutes per day spent on physical activity is met. Taking these national particularities into account, the expert consensus reached for Germany was for 90 minutes of physical activity for children of primary-school age and older [47, 48].

Benefits of the different types of physical activity and volume of physical activity

There are only a few studies on the benefits of physical activity as a means of transport. The German consensus statement recommends using physical activity as a means of getting to school [5, 48, 133].

The literature contains indications for translating the recommendation of 60 minutes of physical activity a day into roughly 11,500 steps/day [5], or – broken down by age and gender – between 10,000 and 12,000 steps/day for girls of primary school age and between 13,000 and 15,000 steps/day for boys of the same age as well as between 11,000 and 11,700 steps/day for older children and adolescents [133].

Various recommendations give indications on certain types of physical activity [85, 131]. These include playing on the floor for younger children and cycling for older children. However, there is no scientific evidence for the preference or superiority of individual types of physical activity or sport. The basic advice is to follow the child's natural tendencies and not to limit the time spent on physical activity, particular for younger toddlers and pre-school children. For older children, most recommendations discuss types of physical activity aimed at improving endurance and muscle strength [57]. They recommend adequately exercising the large muscle groups on three or more days per week in order to improve muscle strength, bone density and cardiorespiratory fitness.

Physical activity should be adapted to age and stage of development in order to avoid any injury to the growing organism and in particular to allow children and adolescents to enjoy physical activity [98]. For small children (aged under 3), there is an additional recommendation to create a safe environment. In a current review on inju-

ries during physical activity [79], between 0.2 and 0.3 medically treated incidents are reported per 1,000 hours of activity for the eight to twelve-year old age group. The absolute figure relating to unstructured recreational physical activity was higher than the absolute number of injuries reported in organized sports. On the whole, there is a lack of data differentiated by age. It was demonstrated that targeted exercise (especially of coordination and strength) can prevent sports injuries in adolescents [108].

As far as introducing inactive children and adolescents to physical activity is concerned, only the Irish recommendations provide for a gradual process [57, 146].

Sitting activities in leisure time and using screen media

Sedentary behavior has emerged more and more as an independent risk factor for the development of overweight, but also for psychosocial conditions [128]. Sedentary behavior refers to physical inactivity characterized by an energy expenditure of less than 1.5 MET, e.g. when sitting, watching TV, playing video games etc.

In addition to pointing out the problem of sitting times spent in (motorized) transport, e.g. in a baby carrier or child seat, the recommendations refer to the use of audiovisual media during leisure time (e.g. playing video games and watching TV) that are not explicitly required for school-related tasks [128]. Longer screen times (generally two or three hours) are linked to an increased prevalence of overweight and obesity, a higher BMI, lower fitness, lower self-esteem, poorer academic achievement and more behavioral problems [131]. The severity of these problems increases in line with screen time [131].

For children below the age of two, the recommendation is to avoid screen time completely [16] and not to expose children to incidental media use (no TV on in the background, no TV in the child's bedroom). For the groups of 2 to 5-year olds, it is recommended [8, 57, 129] to avoid screen time in as far as possible and or to limit it to a maximum of one hour per day. The German consensus statement thus recommends a maximum of 30 minutes/day of unnecessary media use for children of pre-school age and no more than 60 minutes/day for children of primary school age [48]. For older children, the recommendation is generally a maximum of two hours of screen time during leisure time [131], and this has also been adopted for adolescents in the German consensus statement [48].

Physical activity recommendations for adults

Target group

The recommendations apply to healthy adults aged between 18 and 65. They also apply to adults with chronic diseases that do not restrict mobility (e.g. hypertension or type 2 diabetes) for whom there are no specific contraindications for physical activity.

The recommendations are based primarily on the following source recommendations: WHO recommendations [46], national recommendations for physical activity from Canada [140], Australia [17], the UK [99], recommendations by the American College of Sports Medicine (ACSM) [43] as well as the "European Guidelines on Cardiovascular Disease Prevention in Clinical Practice" [96]

Recommendations

- Adults should be physically active on a regular basis. This can help to achieve significant health effects and to reduce the risk of developing chronic diseases
- The greatest health benefits take place when individuals who were entirely physically inactive become somewhat more active. This means that all additional physical activity is linked to health benefits. Every single step away from physical inactivity is important, no matter how small, and promotes health
- To maintain and promote health comprehensively, the following minimum recommendations apply:
 - adults should have moderate-intensity aerobic physical activity for at least 150 minutes/week where possible (e.g. 5 x 30 minutes/week) **or**

- at least 75 minutes/week of vigorous-intensity aerobic physical activity **or**
- aerobic physical activity in a corresponding combination of both intensities
- **and** should group the overall activity in at least 10-minute individual units distributed over days and weeks (e.g. at least 3 x 10 minutes/day on five days per week)
- Adults should also have muscle-strengthening physical activity at least two days per week
- Adults should avoid long and uninterrupted sitting times and should regularly interrupt sitting with physical activity where possible
- Adults can achieve further health effects if they increase the volume and/or intensity of physical activity above the minimum recommendations

Taking pregnancy-specific physical adjustments into account, these recommendations also apply to pregnant women or women who have recently given birth; see Ferrari & Graf in the medical journal "Das Gesundheitswesen"

Reasons for the recommendations

General health benefits of physical activity⁴

Regular physical activity reduces overall mortality risk considerably. In the underlying epidemiological studies, the most physically active groups were compared against the least physically active groups in this regard. The existing international physical activity recommendations that make reference to this point consistently report an approximately 30% lower overall mortality risk for active individuals versus inactive

⁴ The health effects and reasons for the physical activity recommendations reported here are based on the selected source recommendations (for the methodology, see Geidl et al., Füzeki et al., Pfeifer et al. in a special edition of the medical journal "Das Gesundheitswesen"). For other comprehensive current reviews, see e.g. Pedersen & Saltin 2016 [95].

individuals [17, 140]. The WHO recommendations also highlight a lower mortality risk of physically active adults compared with inactive adults [46].

A significant risk reduction of 20 to 33% is reported in the occurrence of cardiovascular diseases through regular physical activity [17, 96, 140]. The recommendations of the World Health Organization emphasize the cardioprotective effects of regular physical activity [46]. The risk reduction achievable through physical activity is independent of other known risk factors for cardiovascular diseases [140]. In addition, based on extensive reviews and meta-analyses, the American College of Cardiology and the American Heart Association describe a positive influence on cardiometabolic risk indicators (reduction in LDL cholesterol and non-HDL cholesterol, drop in blood pressure) and recommend three to four units of aerobic physical activity per week lasting approximately 40 minutes each and reaching both moderate and vigorous intensity [32].

In relation to the prevention of overweight, the Australian physical activity recommendations consider at least 60 minutes of physical activity per day necessary [17]. The ACSM recommends moderate-intensity physical activity between 150 and 250 minutes per week in order to prevent weight gain [28]. The UK physical activity recommendations describe the health benefits achieved through physical activity even without weight reduction [99]. The World Health Organization emphasizes the substantial inter-individual variability between physical activity and weight status, and assumes that more than 150 minutes of physical activity per week is necessary to maintain weight [46]. The substantial inter-individual variability between physical activity and weight gain, which is also influenced by factors such as energy intake, medication, smoking, alcohol consumption and co-morbidities, makes it more difficult to make precise statements on the prevention of overweight.

In relation to the risk of developing type 2 diabetes, the comparison between the most physically active or fittest and least physically active or least fit group in the Canadian physical activity recommendations showed an average risk reduction of 42% [140]. Physical activity was also found to have a favorable effect on diabetes risk even without weight reduction [17 and 141]. The American Diabetes Association describes a risk reduction of 34-43% [119] through lifestyle interventions, physical activity, a change of diet and calorie reduction.

The European Code against Cancer [67], the American Cancer Society [63] and the World Health Organization [46] report substantial evidence that physical activity can

reduce the risk of occurrence of various types of tumor, e.g. breast, intestinal and endometrial tumors. According to the Canadian physical activity recommendations, a comparison of the most physically active with the least physically active group resulted in an average relative risk reduction of 30% [140]. The Australian physical activity recommendations report a somewhat lower risk reduction (20% for men and 14% for women) [17]. The European Code against Cancer mentions a relative risk reduction of 27% [67]. The protective effects appear to be independent of body weight [17, 67], hormone replacement therapy, diet and family history of cancer [17]. The S-3 guideline "Colorectal carcinoma" finds that active individuals have fewer colon polyps (adenomas) and up to 30% lower risk of a carcinoma [66]. For incidences of breast cancer, the Canadian physical activity recommendations calculate a risk reduction from physical activity of 20-40% [141]. The underlying data used by the European Code against Cancer [67] distinguishes between post-menopausal and pre-menopausal cancer. It is considered probable that regular physical activity lowers the risk of post-menopausal tumors.

The Canadian physical activity recommendations and the recommendations of the World Health Organization emphasize that regular physical activity and exercise help bone health, i.e. contributes to the prevention of osteoporosis [46, 140]. Ebeling et al. [31] report on positive effects of weight-bearing aerobic exercise, high-impact exercises (high pressure and tensile forces on bones) and strength exercise on the bone mineral density of pre-menopausal women.

The Australian physical activity recommendations make mention of the potential to prevent depression. According to those recommendations, regular physical activity protects against the onset of depression, although the impact is small to moderate with significant heterogeneity [17]. Effects are assumed to be greater among those who are inactive and those with lower levels of psychosocial functioning.

Health benefits depending on the volume of physical activity

The figures provided in the recommendations on the volume of physical activity are additional to basic activity. Persons who only carry out basic activity are considered inactive.

The dose-response relationship between physical activity and health benefits is generally assumed to be curvilinear (Figure 2). The greatest health benefits are observed

amongst inactive individuals who increase their activity at least a little. Accordingly, even a relatively small increase in physical activity is linked to significant improvements in the health and fitness of initially inactive and unfit individuals. Even physical activity of approximately half the recommended volume is associated with a lower early mortality risk [17, 46, 99]. Larger volumes bring additional benefits, which then decrease again with increasing volume. It is therefore assumed that the curve of the dose-response relationship flattens out above a certain volume and then only small additional health benefits are achievable through additional physical activity. It is not possible to determine this volume precisely based on the source recommendations available [17, 99].

The precise volume and type of physical activity necessary for a specific health benefit cannot be defined precisely [17, 30, 43, 96], nor it is possible yet to make disease-specific preventive physical activity recommendations [99]. It is also probable that the curve of the dose-response relationship will be different depending on the health effect observed and the initial fitness level of the individual. For example, there are indications that a volume greater than 150 minutes/week of physical activity is necessary in order to achieve specific health effects such as weight reduction, the prevention of type 2 diabetes or the prevention of certain types of tumors [17, 46, 63, 66, 140].

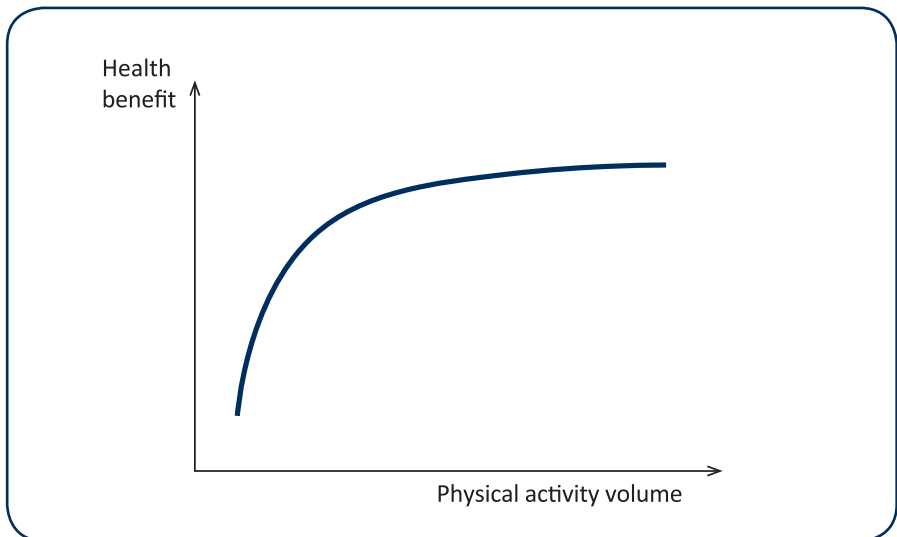


Figure 2: Assumed dose-response relationship between physical activity and health

On the whole, the volume of physical activity plays a more important role than the type of physical activity [17, 99]. Adults can achieve extensive health benefits if their physical activities comprise or address all motor abilities (strength, endurance, mobility, coordination) [43].

The volume and intensity of physical activity should be increased gradually until the set target is achieved. Aerobic physical activity of moderate intensity is viewed more positively from an affective-emotional perspective than vigorous-intensity physical activity and must be seen as more favorable in terms of engaging individuals in physical activity [43].

For very inactive adults, physical activity units of less than ten minutes may make sense, as they can encourage the commencement of an active lifestyle. This recommendation is consistent with the understanding that physical activity even below the recommended volume of 150 minutes/week can be health effective [99].

Health benefits depending on the duration and frequency of the individual units of physical activity

Existing source recommendations give the minimum duration for one individual unit of physical activity as 10 minutes; in addition they describe the option of accumulating the overall duration of physical activity from individual units [17, 43]. Daily physical activity is desirable in order to achieve the desired acute and chronic metabolic effects [17, 43], with health effects considered certain if physical activity is undertaken three times a week. As far as the minimum or ideal frequency of physical activity is concerned, the source recommendations do not yet provide sufficient information. Some studies suggest that even one correspondingly long unit of physical activity per week is beneficial to health [17, 43].

Health benefits depending on the intensity of physical activity

According to source recommendations, it is certain that moderate-intensity physical activity results in the health benefits described. There are indications that vigorous-intensity physical activity reduces the risk of cardiovascular diseases and premature death more substantially than moderate-intensity physical activity (with the same energy expenditure). Accordingly, moderate-to-vigorous intensity physical activity is

recommended [46, 99]. It is assumed that the increased energy expenditure at higher intensities "counts" more. For very inactive individuals and those with a low level of fitness, low-intensity physical activity is also recommended [17, 43].

Health benefits depending on the type of physical activity

The evidence of health benefits from physical activity stem chiefly from epidemiological studies in which recreational physical activity as well as walking and cycling as a means of transport were recorded [17, 46]. In terms of overall mortality, cycling and walking as a means of transport appear to result in comparable risk reductions to recreational physical activity [17]. Based on meta-analysis indications, the Australian national physical activity recommendations state that the effects of work-related physical activity on reducing cardiovascular diseases are smaller than those of recreational physical activity [17]. The Canadian physical activity recommendations recommend work-related physical activity as well as physical activity as a means of transport in order to lower the risk of developing type 2 diabetes [140].

It seems that it is not the type of physical activity but the overall energy expended that is relevant for the prevention of overweight [17]. The ACSM Position Stand recommends a larger volume of physical activity in day-to-day life as a strategy in weight management programs [28].

The benefit of aerobic physical activity as well as strength exercise for bone health, especially amongst post-menopausal women, is considered assured in the source recommendations. The data available does not currently allow for any specific exercise norms for reducing the incidence of osteoporosis. What is certain is that the adaptations in the bone depend on exercise and are specific to the respective body part [17, 140]. In order to prevent osteoporosis, weight-bearing activities or activities with high ground reaction forces as well as strength exercise are recommended [17, 31, 140].

The significance of long sitting periods

There are indications that sedentary behavior increases the risks of developing chronic diseases such as type 2 diabetes, obesity, some forms of cancer or cardiovascular diseases and can be associated with higher mortality [17, 43, 63, 67]. Conversely,

there are studies on interrupting long sitting periods with light physical activity which highlight the significance of muscle contractions in supporting health-enhancing physiological effects [17]. Accordingly, it is recommended to limit the time spent sitting at work, during leisure time and in traffic and where possible to punctuate it with physical activity [17, 27, 43, 67]. It is not yet possible to specify the dose-response relationship based on the source recommendations available [17].

What are the risks of physical activity, and what should be considered before taking up or increasing physical activity?

It can be derived from the existing source recommendations that the benefit of physical activity is far greater than the risks.

Possible risks described include musculoskeletal injuries, cardiac events and upper respiratory tract infections [98]. The incidence of injury is low, and non-contact sports (power walking, running, swimming etc.) are far less risky with approximately one injury per 1,000 hours of physical activity than for example ball sports (basketball: 9.1 injuries per 1,000 hours). Cardiac events are very rare, with one event per 36.5 million hours of physical activity. On the whole, the risks can be minimized by taking precautionary measures such as slowly increasing the volume and intensity of activity, regeneration and recovery phases, correct implementation of physical activity as well as appropriate equipment. Upper respiratory tract infections are less frequent in moderately physically active people than in inactive individuals; the risk increases again for very active individuals [17].

The ACSM and the World Health Organization recommend a medical examination before taking up or returning to physical activity in the case of pre-existing diseases [43, 46]. The Deutsche Gesellschaft für Sportmedizin und Prävention or DGSP (German Association of Sports Medicine and Prevention) generally advises individuals taking up or returning to physical activity to be checked by a physician in order to identify potential pre-existing diseases and risks.

Physical activity recommendations for older adults

Target group

The recommendations contained here apply to older adults aged 65 and above.

They are based on the following source recommendations: The recommendations by the World Health Organization are geared to healthy and chronically ill older adults aged 65 and older [46], while the Canadian recommendations for physical activity are aimed at healthy, non-institutionalized individuals aged between 65 and 85 [94]. The UK recommendations define the target group as persons above the age of 65 [99], while the national recommendations for New Zealand distinguish between older adults aged over 65 and frail older adults aged over 65 [81]. The Position Stand by the American College of Sports Medicine (ACSM) for older adults is geared primarily to persons aged over 65, but also considers individuals in the 50 to 64 age group with more serious chronic diseases or functional limitations that reduce mobility, fitness or physical activity [21].

Recommendations

- Older adults should be physically active on a regular basis. This can help them to achieve significant health effects and to reduce the risk of developing chronic diseases
- The greatest health benefits occur when individuals who were entirely physically inactive become somewhat more active. This means that all additional physical activity is linked to a health benefit. Every single step away from physical inactivity is important, no matter how small, and promotes health

- To maintain and promote health comprehensively, the following minimum recommendations apply to older adults:
 - Older adults should have moderate-intensity aerobic physical activity for at least 150 minutes/week where possible (e.g. 5 x 30 minutes / week) **or**
 - at least 75 minutes/week of vigorous-intensity aerobic physical activity **or**
 - aerobic physical activity in a corresponding combination of both intensities
 - **and** should group the overall activity in at least 10-minute individual units distributed over days and weeks (e.g. at least 3 x 10 minutes/day or 5 x 30 minutes/week)
- Older adults with limited mobility should perform balance exercises at least three days a week in order to prevent falls
- Older adults should have muscle-strengthening physical activity at least two days per week
- Older adults should avoid long and uninterrupted sitting times and should regularly interrupt sitting with physical activity where possible
- Older adults can achieve further health effects if they increase the volume and/or intensity of physical activity above the minimum recommendations
- Older adults who cannot meet the recommendations due to health conditions should be as active as their current state of health allows

Reasons for the recommendations

General health benefits of physical activity

While the biological aging process cannot be halted through physical activity, regular physical activity is a prerequisite for maintaining physical functions. Regular physical activity can thus slow down the age-related physiological loss of function and increase life expectancy in good health [21]. Overall, comparable positive effects of physical activity can be expected for older adults as for adults aged between 18 and 65 (see the chapter on "Physical activity recommendations for adults") [21, 81, 94, 99]. The dose-response relationship between physical activity and health benefits also appears to be very similar for adults and older adults [99]. Older adults can achieve extensive health benefits if their physical activities comprise or address all motor abilities (strength, endurance, mobility, coordination) [21, 81, 99]. Older adults who were very inactive in the past already benefit from relatively little additional physical activity; greater volumes (>150 minutes per week) result in additional health benefits, which are however smaller in relative terms [99]. Because acute effects of physical activity are short-lived and are lost relatively quickly after the end of the exercise program, physical activity or exercise should take place regularly in order to create chronic adaptations [21, 99].

In addition, further health effects relevant for older adults from physical activity are described.

Reducing the risk of falling

The various source recommendations consistently agree on the ability of physical exercise to lower the risk of falling. There are reliable indications that this is the case from multimodal exercise programs comprising elements from at least two areas (strength, balance, flexibility or endurance) as well as Tai Chi as an intervention form [21, 81]. Physical activity-related fall prevention is also effective in a hospital or nursing home setting [81]. For older adults living independently, there are reports of a reduction in the relative fall risk of between 17 and 34%, and of 42% when they carry out challenging balance exercises and take a higher dose of physical activity (e.g. 50 hours of 2 x 1h/week) [126]. Accordingly, physical exercise is recommended as a central element of fall prevention strategies [21, 46, 77, 81]. Both group exercise and

exercise interventions that take place at home are effective. A large range of exercise volumes (from fewer than 9 hours to more than 75 hours) appear to be effective [77].

It is probable that lasting risk reduction can only be achieved if exercise takes place continuously. Strength exercise probably is most significant for individuals who are out of shape and can increase their functional capacity through improved strength. The role of general physical activity for fall prevention, i.e. not of systematic exercise, has not yet been clearly described. It appears certain that more active individuals suffer from fewer falls than inactive individuals. The effects of health sports activities like aerobic gymnastics, tennis, yoga or dancing have not been examined in detail. Because they require coordination and balance, it can be assumed that these activities can contribute to maintaining balance in middle-aged and older adults without a risk of falling.

Osteoporosis

Aerobic physical activity can counteract the age-related reduction in bone mineral density in post-menopausal women. Several large prospective cohort studies show that a high volume of physical activity, in particular walking, can reduce the risks of osteoporosis-related fractures by between 30 and 50% [21]. Furthermore, the positive effect of aerobic exercise and strength exercise on bone mineral density in pre-menopausal and post-menopausal women is seen as proven [21, 81].

In particular, weight-bearing physical activity is recommended to maintain bone density [31, 81]. Activities with higher intensities such as climbing stairs, brisk walking, walking with weights or running as well as intensive strength exercise are associated with more pronounced effects [21, 31]. The focus of the exercise should not only be on slowing down the loss of bone mineral density but also on maintaining or increasing muscle mass and strength in order to lower the risk of falling thanks to improved gait and mobility. At least three exercise sessions per week are recommended. The strength exercise should challenge particularly those muscle groups connected to bones frequently affected by osteoporotic fracture and that play an important role for gait and balance [31].

Independence, physical functions and activities

Physical exercise or activity is thought to have a positive effect on physical functioning capacity or lead to increased ease in carrying out everyday activities [21, 81]. However, the source recommendations report that the underlying data are not yet precise. Some but not all studies report improvements after exercise interventions including walking, climbing stairs and balance exercises. Some studies showed evidence of an improvement in various different functional tasks, while others indicate that the adaptations are more specific in the individual functional areas. The principle of exercise specificity suggests that the most unambiguous adaptations can be expected when the exercise program imitates the specific requirements of the activities of everyday life. The effect of the exercise and physical activity on maintaining functional capacity also appears to depend on hormonal status [21]. The literature review for the Canadian national physical activity recommendations [94] summarizes 66 studies on the effects of physical activity on functional limitations. The prospective studies show that regular physical activity in middle age and old age is linked to fewer functional losses; depending on the outcome variable, the risk reduction lies between 30 and 50%. Studies that also record the changes in physical activity behavior provide indications that even physical activity taken up later in life can be effective. Experimental studies show the positive effects of combined aerobic and strength exercise interventions on physical functions and activities in particular [94].

Cognitive functions

The source recommendations assume a positive link in relation to maintaining cognitive functions and preventing dementia. For example, the ACSM Position Stand states that regular physical activity reduces the risk of dementia and the risk of cognitive decline [21]. The intervention studies described show that physical exercise can lead to direct short-term improvements in memory, attention and reaction times. Regular activity can improve executive functions. In the national physical activity recommendations for New Zealand, based on two systematic reviews, six randomized controlled trials and one prospective cohort study it is assumed that physical activity can influence cognitive function positively [81]. Based on the 34 studies summarized for the Canadian physical activity recommendations, habitual physical activity appears to be linked to a lower risk of dementia and Alzheimer's disease [94]. In addition, physical exercise can improve cognitive functions in healthy older people. On the whole,

however, the underlying data are described as inconsistent. This was also confirmed in a comprehensive evidence report by Williams et al. [141] for the link between dementia and physical activity.

Psychosocial well-being and quality of life

Physical activity is associated with significant improvements in mental health and well-being as well as in some areas of quality of life [21]. New Zealand's national physical activity recommendations based on eight systematic reviews, eleven randomized controlled trials and one prospective cohort study found that physical activity is linked to positive effects on quality of life in both healthy and chronically ill older adults [81]. The intervention studies reported on therein provide indications that physical exercise can have a positive impact on quality of sleep and can promote vitality. On the whole, moderate-intensity physical activity appears to be more effective than low or high-intensity physical activity for improving well-being. The precise dose-response relationships cannot yet be described [21, 81].

The significance of long sitting periods

Some of the source recommendations available describe a link between the time spent sitting and an increased mortality risk (overall mortality, cardiovascular and tumor-related morbidity) [31, 81, 99]. There are also reports of indications that long periods spent sitting increases the risk of developing certain chronic diseases such as type 2 diabetes, breast cancer, cardiovascular diseases, dementia and osteoporosis. It is also assumed that sitting for long periods raises the risk of stroke and of mobility restrictions. Accordingly, older individuals are advised to limit the time spent sitting and where possible to interrupt with frequent physical activity. It is not yet possible to derive a precise dose-response relationship based on the source recommendations.

What are the risks of physical activity, and what should be considered before taking up or increasing physical activity?

It can be derived from the existing source recommendations that the general benefit of physical activity for older adults is far greater than the risks.

However, the need for older adults to take into account specific age-related risks is highlighted. For example, age-related sensory impairment or slowed reactions as well as possible pre-existing conditions mean that individual adjustments are necessary in terms of the type and dose of physical activity or its increase [46, 81, 94, 99, 126].

Older adults, in particular individuals who had been inactive along with individuals with existing illnesses, are advised to consult with a healthcare professional (e.g. doctor, sports scientist, physiotherapist) [81] or get medical advice before taking up exercise. [46]. The Deutsche Gesellschaft für Sportmedizin und Prävention or DGSP (German Association of Sports Medicine and Prevention) specifically advises individuals taking up or returning to physical activity to be checked by a physician in order to identify potential pre-existing diseases and prevent risks.

Physical activity recommendations for adults with a chronic disease

Target group

The recommendations apply to adults aged between 18 and 65 with a chronic disease such as type 2 diabetes, chronic obstructive pulmonary disease (COPD), arthritis in the hip or knee, clinically stable ischemic heart disease, after a stroke (> 6 months after the acute event), with clinical depression or chronic non-specific back pain.

Recommendations

- Adults with a chronic disease should be physically active on a regular basis. This will allow them to achieve significant health effects
- Health effects already take place when individuals who were entirely physically inactive become somewhat more active. This means that all additional physical activity is linked to health benefits. Every single step away from physical inactivity is important, no matter how small, and promotes health
- In order to maintain and promote health comprehensively, adults with a chronic disease should follow the physical activity recommendations for adults without chronic illnesses. Most adults with a chronic disease can and should have
 - moderate-intensity aerobic physical activity for at least 150 minutes/week where possible (e.g. 5 x 30 minutes / week) **or**

- at least 75 minutes/week of vigorous-intensity aerobic physical activity **or**
 - aerobic physical activity in a corresponding combination of both intensities
 - of which the overall activity should be in at least 10-minute individual units distributed over days and weeks (e.g. at least 3 x 10 minutes/day on five days per week)
 - **additionally**, should also have muscle-strengthening physical activity at least two days per week
- In phases in which they cannot be as physically active as the recommendations for healthy adults suggest, e.g. due to severity of the illness, symptoms or physical functional capacity, adults with a chronic disease should be as active as their current situation permits
 - To increase the safety and effectiveness of physical activity, adults with a chronic disease should
 - have a (sports) medical examination carried out when beginning a physically active lifestyle or entering a physical exercise program decide together with a doctor whether independent implementation of physical activities is safe and appropriate or whether it is better to have professional care from physical activity professionals upon commencement
 - adjust the dose of physical activity (type of physical activity, exercise intensity, duration, frequency) individually together with a physical activity professional
 - obtain professional advice from healthcare professionals in phases of progression of the illness, lack of control over the illness or deterioration of the state of health. as it may be necessary to change physical activities or even take a break

Reasons for the recommendations

The generic physical activity recommendations described here for adults with a chronic disease are based on disease-specific physical activity recommendations developed separately for seven nationally significant diseases [101]. Namely for arthritis (hip/knee), type 2 diabetes, chronic obstructive pulmonary disease (COPD), clinically stable ischemic heart disease, stroke, clinical depression and chronic non-specific back pain. These seven disease-specific recommendations can be found at www.sport.fau.de/bewegungsempfehlungen (German language).

Health effects of physical activity with chronic diseases

Physical activity is highly significant for the health of adults with a chronic disease, and constitutes an effective therapy option as exercise therapy [95, 123]. Consequently, exercise therapy is used as an extensive standard intervention as part of medical rehabilitation of chronic diseases. The diverse health effects of physical activity for individuals with chronic diseases include favorable effects in terms of pathogenesis and pathophysiology, weakening of symptoms, increased physical functional performance and capacity, improved psychosocial well-being as well as a better health-related quality of life [e.g. 95, 123]. For some diseases, the positive effects of physical activity on overall mortality rates are also proven, for example in the case of type 2 diabetes and obesity [38, 115] or for cardiovascular diseases [14].

What are the risks of physical activity, and what should be considered before taking up or increasing physical activity?

Physical activity is linked to a variety of positive health effects for people with a chronic disease. However, physical activity is not completely without risk for such individuals. In particular any increase in the level of physical activity as well as the commencement of a physical exercise program can be linked to a higher risk of the occurrence of side effects and the incidence of undesired events [106, 137]. Potential risks of physical activity range from minor negative effects (e.g. sore muscles) to severe and life-threatening side effects (e.g. heart attack).

Most of the risks of physical activity can be minimized by adjusting the exercise individually to the disease and symptoms, and by finding a suitable type of physical activity [74]. Side effects can be avoided if implemented correctly. Suitable physical activity in line with the recommendations for healthy adults can be carried out safely and at low risk by adults with a chronic disease [13, 20, 35, 37, 39, 42, 53, 82, 91, 104, 144]. The positive benefits of physical activity outweigh the costs or side effects [52]. A sedentary or physically inactive lifestyle is linked to more significant health risks (e.g. in relation to the emergence of follow-on damage and related illnesses) than physical activity [72, 114].

The incidence of side effects among adults with a chronic disease from physical activity depends among other things on the nature and severity of the disease, individual symptoms, the individual level of fitness as well as on the type and dose of physical activity (e.g. type of physical activity or sport, intensity, volume of physical activity) [45, 106]. In order to assess current state of health and fitness precisely, it is essential for men and women with a chronic disease to obtain medical advice or undergo a medical check before beginning a physical exercise program and before increasing their physical activity [13, 20, 42, 44, 45, 60, 91, 114, 144]. The physician should clarify, among other things, the nature and severity of the health issue and consider tests of physical functions/structures, limitations of activities and participation as well as individual context factors. Based on this, the risk for the incidence of side effects can be estimated and suitable physical activities and exercise doses can be selected [2]. Further to the medical examination, it can be decided whether the persons concerned can be physically active independently or whether it makes sense to be assisted by physical activity professionals.

Based on a medical examination, physical activity professionals can help individualize and adjust physical activities, e.g. in relation to symptoms, pain, physical performance and capacity, psychological state, experience with physical and sporting activity, exercise-related preferences etc. [35, 53, 105, 136]. Professional support and expert instruction by a physical activity specialist should in particular play a part for persons who, because of their chronic disease, a) are subject to a higher risk of side effects from physical activity, b) need physical activity to be customized to their current symptoms, c) need adjustments to medications or d) are fearful in respect of physical activity [18, 37, 75, 91, 113, 144]. For individuals with a chronic disease that does not entail any limitations in terms of carrying out physical and sporting activities, these individuals can be physically active independently. Professional support and instruction is not essential.

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Recommendations for physical activity promotion

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Concept

In these recommendations, the term "physical activity promotion" relates to targeted measures geared to improving the physical activity behavior of individuals. These measures include approaches targeting individuals as well as approaches targeting entire populations or sub-populations. Recommendations are made for the target groups of children and adolescents, adults, older adults, adults with pre-conditions and the general population. The recommendations are based on three pillars: theory, evidence and quality.¹

Theoretical frame of reference and classification

Physical activity behavior in the population depends firstly on the physical activity-related knowledge and the corresponding abilities and motivation of the individuals. Secondly, the opportunities for physical activity that the individuals have in their individual settings, e.g. at school, at work or in their home environment, are also significant. A socio-ecological view has become established in theoretical models on physical activity promotion that considers individual physical activity behavior to be embedded in different "physical activity circumstances", i.e. behavior-relevant settings which in turn are shaped by certain environmental conditions and political regulations. In this context it is important to take into account not only the single components of such models but also the various interdependencies between individual action and structural framework conditions.

In general, there are various options for classifying physical activity promotion measures: distinctions based on the type of intervention (e.g. mass-media campaigns, physical activity counseling), the setting in which they take place (e.g. school, work),

¹ Detailed scientific documentation of the theories and quality criteria underlying the concept as well as the evidence-based methods used can be found in an accompanying publication as a special issue of the medical journal "Das Gesundheitswesen".

the target group (e.g. children, older adults) or a mix of different categorizations. In order to link the target group specific recommendations for physical activity (see above) with physical activity promotion recommendations consistently, a classification by target group is used as a basis in the following. It is on this basis that the further differentiation according to the theoretical frame of reference is made, primarily across the target group relevant settings.²

Evidence base

A fundamental characteristic of the following recommendations for physical activity promotion is their evidence base. This means that enough evidence should exist for the effectiveness of a recommended measure. The cause-and-effect of an intervention for promoting physical activity (efficacy) as well as its further effectiveness in terms of public health, i.e. promoting health at the population level (effectiveness), must be considered. In addition, the effectiveness of an intervention can be expressed in terms of its cost in proportion to the expected benefit (cost-effectiveness).

Evidence of effectiveness is different for the first and second criteria: For efficacy, ensuring internal validity by means of rigid controlled experimental study designs as well as the impacts measured are the relevant factors. By contrast, the factors relevant for public health effectiveness include external validity as well as feasibility in everyday use and robustness, i.e. implementability of a measure in different contexts. Other relevant factors for public health significance include the extent of the impact of an intervention (e.g. physical activity promoting influence on the general population, on certain sub-populations or on selected small groups of individuals) as well as the effects on health equality. Determining cost-effectiveness involves expressing the efficacy and effect-size of an intervention in relation to its reach and costs. The convincing factor for demonstrating cost-effectiveness is to provide evidence of an improved cost-benefit ratio from the physical activity promotion intervention compared to no intervention and/or other interventions.

When considering the evidence base of interventions in recommendations for physical activity promotion, a distinction can be made between different levels of evidence and

² A detailed description of the theoretical frame of reference and the classification is included in Rütten et al (I) in the special edition of the medical journal "Das Gesundheitswesen" [1].

corresponding recommendation levels. In the present context, a pragmatic distinction is made between three evidence levels: (1) "Strong evidence" – proof of effectiveness generally exists in the form of systematic scientific reviews of a large number of single studies; (2) "Medium evidence" - proof of effectiveness based on individual reviews and a small number of studies; (3) "Weak evidence / not researched" – no proof of effectiveness or only single studies. Because of the heterogeneous nature of the intervention approaches and of the methods used to test effectiveness, a more detailed presentation of the evidence level does not appear relevant.³

Quality criteria

In addition to the "What?" (intervention with proven effectiveness), recommendations for physical activity promotion should also incorporate the "How?", i.e. the effective implementation of such interventions in practice. Quality criteria can be determined for the design, implementation and evaluation of physical activity promotion. They provide information on factors that should be considered in order to safeguard the long-term effectiveness of evidence-based interventions in practice.

The fundamental quality criteria for designing interventions for physical activity promotion relate to the use of theory and multiple components of the intervention approach, the relevance for the context and target group as well as the involvement of different stakeholders (especially the target group, relevant professional groups/multipliers and decision makers). Other relevant factors of course include the appropriate specification of endpoints and of the target behavior as well as differentiated planning of the content and organizational procedure in terms of quality management.

Quality criteria for the long-term implementation of physical activity promotion include appropriate involvement of different stakeholders in implementation and, in a related area, empowerment of the stakeholders and/or capacity development of the organizations involved. In addition, quality in this context is determined by an appropriate amount of resources, the interconnectedness of the stakeholders in cooperation and partnership as well as a suitable balance of "program loyalty" and

³ A detailed description of the evidence base is included in Rütten et al (1) in the special edition of the medical journal "Das Gesundheitswesen".

necessary adjustment to the implementation context. A further criterion for the implementation quality is sustainability in terms of a lasting structural entrenchment of the measure.

Last but not least, there are four dimensions with corresponding quality criteria as far as evaluation is concerned: process evaluation, the evaluation of reaching the target group, adequate evaluation of the results as well as evaluation of the cost-benefit ratio.⁴

Scientific basis and structure of the recommendations for physical activity promotion

Based on the existing concept, there are four main criteria for the development and structuring of the recommendations. The top priority is scientific proof of the efficacy of an intervention in terms of physical activity promotion. In addition, the effectiveness from a public health perspective (e.g. health equity), the cost-effectiveness and the quality of implementation in practice are taken into account.

(1) Scientific proof of the effectiveness for promoting physical activity

(2) Effectiveness in terms of promoting public health

(3) Cost-effectiveness

(4) Quality of design, implementation and evaluation

In order to develop scientifically proven recommendations for physical activity promotion against this backdrop, three comprehensive scientific reviews were carried out to investigate the current state of research:

- A systematic review of reviews of interventions for physical activity promotion. This review included more than 200 reviews on thousands of single studies. Over one third of those relate primarily to children and adolescents, somewhat fewer to adults and considerably fewer to older adults. Approximately 20% of the reviews are geared primarily to adults with pre-existing diseases, while approxi-

⁴ A detailed description of the quality criteria is included in Messing et al in the special edition of the medical journal "Das Gesundheitswesen".

mately 30% deal with the general population. It was possible to allocate one review to several target groups.⁵

- A systematic review on the health-economic effectiveness of interventions for physical activity promotion with a total of 25 reviews and more than 100 single studies.⁶
- A review of quality criteria of interventions for physical activity promotion that comprised more than 30 scientific publications and documents by relevant stakeholders (e.g. WHO, BZgA (Federal Centre for Health Education)).⁷

In the following sections, recommendations are set out for each respective target group and these are followed up by the scientific reasons. Existing evidence in terms of scientific proof of the efficacy of interventions is given priority. In addition, to the extent possible based on the existing evidence, recommendations are also formulated from the aspects of public health effectiveness (e.g. health equity), health-economic effectiveness and quality criteria (in particular for implementation).

The structure is in accordance with the division into population groups (children and adolescents, adults, older adults, adults with pre-conditions), which was also used for the recommendations for physical activity. In this way, a direct link can be made between the two sets of recommendations. Within the population groups, classification is generally in accordance with the respective relevant setting. The special significance of setting-based interventions is recognized as set out in the theory e.g. the socio-ecological models mentioned at the outset and politically for example in the German Act to Strengthen Health Promotion and Disease Prevention ("Präventionsgesetz"). In this way, a foundation is laid to render the recommendations usable for the different professional groups and multipliers involved in the respective settings. Additionally, the "General population" chapter sets out recommendations for population-based physical activity promotion measures.

⁵ A detailed description is included in Abu Omar et al in the special edition of the medical journal "Das Gesundheitswesen".

⁶ A detailed description is included in Rütten et al (II) in the special edition of the medical journal "Das Gesundheitswesen".

⁷ A detailed description is included in Messing et al in the special edition of the medical journal "Das Gesundheitswesen".

Children and adolescents

Overview

Promoting physical activity in children and adolescents should refer to all settings relevant for that target group and should take mutual influences into consideration. These include in particular the family and home environment, child care facilities, schools and settings where children and adolescents can be physically active in their leisure time, e.g. sport clubs.

In terms of the development of the infrastructure and transport routes in municipalities, special consideration must be given to the physical activity needs and opportunities for children and adolescents. This encompasses urban planning (e.g. safe cycling and walking paths) and designing the residential environment (e.g. places to play) as well as access to and the child and adolescent-friendly design of parks, leisure and sports facilities (see also "Recommendations for the general population" below)

Table 3: Status of research on the effectiveness of interventions for promoting physical activity in children and adolescents.

Status of research	Settings of children and adolescents
Strong evidence: Detailed evidence-based recommendations can be made for this setting / these settings.	School
Medium evidence: Limited recommendations can be made for these settings based on individual reviews and a small number of studies.	Family and home environment Child care facilities
Weak evidence / not researched: No recommendation can be made based on the status of research.	Leisure and sport

Based on the number of extant empirical studies on physical activity promotion, research on the target group of children and adolescents is clearly top of the table [2]. This in turn is primarily attributable to the dominance of school-related research [3]. The majority of the reviews underlying the recommendations for children and adolescents also refer wholly or partly to this setting. The status of research on the home setting as well as in child care facilities is already much smaller in scope. For leisure settings such as sport clubs, the current stock-take suggests that scarcely any scientifically proven research exists in terms of reviews and/or individual studies on the empirical evidence of physical activity promotion for children and adolescents.

Children and adolescents

Recommendations

Physical activity promotion in different settings

Family and home setting

In the first years of a child's life, the home setting provides the most important impetus for physical activity. Parents in particular play a central role and should be actively included in interventions for physical activity promotion.

It is recommended that parents are physically active together with their children, that they are a role model for physical activity, support the child's urge for physical activity and give them materials to promote physical activity.

Two systematic reviews investigate the influence of parents on the physical activity of children in their early years [4, 5]. Both reviews come to the conclusion that there is a clear link between physical activity and the attitude of the parents and of their children and that parental support and encouragement promotes the physical activity of the children. Various individual studies also describe a physical activity promoting effect if parents provide children with diverse materials for physical activity [4].

Two further reviews are relevant for family-based interventions with schoolchildren. While one is primarily concerned with the additional effect the involvement of parents/family has on the effectiveness of school-based physical activity promotion [6], the other focuses on interventions in home settings. Based on the review, the active involvement of the parents in corresponding interventions is highly recommended [7].

Child care facilities

In educational and day care facilities for children below the age of six, e.g. child care facilities, an appropriate environment should be created for physical activity to allow the children to develop physical activity. In particular, spaces that can be freely designed by children for physical activity are recommended. Educational staff well trained in physical activity promotion should accompany the children's activities. It is also recommended that the parents or reference persons are involved to increase physical activity.

Compared to the large number of reviews on the school setting, only a few reviews were found and considered relevant for the child care facilities setting. Of those, one was also focused on a different area (obesity), only included a small number of studies and found the evidence to be inconsistent [8]. Another oft-cited Cochrane review found absolutely no studies effective for physical activity promotion for the 0 to 5 age group [9].

In one of the remaining three reviews, fewer than half the studies arrive at positive conclusions regarding the promotion of physical activity [10]. The authors conclude that good outdoor equipment and corresponding training measures for teachers and child care staff lead to significant effects. According to the review, additional materials also have a consistently positive influence on the physical activity of the children in child care. Regular structured exercise sessions can increase the scope and intensity of physical activity but should not replace free time for physical activity. Based on two studies it was found that outdoor activities do not increase when children are given more time. They are most active in the first quarter of an hour. Consequently, the recommendation is to provide for more periods spent outdoors but not to extend the individual periods [10]. Another review analyzed studies against the background of a socio-ecological model [11]. Only a few of the studies recorded were described as very high quality, and only two of those demonstrated significant effects of the intervention on physical activity. The most promising measures were those that are structured and offered on a daily basis. The staff seem to play an important role, with staff who themselves enjoy physical activity supporting the success of a measure to promote physical activity. The authors cautiously see the expertise of the teaching

staff as the central success factor and recommend corresponding training [11]. Likewise in one systematic review on physical activity promotion among children aged between two and five, significant effects on the objectively measured physical activity were substantiated only in the minority of the studies [12]. The corresponding interventions took place in a child care facility and involved a structured physical activity program of 20 to 45 minutes per unit. Based on the individual studies, the authors point out that these structured physical activity programs should not reduce the amount of free (unstructured) play time and that instead both variants should be integrated in a child's day as opportunities for physical activity. In addition, the majority of effective interventions had in common that they comprised several components and were theory-based. Half of them also actively involved the parents in promoting physical activity [12].

Schools

The school setting has proved to be a central point of departure for promoting physical activity among children and adolescents. There is a range of measures which are sufficiently evidence-based. Accordingly, multi-component approaches are especially highly recommended, i.e. school-based interventions that integrate various measures to promote physical activity.

The following are recommended as individual measures and in combination with other measures: (1) Increasing the amount of time spent on physical activity, i.e. more physical education and more physical activity offerings outside of class (e.g. breaks for exercise), (2) Improving the quality of the physical activity offerings (e.g. optimizing the time spent on physical activity in physical education class by means of improved offerings and teaching methods) and (3) Developing the skills of the staff used to promote physical activity (e.g. physical education teachers).

In addition, the following recommendations are specific to multi-component approaches: (1) Integrating the promotion of physical activity (better) in school curricula, (2) Creating a school environment conducive to physical activity (e.g. by means of possibilities for physical activity using infrastructure, equipment), (3) Involving parents in promoting the physical activity of their children and (4) Promoting active transport for getting children to school (in combination with the involvement of the parents and community).

In principle, it is fair to say in terms of efficacy that – based on the existing evidence – the special focus on promoting physical activity at school is justified [13]. School-based interventions that integrate several components are particularly effective [3, 13-18]. The individual measures shown in the above recommendations are consistently listed as evidence-based components [3, 9, 15, 18, 19].

In terms of prioritizing possible individual strategies, based on existing evidence a potential emphasis could be placed on optimizing physical education (more time, better geared to physical activity, trained sports teachers), as there is clear evidence of the potential effects on physical activity in children and adolescents [9, 15, 18-21]. The effectiveness of brief activity breaks during class that are integrated in day-to-day school life as organizational routines, is also proven [21, 22]. By contrast, there is currently no clearly positive evidence in relation to other physical activity offerings during recess or that take place after school but in a school setting (e.g. as after-school support) [23].

Although moderate effects were determined for sub-components (provision of play equipment) of interventions to create possibilities for physical activity [15, 24, 25], the effectiveness of solely policy and environmental approaches that relate only to a change in school policy (e.g. health-promoting physical activity on the curriculum) or in the school environment (e.g. more possibilities for physical activity) should be assessed more cautiously. In fact, such measures become effective primarily in combination with direct behavioral approaches (e.g. physical activity offerings aimed at changing behaviors) [26]. The involvement of parents in promoting physical activity in their children is also recommended across the board as part of a multi-component approach [3, 6, 7, 9, 21, 27].

Existing findings on the effects of interventions to promote active transport to school are positive but qualified. Based on the evidence available, these approaches are recommended especially if they focus clearly on this objective and are supported by the involvement of schools, parents and communities [28].

A clear distinction should be made between the multi-component approach recommended above in terms of promoting physical activity which for example combines more time for physical activity and competency development for physical education teachers and an approach that has several behavioral components as its objective, i.e. that integrates measures to change physical activity behavior and dietary behavior for example. In this regard, three of the reviews considered relevant contain clear indications [14, 28, 29] that interventions exclusively geared to promoting physical activity are more effective than interventions that also seek to change various health behaviors at the same time.

Other settings

No sufficient evidence base for recommendations yet.

Interventions in other relevant settings for children and adolescents such as community and healthcare facilities are integrated in some of the broader-based reviews mentioned, but there are no recognizable standalone strategies with an evidence base that can be used for recommendations. So far there is no scientific review on the effectiveness of sport clubs as a setting for promoting physical activity among children despite the fact that, at least in Germany, the majority of children and adolescents are involved in clubs (see the recommendation below on the special promotion of research on the promotion of physical activity by sport clubs).

In the only review considered relevant in this context on the effectiveness of computer and web-based interventions on physical activity promotion, the authors distinguish between "School" and "Home setting" [30]. Because the status of research on these approaches is not well developed and inconclusive, it does not seem pertinent to make recommendations in favor of or against such approaches at present. This also applies to the related area of interventions for physical activity promotion via

internet-based social networks (one existing review on this topic includes just a very small number of individual studies [31]).

Effects on health equity

No sufficient evidence base for recommendations yet.

One important overriding topic for all interventions to promote physical activity that so far has only been investigated specifically for children and adolescents in one of the reviews included relates to inequality in terms of physical activity that can possibly be increased or reduced by corresponding interventions [32]. Although it is scarcely possible to derive recommendations from that review due to the very early stage of research, there are now comprehensive reviews on this topic that indicate three tendencies: (1) Environmental interventions appear more suitable than behavioral and/or individual interventions for counteracting any inequality [33], (2) Health equity can be promoted by interventions geared directly to socially disadvantaged groups [34] and (3) Interventions should facilitate active participation of the target groups in decisions concerning the structure and implementation of the intervention [34].

The question of who benefits from which interventions and whether boys need different interventions from girls was analyzed in connection with promoting physical activity in child care facilities [11], but there is no clear answer to this question. Boys tend to have a higher activity level than girls in interventions related to types of sport (e.g. ball games). But if boys and girls are observed not just during the period of the intervention but over the entire day, there is scarcely any evidence of differences when measuring activity levels. The aspect of competitiveness also appears to attract boys more than girls. If this aspect is not important in the child care facilities, there are no differences in the physical activity of boys and girls. Girls benefit more than boys from more playground space, provided that there are not too many children there [11].

Cost-effectiveness

To ensure optimal use of resources for promoting physically activity in different settings, it is recommended to observe the respective cost-effectiveness when choosing between the effective measures recommended to date.

From this perspective, regulatory measures are recommended which in an institutional context lead to more time for physical activity (e.g. more physical education) and more physical activity-related teaching skills (e.g. through changed training curricula). Low-cost environmental measures are also recommended, such as opening up existing spaces indoors and outdoors (e.g. sports halls, school yards) for physical activity and making simple changes to such spaces for physical activity use (e.g. by marking out playing fields).

The use of resource-intensive interventions such as instructed exercise programs is recommended in particular for selected target groups of children and adolescents who are more difficult to reach through population-related measures to promote physical activity (e.g. socially disadvantaged groups) or have certain health risk factors (e.g. overweight).

An analysis of the cost-effectiveness of measures to promote physical activity in children and adolescents can take place using different perspectives [35] and thus leads to some contradictory conclusions. For example, on the one hand findings cite a greater need for and economic legitimization of state intervention in preventive measures for children and adolescents than for adults [36] and show that interventions targeted at this target group have the most potential to be cost effective

because of the longer time-frame over which health benefits can be realized [37]. On the other hand, from the perspective of the cost carriers in the healthcare system, relevant factors include for example the time-frames in which significant effects of measures to promote physical activity on the cost of illnesses can be observed: While this can take between 40 and 50 years for children and adolescents, the corresponding cost reductions can already be expected after a very short time for older adults [38].

Studies from a school setting also dominate investigations of cost-effectiveness for the target group of children and adolescents. As already indicated above, the findings are inconclusive: While one review classified interventions to promote physical activity at school relatively cost effective as long as no additional personnel costs were incurred [39], another review deemed precisely the included school interventions not to be cost effective [40]. These contradictory findings are primarily attributable to the use of different methods when determining cost-effectiveness.

In terms of simple environmental measures in a school setting, one review cited two studies that found such measures to be highly cost effective [39]. In addition, the above recommendations on cost-effectiveness are based on findings from different reviews carried out within a broader context (e.g. on regulatory and environmental measures as a "best buy" [40]). Several reviews arrive at the conclusion that more cost-intensive measures such as individualized exercise programs are potentially necessary in order to reach certain target groups (e.g. socially disadvantaged groups) and to obtain greater effectiveness with regard to risk groups [39, 41, 42].

Quality criteria

For the successful implementation of the evidence-based measures listed, compliance with the following quality criteria is especially relevant: (1) Ensuring the resources necessary for implementation (e.g. in terms of materials, spaces, finance and the time and number of persons used), (2) Developing the capacities needed for successful implementation by means of further training and other empowerment approaches, (3) Long-term support by the management and administration of the institution for implementation of the measures, (4) Compatibility or adjustability of the measures selected for the respective context and (5) Ensuring the involvement of all relevant stakeholders (e.g. children, their families, teaching staff and management) in planning, implementation and evaluation.

Ultimately the actual effectiveness of the strategies to promote physical activity recommended here depends on how they are implemented in the respective real-life context. There is currently one review that examined the evidence for implementation factors specifically for school-based interventions to promote physical activity [27]. It found that the requisite time and personnel resources of those carrying out the physical activity promotion measures must be considered alongside the necessary support from the whole "school family" as well as the potential adjustment of the approach to the respective school setting [15, 19].

Adults

Overview

Promoting physical activity in adults should refer to all settings relevant for that target group and should take mutual influences into consideration. In addition to the home environment, a special role is played by the workplace, primary care institutions (e.g. doctors' practices, clinics) and settings where adults spend their free time (e.g. sport clubs).

Furthermore, the community setting is of course also significant for adults, e.g. with the possibilities for physical activity that arise from the infrastructure and transport routes (see also "Recommendations for the general population" below).

On the whole, there are a considerable number of empirical reviews on the promotion of physical activity in adults. However, most of these are concerned with one specific type of intervention: physical activity counseling, which in some cases is in

Table 4: Status of research on the effectiveness of interventions for promoting physical activity in adults.

Status of research	Settings of adults
<p>Strong evidence: Detailed evidence-based recommendations can be made for this setting / these settings.</p>	There was no strong evidence for any setting.
<p>Medium evidence: Limited recommendations can be made for these settings based on individual reviews and a small number of studies.</p>	Work Health care Home environment
<p>Weak evidence / not researched: No recommendation can be made based on the status of research.</p>	Leisure and sport

turn linked to exercise programs (e.g. exercise referral schemes). Overall, research on promoting physical activity in the workplace as well as on physical activity counseling as part of health care is dominant in this context. A range of reviews are available for both of these areas. However, the findings concerning the effectiveness of specific intervention components for these approaches are insufficient, such that the status of research can only be classified as average in this respect. In addition, based on this stock-take, research only seems to be developing at best for physical activity counseling at home, e.g. via telephone or computer aided. For the adult target group, there is no sufficient evidence base yet for other interventions and recreational settings.

Adults

Recommendations

Physical activity promotion in different settings

Workplace

As an evidence-based measure for promoting physical activity at work, multi-component approaches are recommended that should above all else incorporate the following elements: (1) Specific course offerings (exercise programs) for the staff, (2) Redesigning work processes (e.g. incorporating exercise breaks) and (3) Creating infrastructures that promote physical activity at work (e.g. on-site fitness facilities, bicycle parking).

The evidence available suggests that multi-component approaches are particularly important for the workplace. For example, one review of 15 reviews examined the effects of lifestyle-based interventions (including physical activity) in the workplace. On the whole, the authors found evidence for small effects on physical activity from these interventions. Based on their analysis, multi-component approaches are most effective that involve for example providing on-site fitness facilities, reorganizing company processes to promote physical activity, encouraging "active transport" (e.g. with bicycle parking, showers) and pedometer-based interventions (i.e. that go beyond merely informative physical activity counseling) [43]. Another review of reviews comes to a similar conclusion, presenting multi-component approaches in companies as effective and recommendable [44].

By contrast, there is currently no sufficient evidence for single health-promotion measures at work through physical activity. For example, one review on interventions aimed chiefly at promoting the use of the stairs at work found that only a minority of the single

studies demonstrated effects on physical activity behavior [45]. In another review, interventions were analyzed that were mostly geared to information and advice on physical activity in workplaces. The authors concluded that there were no uniform outcomes regarding the effectiveness of these interventions [46]. According to two further reviews, there are currently also no sufficient indications that interventions to reduce sitting at work are effective [47, 48].

Physical activity counseling and exercise programs in different settings

One frequently examined approach for measures to promote physical activity in different settings is "physical activity counseling". This can involve passing on information on the health benefits of physical activity, targeted instructions for physical activity or exercise programs.

Based on the evidence available, physical activity counseling can be recommended as an approach for promoting physical activity in different settings. Even short interventions can have an impact, but an increase in physical activity is all the more successful the more time that is spent on physical activity counseling and the longer it is implemented. In this regard, there is also a recommendation to combine the counseling with specific activation measures, in particular using pedometers.

General evidence on physical activity counseling and exercise programs

Physical activity counseling is the most commonly examined intervention approach for promoting physical activity in adults. By contrast, the almost complete lack of any reviews on the specific effectiveness of exercise programs is striking. In the various reviews, interventions that include exercise programs are generally subsumed under physical activity counseling [e.g. 49, 50]. As a consequence, it is not possible to decide whether effects on physical activity behavior were obtained through counseling, teaching cognitive strategies or an exercise program.

In a meta-analysis of physical activity counseling [51], significant effects on physical activity were determined for a small majority of these measures. As a tendency, these findings are confirmed by four further reviews [49, 52-54]. These interventions are more successful when the aim is to achieve short or medium-term effects on physical activity. By contrast, one review on long-term effects of physical activity counseling shows [49] that more often than not such effects are not achieved. Furthermore, that review raises the fundamental question surrounding the efficiency of such interventions when it is taken into account that they have to be carried out at very frequent intervals and often only achieve short to medium-term effects [49] (see below: Cost-effectiveness).

Interventions with pedometers

One special type of intervention involves physical activity counseling that uses pedometers. Pedometers allow adults to control their physical activity behavior independently. In many studies, the use of pedometers is linked to a specific target for the participants (e.g. 10,000 steps per day). According to one meta-analysis [55], an increase in physical activity of approximately 2,000 steps per day was achieved in interventions to promote physical activity with the help of pedometers. However, the follow-up periods vary, as a result of which it is not possible to make a statement concerning medium or long-term effects. The observable effects were greatest in instances where the intervention was explicitly linked to the goal of walking 10,000 steps per day. Another review on this topic arrives at similar conclusions [56].

Physical activity counseling in health care

Physical activity counseling as part of health care generally takes place within the framework of medical routine examinations of healthy adults. The counseling is either carried out directly by medical staff or the medical staff refer patients to other specialists or institutions such as sport clubs or gyms (exercise referral scheme). A distinction can be made between programs that use one-off "brief interventions" (e.g. ten minutes) and those that operate over longer periods with several counseling sessions.

On the whole, the evidence base of this type of measure to promote physical activity is considered inconclusive and insufficient. For example, several reviews complain of

the lack of high-quality studies [57, 58]. Across all of the reviews, only just over half of the studies showed effectiveness. Moreover, two reviews question in particular the medium and long-term effectiveness of exercise referral schemes [50]. By contrast, two meta-analyses found a (small) positive effect specifically of short physical activity counseling on physical activity behavior [59, 60].

Physical activity counseling using computers and new technologies

In recent years, more and more interventions to promote physical activity have been developed that use computers and new technologies. These interventions often combine face-to-face or telephone counseling sessions with sending or referring to computer-based intervention content. On the whole, the evidence for the effectiveness of this type of intervention is currently considered insufficient. This is due first and foremost to the fact that only a small number of reviews have so far examined such interventions, and the results are rather inconclusive. As a result, it is not yet possible to make a recommendation in relation to this type of intervention.

The interventions in the different reviews are heterogeneous and some of them also use newer technologies alongside face-to-face and telephone counseling. While two reviews reported that the majority of studies found that computer-aided physical activity counseling had an effect on physical activity behavior [61, 62], two further reviews found only a small amount of evidence for the effectiveness of interventions that use social media (e.g. Facebook, Twitter) [31] or special websites [63]. According to another review, only around half of the studies that use websites showed moderate effects on physical activity behavior [64].

Effects on health equity

No sufficient evidence base for recommendations yet.

The status of research on the impact of interventions to promote physical activity on health equity in adults is still rudimentary. One review devoted specifically to socially disadvantaged women found in the studies analyzed that group-based interventions to promote physical activity were particularly effective [65]. In addition, a review by

the WHO compiled not scientific studies but projects evaluated systematically by experts and determined various characteristics of interventions to promote physical activity that help to reach socially disadvantaged groups. These include the participation of the target group(s) in designing, implementing and evaluating the intervention, the cultural sensitivity of intervention content and the development of intersectoral and multidisciplinary networks for the development and implementation of such interventions ([66], see Quality criteria below). As already mentioned for children and adolescents, reviews comparing different intervention approaches also indicate that environmental approaches should be implemented in order to reduce health inequity and that interventions should be geared directly to socially disadvantaged groups [33, 34].

Cost-effectiveness

Based on the extant scientific evidence, physical activity promotion in the workplace as part of multi-component approaches can be recommended as cost effective.

In the context of "physical activity counseling", brief physical activity counseling sessions are recommended from a cost perspective. It should be noted, however, that these generally only achieve small effects on physical activity behavior. More intensive physical activity counseling and exercise programs under supervision are often more cost intensive. The implementation of these measures can be recommended in particular for special target groups of adults (e.g. socially disadvantaged individuals, people with health risk factors).

Various reviews exist on interventions in the workplace that show such measures to be cost effective or even cost-saving, e.g. through lower illness-related costs and the reduction of health-related absenteeism that is higher as the intervention costs [67, 68]. However, the corresponding measures and studies generally incorporate physical activity promotion in more complex approaches to health promo-

tion at work. In addition, one more recent review found that such "return on investment" was only evidenced in non-randomized trials [69].

The ultimate cost-effectiveness of individual physical activity counseling and exercise programs depends not least on their specific design and on the costs included in the calculation. Brief interventions, i.e. physical activity counseling in one individual or several short sessions, appear generally to be implementable with a comparatively high level of cost-effectiveness [70, 71]. By contrast, exercise programs carried out over a longer period and under professional instruction are less cost effective [41, 72].

According to the most recent review, exercise referral schemes are no longer being seen as cost-effective [73]. The tendency is that such interventions are more resource-intensive than other physical activity counseling measures, particularly when they require professional instruction and social support [39]. Nevertheless they are necessary in certain circumstances in order to reach certain target groups such as socially disadvantaged groups and to achieve more pronounced effects in risk groups [41].

Quality criteria

For the successful implementation of measures to promote physical activity in adults, compliance with the following quality criteria is especially recommended: (1) A theoretical basis for the specific measures, (2) Appropriate training for staff responsible for physical activity counseling and (3) Multi-dimensionality of the intervention approach by using different strategies to promote physical activity (multi-component approaches).

In terms of physical activity promotion for adults, it was not possible to include any review that analyzes the quality of the design, implementation and evaluation of interventions specifically for this target group. Nevertheless various reviews contain indications of how to successfully structure the implementation of measures. As far as the theoretical basis is concerned, there is evidence that interventions which use the transtheoretical model are more effective [49, cf. also 74]. One review on physical activity counseling also concluded that all healthcare employees should be trained to view

physical activity promotion as a normal part of their daily work [75]. In terms of the multidimensionality of an intervention approach, two reviews recommend integrating individual-centered, social and environmental elements in one measure [76, 77].

Older adults

Overview

Promoting physical activity in older adults should refer to all settings relevant for that target group and should take mutual influences into consideration. These include the home and community environment, primary care institutions (e.g. clinics, doctors' practices), assisted living institutions and retirement homes as well as settings where older adults can spend their free time (e.g. sport clubs).

In terms of the community setting, the physical activity needs of older adults should receive special attention. This encompasses urban planning (e.g. safe cycling and walking paths) and designing the residential environment (e.g. opportunities for physical activity that are appropriate for older people and near home) as well as the design of parks, leisure and sports facilities (see also "Recommendations for the general population" below).

Table 5: Status of research on the effectiveness of interventions for promoting physical activity in older adults.

Status of research	Settings of older adults
<p>Strong evidence: Detailed evidence-based recommendations can be made for this setting / these settings.</p>	There was no strong evidence for any setting.
<p>Medium evidence: Limited recommendations can be made for these settings based on individual reviews and a small number of studies.</p>	Home environment Community setting Health care
<p>Weak evidence / not researched: No recommendation can be made based on the status of research.</p>	Leisure and sport

Based on the existing findings, there is a lack of research on the effectiveness of interventions to promote physical activity in older adults specifically. On the whole, there are only a comparatively small number of reviews on this topic, most of which relate to physical activity counseling and exercise programs in the home and community settings as well as in primary care institutions. These reviews are limited in their suitability for deriving recommendations for designing interventions. Similar to the other target groups, there were no reviews at all on the empirical evidence on physical activity promotion for older adults in the fields of „leisure and sport“.

Older adults Recommendations

Physical activity promotion in different settings

Physical activity counseling and exercise programs in different settings

For measures in the home environment and community settings, physical activity counseling and exercise programs tailored specifically to this target group are recommended that take adequate consideration of the socio-spatial context (social integration, opportunities for physical activity). These criteria are also recommended for interventions in the context of health care (e.g. exercise referral schemes). Due to existing deficits, it is recommended to prioritize increasing the research on physical activity promotion in older adults in particular. In addition, the recommendations for adults (see above) and for the general population (see below) can serve as a guide.

Physical activity counseling in the home and community settings

Three reviews examined the effectiveness of measures to promote physical activity in older adults in general [3, 78, 79]. One high-quality review specifically analyzes the effects of intervention studies geared to a long-term effect of measures to promote physical activity [78]. The review found evidence of increases in physical activity after 12 months. It was not possible to identify longer-term effects due to the lack of high-quality single studies. The authors see indications for a higher effectiveness of interventions geared to individually tailored personal activity targets to increase the number of steps and/or that include information on opportunities for physical activity. In a review by the WHO, interventions for older adults eit-

her carried out in a group setting and/or in integrated in existing social structures are described as moderately effective for promoting physical activity [3].

Physical activity counseling in health care

Three of the reviews included for the target group of older adults focus on the effectiveness of approaches to promote physical activity as part of health care [80-82]. The intervention approaches used include the provision of information materials, individualized physical activity counseling, exercise referral schemes and course offerings. One review concludes by recommending interventions that include a written prescription for physical activity, a targeted approach to tackle risk factors and the consideration of individual barriers as well as appropriate time resources to implement a high-quality intervention [81]. In another review, only half of the studies relating to the effect of doctors' recommendations on the physical activity behavior of older adults found evidence of significant effects [82].

Effects on health equity

No sufficient evidence base for recommendations yet.

No reviews were recorded that deal specifically with physical activity promotion and health equity in older adults. As for the other target groups, the developing general evidence indicates, however, that environmental approaches and interventions aimed directly at socially disadvantaged groups as well as those that facilitate active involvement of the target groups in decisions regarding the design and implementation of the intervention can have positive effects on health equity [33, 34].

Cost-effectiveness

In principle, older people are a particularly relevant target group for cost-effective physical activity promotion because health gains and a reduction in illness costs through physical activity can be achieved faster than in other target groups (e.g. children and adolescents). At present, however, there are very few reviews and studies on this topic, and they do not yield any clear outcomes. Consequently, it is not possible to make recommendations for individual measures from this perspective.

Physical activity promotion for older adults is particularly relevant from the perspective of the health economy, as cost savings for the health system can already be achieved in the short and medium term [38]. However, the onset of chronic diseases can often no longer be prevented by promoting physical activity among older people, but can only be delayed [38].

The cost-effectiveness of training programs for older adults was examined in scientific reviews particularly from the aspect of fall prevention [83, 84]. On the whole, there are indications that corresponding interventions can be cost effective. Nevertheless there is still disagreement as to whether cost-effectiveness is greater for younger and healthy elderly people or for older elderly people aged 80 or over [83, 84]. No generalizable recommendations can be made from the findings of these reviews, because they refer particularly to one single intervention program. In one of the reviews, the authors also expressly refer to the fact that the existing studies only provide very little information that is usable in a German context [83].

Quality criteria

For the successful implementation of measures to promote physical activity in older adults, compliance with the following quality criteria is especially recommended: (1) A nuanced link to the target group that facilitates targeted physical activity taking into account individual barriers, (2) Detailed planning of the content and organizational process for the measure and (3) Sufficient time resources of the stakeholders involved in order to ensure high-quality implementation of the intervention.

The scientific literature on physical activity promotion in older adults recommends observing various items from the list of quality criteria outlined above when implementing the interventions. Involving the target group is important, as it allows risk factors to be tackled in a targeted manner and individual barriers to be given adequate consideration [81]. The significance of this quality criteria is also confirmed by a WHO review for all target groups which finds that interventions for "hard-to-reach populations" should be well adjusted to the respective target group [66]. In another review, interventions that are culturally adapted are considered very important for the successful promotion of physical activity in older adults [85]. It is also particularly relevant that the stakeholders involved invest sufficient time resources in order to ensure high structural and process quality of all measures [81].

Adults with pre-existing diseases

Overview

Promoting physical activity in adults with pre-existing diseases should refer to all settings relevant for that target group and should take mutual influences into consideration. The healthcare setting is particularly suited for the implementation of measures for this target group (e.g. hospitals, rehabilitation clinics, doctors' and physiotherapy practices).

The effectiveness of measures to promote physical activity in adults with pre-existing diseases is researched in a range of single studies and reviews. Despite the quite large number of existing reviews, the heterogeneity of the different pre-existing diseases, target groups examined and intervention measures implemented means that there is no clear research outcome.

Table 6: Status of research on the effectiveness of interventions for promoting physical activity in adults with pre-existing diseases.

Status of research	Settings of adults with pre-existing diseases
<p>Strong evidence: Detailed evidence-based recommendations can be made for this setting / these settings.</p>	There was no strong evidence for any setting.
<p>Medium evidence: Limited recommendations can be made for these settings based on individual reviews and a small number of studies.</p>	Health care
<p>Weak evidence / not researched: No recommendation can be made based on the status of research.</p>	All other settings have not been researched at all or in any great detail thus far.

Adults with pre-existing diseases

Recommendations

Physical activity promotion in different settings

Healthcare institutions

As part of health care, the measures to promote physical activity in adults with pre-existing diseases must be (1) theory-based, (2) specific to physical activity behavior and (3) tailored to the respective target group. In this context, exercise referral schemes have also proved recommendable.

General interventions to promote physical activity

A very comprehensive and high-quality meta-analysis comes to the conclusion that interventions to promote physical activity in adults with various chronic diseases lead to a considerable increase in physical activity. The effects were greater when physical activity behavior was targeted specifically rather than other additional health behaviors. Exercise programs were not superior to purely educational or motivational interventions [86]. One medium-quality review also found that the majority of studies showed significant effects on physical activity. Theory-based interventions that used behavioral change techniques were most effective [87].

Indication-based physical activity promotion

A range of reviews examined the effect of measures to promote physical activity for indication-specific target groups. However, the number of existing reviews for the individual indications is very small in each case, as a result of which it is not possible to make indication-specific recommendations at the present time.

One review classified as high quality deals with interventions to influence the physical activity behavior of adults after breast cancer treatment. The authors conclude that interventions that use special behavior-based intervention techniques are successful for increasing physical activity in the short to medium term after breast cancer [88]. There are two reviews on physical activity promotion for people with rheumatoid arthritis (RA) [89, 90]. One medium-quality review gives clear indications that the physical activity of individuals with RA can be influenced in the long term. However, there are no further studies to back up these indications [90]. In a Cochrane review on promoting physical activity in individuals with cystic fibrosis, only one study showed effects on self-reported physical activity. On the whole, there are not enough studies for this specific disease in order for any recommendations to be made [91]. In one medium-quality review on the effectiveness of home-based exercise programs for people with chronic low back pain, the majority of the studies reported significant effects on the implementation of home-based exercise programs up to twelve months after the intervention. This greater adherence to a home-based exercise program was linked (moderate evidence) to a higher health-related locus of control or to participation in a supervised physical activity or behavior change program [92]. One high-quality review examined studies on physical activity promotion in adults after a stroke. The studies provide clear indications that specific behavioral interventions, namely targeted counseling or specially tailored exercise programs, are more effective than simple exercise programs with general counseling [93]. In the field of rehabilitation after cardiovascular diseases, one high-quality review shows that the usual rehabilitation measures comprising physical activity therapy combined with psychosocial or educational interventions can increase physical activity in the short term (up to six months) [94].

Interventions in primary care and/or curative care

One high-quality methodologically comprehensive review included reviews and individual studies in a Health Technology Assessment (HTA) that dealt with the effects of exercise referral schemes. The HTA shows that increases in physical activity through exercise referral schemes are possible in the short to medium term, albeit to a small extent. The authors call for more studies (if possible with longer intervention periods than ten to twelve weeks) to examine the effects of such measures for specific pre-existing diseases over longer periods and to integrate the specific behavioral change techniques [95]. Another review summarizes various different measures to promote physical activity in primary care. Based on the meta-analytic

evaluation, the interventions proved effective in the 12-month follow-up. The measures ranged from simple counseling to prescribed participation in specific exercise programs. No distinction was made in terms of the intervention intensity [58]. In one comprehensive review (with meta-analysis), the effects of theory-based motivational interventions were specifically analyzed as part of physiotherapeutic treatment programs. The authors conclude that motivational interventions can increase adherence to physical activity, reduce illness-related activity limitations and improve self-efficacy expectations [96].

Effects of different types of intervention

Some reviews have focused on the effectiveness of different types of intervention [97-102]. In one medium to high-quality review, pedometer-based interventions to promote physical activity in individuals with musculoskeletal diseases were examined. All of the studies included showed effects up to six months after the intervention. Accordingly, the authors rated the outcome as proof of strong evidence in favor of the use of pedometer-based interventions for this target group [97]. In a high-quality review on the use of internet-based interventions in cardiac rehabilitation, there are clear indications of their effectiveness on the promotion of physical activity. However, the authors point out that the underlying data is too scant on the whole [98]. Another medium-quality review on internet-based interventions also shows effects on physical activity. However, the authors describe the evidence base as inconclusive [99]. In a high-quality meta-analysis that examined the use of "motivational interviews" as a specific intervention method to promote physical activity in individuals with chronic diseases, a small but significant effect on physical activity was determined directly after the intervention [100].

Health equity

No sufficient evidence base for recommendations yet.

There are no reviews on the topic of physical activity promotion and health equity specifically for people with pre-existing diseases. A comprehensive review looked at the effect of active patient engagement in healthcare decisions on health equity

and found that shared decision-making and the specific tailoring of the health care to socially disadvantaged groups can impact positively on health equity [34]. From this perspective, it has also proved helpful generally to gear interventions directly to socially disadvantaged groups and the environment [33].

Cost-effectiveness

Although the cost-effectiveness of measures to promote physical activity in individuals with pre-existing diseases has not yet been examined extensively and the study outcomes are partly also inconclusive, based on the reviews available to date there is preliminary evidence that recommends training programs tailored to the respective patient target group.

One systematic review examined the cost-effectiveness of programs to promote physical activity generally for different pre-existing diseases [103]. The authors arrive at the conclusion that training programs can be cost effective but that there are also single studies for the different pre-existing diseases that did not show any cost-effectiveness of a training program. Accordingly, the most convincing evidence for the cost-effectiveness of training programs is in the rehabilitation of patients with cardiac and back problems, but even these studies arrive at some contradictory findings [103]. Specifically in relation to individuals with hip and/or knee arthritis, one review finds that exercise programs achieve better health results than other interventions at lower costs and can therefore be cost effective. However, the quality of the existing individual studies is almost universally considered as critical [104]. According to another review, training programs for people with heart problems reduce the risk of hospital admissions and improve health-related quality of life [105]. An analysis of interventions for people with psychiatric illnesses also finds training programs to be cost effective. However, the authors qualify this assessment by stating that the success of physical activity-related interventions hinges on how they are designed and that additional studies in various settings are needed for comparability of the cost-effectiveness which include different target groups with various pre-existing diseases [106].

The cost-effectiveness of exercise referral schemes is not without controversy in current research (see above). One review that examines the cost-effectiveness of such programs for different target groups concludes, however, that the cost-effectiveness of interventions for people with pre-existing diseases is better than for individuals without any specific diagnosis [42]. Broken down by illness, in this review the programs were most cost effective for people with depression, followed by interventions for patients with hypertension and overweight individuals.

Quality criteria

No sufficient evidence base for recommendations yet.

As long as there are no target group-specific reviews on quality criteria for measures to promote physical activity in people with pre-existing diseases, the quality criteria listed in the introduction can serve as a guide for designing, implementing and evaluating corresponding measures (see above under Concept).

General population

Overview

Measures to promote physical activity that are targeted at the general population have high potential for public health on account of their reach. These include population-based information approaches (e.g. mass-media campaigns), community-based interventions and policy and environmental approaches.

However, the status of research on the effectiveness of corresponding approaches is not easily assessed. This is primarily due to the fact that it is very difficult to investigate the efficacy of complex, structural, policy and environmental interventions with experimental designs. Conversely, giving precedence to the method, e.g. specifying an experimental design as an inclusion criteria, leads among other things to a prioritization of those intervention strategies that are least relevant for public health and

Table 7: Status of research on the effectiveness of interventions for promoting physical activity in the general population.

Status of research	Types of intervention
<p>Strong evidence: Detailed evidence-based recommendations can be made for this setting / these settings.</p>	There was no strong evidence for any intervention type.
<p>Medium evidence: Limited recommendations can be made for these settings based on individual reviews and a small number of studies.</p>	<ul style="list-style-type: none"> Mass-media campaigns Point-of-decision prompts Community-based multi-component approaches Environmental approaches Policy approaches
<p>Weak evidence / not researched: No recommendation can be made based on the status of research.</p>	Physical activity promotion through sport clubs

health promotion, e.g. easily controllable measures with short-term effects at sub-population level that are of modest effect size. In order to counter this dilemma, many reviews of population-based interventions are willing to allow a very broad range of study designs. In the present context, such reviews were generally taken into account but also discussed in terms of possible limitations.

General population Recommendations

Population-based physical activity promotion

Mass-media campaigns

Mass-media campaigns are recommended as an approach for promoting physical activity if they are used as part of a multi-component approach that integrates especially structural components (environment and policy) as well as context-based physical activity offerings.

The current status of research does not provide any uniform picture on the effectiveness of mass-media campaigns for promoting physical activity: The most current systematic review from the US Center of Disease Control and Prevention (CDC) [107] comes to the conclusion that there is still insufficient evidence for stand-alone mass-media campaigns that are not combined with other measures [cf. also 108, 109]. Two other systematic reviews dealing specifically with mass-media campaigns also show inconsistent results, i.e. significant effects on physical activity behavior were determined for only about half of the studies [110], while a meta-analysis found indications of the promotion of walking but no significant effects on activity as a whole or on sedentary lifestyles [111]. By contrast, a review by the WHO and one other current review classify mass-media campaigns as generally effective. However, these two publications also emphasize that the evidence exists in particular for mass-media campaigns as part of multi-component approaches, e.g. in combination with policy and environmental measures and program offerings at municipal level [19].

Point-of-decision prompts

Point-of-decision prompts to support incidental physical activity, e.g. by means of corresponding prompts to use the stairs instead of elevators or escalators, are recommended. However, these alone are not able to generate sufficient and lasting effects. As a result, it is once again recommended that these prompts are integrated in a multi-component approach.

The effectiveness of point-of-decision prompts has been examined relatively frequently and they are identified as an evidence-based approach [3, 19]. At the same time, some authors point out that the impact of the effect of such point-of-decision prompts is limited and its sustainability has not been well examined ([112], see also cost-effectiveness [39]).

Community-based multi-component approaches

Community-based multi-component approaches are recommended when they are based on effective individual components and make use of their mutual interaction. It is recommended that such approaches integrate structural components (environment and policy) as well as context-related physical activity offerings in particular.

While community-based approaches with several components were consistently seen as an effective strategy for population-based physical activity promotion in earlier reviews [3, 109], two more recent Cochrane reviews [113, 114] conclude that the study quality is poor and the study results are inconsistent. To differentiate between individual measures, one review of community-based interventions to promote incidental physical activity showed that primarily policy and environmental measures can be effective, i.e. in particular promoting active transport, taking the stairs and playgrounds for children [115]. The WHO also lists group-based physical activity offerings as well as computer-based interventions with interactive feedback as promising components at community level [3].

Environmental approaches

A large number of studies has shown positive effects of different aspects of the built environment on population-based physical activity behavior. The following are recommended in particular: (1) geographical proximity, land use mix and connectivity of residential, commercial and school/work zones, (2) traffic-calmed, safe and aesthetically appealing zones in the residential environment, (3) sports and leisure facilities and parks near home and accessible for the whole population as well as (4) an infrastructure of cycling and walking paths that is as extensive as possible.

The already above mentioned difficulty of evaluating population-based approaches in a way that allows for testing causal efficacy is particularly evident with environmental approaches. For example, the vast majority of studies available are cross sectional, i.e. they only provide information on associations between certain spatial features and the physical activity behavior in the population but generally cannot "explain" this as a causal effect of a spatial intervention. As a result, the "evidence" in this area is mainly subject to the proviso that while there is often a substantiated correlation between the corresponding environmental components and physical activity at the population level, there is no causality in terms of cause and effect.

Urban planning

Urban planning that favors physical activity at different levels is one of the best-researched environmental approaches for promoting physical activity. On the one hand, there is a stated link between physical activity and integrated urban planning and development, e.g. land use planning, building density or accessibility of schools and healthcare facilities on foot. On the other hand, smaller urban areas are analyzed, e.g. in terms of the quality of roads, paths and squares in the residential environment. As far as both planning areas are concerned, current reviews for physical activity promotion state that factors such as the creation of an appropriate infrastructure for cycling and walking, a mix of different uses (e.g. residential, commercial, industrial), traffic calming and safety as well as an appealing design all have a role to play [19, 112, 116]. However, one higher-quality review that included only (quasi-)experimental studies and cross-sectional studies that control for self-selection mentioned limitations

in terms of the cited effect of aesthetics, traffic calming and cycling and walking infrastructure [117]. The association between the availability of facilities and spaces that can be used for recreational physical activity on the one hand and physical activity behavior on the other is also stated in the reviews. This holds true for its construction and use (e.g. access) [3, 19, 112, 118].

Physical activity in the natural environment

Although the (ecologically appropriate) use of the natural environment for physical activity could have considerable potential for physical activity promotion, no recommendation can be derived on the basis of the existing reviews, as practically no corresponding studies with sufficient methodological quality have been conducted [116].

Policy approaches

Many population-based measures to promote physical activity require political decisions and their implementation. Based on the scientific studies available, policies that promote physical activity are recommended in particular as a constitutive part of the regulations for urban and spatial planning (e.g. land use plans and their local implementation), traffic policy (e.g. traffic calming, bicycle infrastructure) as well as policy on green spaces and sports areas (setting up sports and recreational facilities and parks and making them accessible).

Also for policy approaches, there is generally only evidence of a correlation between corresponding regulatory framework conditions and physical activity at population level.

Intersectoral policy

Although there has long been calls for intersectoral policy to promote physical activity, e.g. at international level by the EU [119, 120] and the WHO [121, 122], there

are scarcely any empirical evaluation studies related to such policy thus far. Even the review by the WHO only explicitly recommends approaches for sector-specific policy and does not provide any indications of the effectiveness of intersectoral approaches to promote physical activity [3]. Beyond the realm of physical activity, public health research has recently been looking more closely at the topic of intersectoral policy. However, the corresponding reviews also find that the evidence base is (still) insufficient [51, 123, 124].

By contrast, in respect of factors favoring successful implementation of measures to promote physical activity, there are clear indications from scientific reviews that intersectoral partnerships are effective in this regard [27, 125]. A WHO review of "good practice" in promoting physical activity for socially disadvantaged groups also emphasizes that intersectoral partnerships are a key factor in implementation success [66].

Environment and transport-based regulations and incentives

As already mentioned above, most policy and environment-related studies on promoting physical activity that are dealt with in the relevant reviews are concerned with the topics of urban planning and transport. The positive factors listed include in particular political regulation of land use (in a German context: land use and development plans for example) that allow the promotion of urban development that favors physical activity as well as traffic policy regulations (e.g. promoting cycling infrastructures and restricting car traffic) [3, 19, 116].

Other regulation and incentives

The political promotion of available space and facilities for leisure and recreational physical activity (construction and access, see above) is highlighted as effective by the WHO in particular [3], but there are likewise corresponding indications in other reviews [19, 112]. By contrast, direct economic policy instruments to control population-based physical activity behavior, in particular the taxation of car use (e.g. city tolls) or tax incentives (e.g. for active transport), are classified as still in too early a stage of research [112, 126].

Physical activity promotion through sport clubs

It is recommended to promote in particular scientific research that relates to potentially promising approaches for population-based physical activity promotion for which there is currently still a lack of reliable studies: These include in particular physical activity promotion by sport clubs, i.e. specifically their possible contribution to promoting health-enhancing physical activity

The sport sector offers major potential for physical activity promotion in terms of health-enhancing physical activity that goes beyond performance or competitive sports. The significance of this sector is huge in Germany in particular. Studies on approaches for physical activity promotion by sport clubs were to be examined in two Cochrane reviews [127, 128]. Both studies came to the conclusion that no studies existed which met the broadly defined inclusion criteria. Also in terms of sporting events and their impact on physical activity behavior, one existing review could only include a small number of studies, which in fact tended to suggest ineffectiveness for high-performance sporting events (e.g. Olympic Games), while possible effects were suggested for mass events geared directly to recreational physical activity (e.g. cycling) [129]. On the whole, there is urgent need for action for the development, implementation and evaluation of corresponding studies in this area [cf. also 130, 131].

Effects on health equity

No sufficient evidence base for recommendations yet.

Research on the effects of different intervention approaches on health equity is not yet sufficiently developed. One review on policy and environmental strategies in the prevention of overweight in children has presented an evaluation system that also reports specific measures for physical activity promotion. According to that review, the following were found to be sufficiently evidence based: the consideration of physical activity promotion in children and adolescents in urban planning and land use policy (both

at whole-city level and at the level of the residential areas) and improved access of this target group to parks, recreational and sports facilities [132]. Health equity can also be promoted by means of interventions geared directly to socially disadvantaged groups as well as interventions that facilitate active involvement of the target groups in decisions regarding the design and implementation of the intervention [132]. Alongside the intersectoral partnership already mentioned, a WHO review on key factors for successful implementation of physical activity promotion with socially disadvantaged groups highlights the significance of the involvement of the target groups [66].

Cost-effectiveness

Population-based measures to promote physical activity are particularly recommended, not least due to their advantageous cost-benefit ratio. Thanks to the extent of their impact, these measures are regularly listed among the most cost-effective approaches. In this context, low-cost regulatory and infrastructural measures are particularly recommended. Population-related information approaches such as mass-media campaigns and point-of-decision prompts are also seen as cost effective, but should be combined with other measures on account of their very limited effectiveness for physical activity behavior.

Because of their wide-scale impact, population-based measures can be regarded as potentially the most cost-effective approaches if their effectiveness is proven and the costs are kept as low as possible. Regulatory measures within physical activity promotion policy at different levels could be a model for this, but so far these are insufficiently developed and investigated (see above). Consequently it is currently easier to draw conclusions by analogy with other interventions relating to health behavior (e.g. smoking prevention, nutrition), which suggest high cost-effectiveness of regulatory measures [40].

By contrast, an evidence base related directly to physical activity is available for the cost-effectiveness of environmental measures [39, 40, 72, 133]. Above all else, the measures named are low-cost infrastructural measures such as access to opportunities for physical activities [39, 133] or simple measures for designing spaces for physical activity [39, 72].

For population-based information approaches, there is a range of reviews showing the cost-effectiveness of such approaches in physical activity promotion. For example, one review showed interventions with signs at elevators recommending use of the stairs to be the most cost-effective measure, as such measures reach a relatively large number of people at very low cost. At the same time, however, the authors also made clear the limited effects of this intervention on physical activity behavior and volume as a whole. Accordingly, they point out that using the stairs can only contribute a minimal amount to reaching the 150 minutes per week of physical activity recommended for adults [39].

The WHO (2011) counts mass-media campaigns to promote physical activity as one of the "best buys" in the prevention of chronic diseases [134]. This assessment is supported by various reviews and studies on the cost-effectiveness of different preventive measures [37, 38, 135]. However, reference is also made to reviews on effectiveness which could only find significant effects on physical activity behavior in less than half of the studies included [110] or rated the existing evidence as "insufficient" [37, 109]. Against the backdrop of the limited and inconclusive evidence with regard to behavior effectiveness (which one of the reviews on cost-effectiveness also specifically concedes [135]), it is difficult to understand how at the same time cost-effectiveness can be assessed positively.

Quality criteria

Successful implementation of the recommended measures for population-based physical activity promotion presupposes the consideration of the quality criteria presented in the introduction. Consideration of the following factors is particularly recommended: (1) Health equity in physical activity promotion should be considered when selecting population-based measures. Policy and environmental approaches are more suitable for promoting health equity or avoiding additional inequality in this respect than informational measures, e.g. mass-media campaigns. (2) In order to ensure adequate participation of socially disadvantaged groups in population-based physical activity promotion, the involvement and empowerment of such groups in the context of planning, implementation and evaluation of corresponding measures is essential. In addition, it is

particularly recommended to adjust the measure to the implementation context and to ensure sufficient time and financial resources. (3) For the implementation of policy and environmental approaches, the development and continuity of intersectoral partnerships is often fundamental – both between different policy fields and between governmental and non-governmental organizations at different levels (from local to international).

The question of which types of intervention promote health equity is also relevant in respect of population-based measures to promote physical activity. One review of reviews summarized the results from a range of different reviews [33]: According to that review, there are clear indications that mass-media campaigns promote rather than reduce health inequality between socio-economic groups. By contrast, behavioral approaches, e.g. policy and environmental measures, can contribute to reducing health inequality.

The involvement and empowerment of socially disadvantaged groups is a particularly important factor in order to ensure the sustainability of an intervention. Firstly this takes a lot of time and secondly it has to be linked to the provision of financial resources, as economic barriers have a negative impact on the participation of socially disadvantaged groups [66, 132]. For policy and environmental interventions, the WHO also recommends an intersectoral approach in this quality context that promotes physical activity in a holistic manner through a combination of different measures [66].

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The National Recommendations for Physical Activity and Physical Activity Promotion target experts and stakeholders. The recommendations have been developed for Germany, but may also apply to other countries. They were created by a group of scientists and aim to offer a scientific orientation in the field of physical activity promotion.

Two characteristics of these recommendations are distinguishing: At national level, they provide the first scientifically proven and developed recommendations for the Federal Republic of Germany, and at an international level, they systematically link recommendations for physical activity and physical activity promotion for the first time.

The book is structured on three levels: Firstly split up into recommendations for physical activity and then recommendations for physical activity promotion. Within these two sections are chapters for the target groups children and adolescents, adults, older adults, adults with a chronic disease and – in the recommendations for physical activity promotion – the general population. Furthermore, the recommendations for physical activity promotion differentiate between settings, e.g. kindergarten, school, workplace or the home, to support the following process of dissemination.