

Methodology for the evaluation of evidence

No. 2017/08Ae, The Hague, August 22, 2017

Background document to:

Physical activity guidelines 2017

No. 2017/08e, The Hague, August 22, 2017

Health Council of the Netherlands



contents

01 Introduction	3	05 Conclusions in background documents	11
1.1 The field of the recommendation: the prevention of chronic diseases	3	5.1 Summary of findings in standardized tables	13
1.2 Methodology	4	Literature	16
02 Aspects of physical activity that were evaluated	4	Annex	18
2.1 Physical activity	4	A Definitions	19
2.2 Sitting	4		
2.3 Methodological aspects of RCTs	5		
2.4 Methodological aspects of cohort studies	6		
03 Outcome measures	7		
3.1 Conditions that are central to the Physical Activity Guidelines 2017	7		
04 Literature review for the background documents	9		
4.1 Pooled analyses, meta-analyses and systematic reviews	9		
4.2 General population, risk groups and patient groups	10		
4.3 Types of study	10		
4.4 Sources	10		



01 Introduction

Three background documents were prepared for the Physical Activity Guidelines 2017.¹ In this background document, Methodology for the evaluation of evidence, the Physical Activity Guidelines 2017 Committee describes how it evaluated the current state of scientific knowledge. This evaluation resulted in two other background documents, one on physical activity and one on sitting (sedentary behaviour) and the risk of chronic diseases.^{2,3} The conclusions with a strong level of evidence from these two background documents form the basis for the derivation of physical activity guidelines.

In this introductory section, the committee addresses the field of the recommendation and explains the methodology applied. Section 2 explains the subjects of physical activity and sitting in more detail. Section 3 identifies which diseases were central to preparing the guidelines and how this translated into specific results for each type of research. The approach taken in the literature review is described in Section 4. Section 5 explains how the committee arrived at its conclusions in the background documents. Appendix A provides a glossary of terms.

1.1 The field of the recommendation: the prevention of chronic diseases

The Physical Activity Guidelines 2017 focus on preventing chronic diseases and disability among the general population. The guidelines

describe the amount of physical activity required in order to produce health benefits in the Netherlands. The description of the current state of scientific knowledge in these recommendations is based on international scientific literature. However, the Physical Activity Guidelines 2017 focus specifically on the situation in the Netherlands. Guidelines have also been established for other countries. These sometimes take account of the extent to which a population (or population group) currently engages in physical activity. Differences between the guidelines in place in Western countries can therefore not only be attributed to differences in methodology, but also to differences in existing behaviours. The extent to which the average amount of physical activity deviates from the optimum level determines which health benefits could be derived from changes in physical activity levels.

Specific recommendations for particular diseases fall outside the scope of these recommendations.

Although the 2017 guidelines are aimed at the general population, they are also important for many specific patient groups. However, some patient groups require tailored physical activity guidelines. Such disease-specific physical activity guidelines are not discussed in these recommendations and are the responsibility of medical professionals, among others.



1.2 Methodology

The Physical Activity Guidelines 2017 Committee adopted the methodology of the Dutch Dietary Guidelines 2015 Committee⁴ when evaluating the relevant literature. That committee's evaluation work involved pooled analyses, meta-analyses and systematic reviews from prospective research (see Section 4).

By prospective research, we refer to cohort research (the collective name for prospective cohort research, nested case-control research and case-cohort research) and RCTs. Both these types of research complement each other. When it comes to the associations between physical activity and the risk of chronic diseases, the value of cohort research lies in the (potential for) long-term follow-up, the (potentially) large number of participants and the representativeness of the participants of the general population or the relevant population group. The strength of RCTs lies in the fact that this kind of research can provide strong evidence of a causal relationship by eliminating confounding effects.

02 Aspects of physical activity that were evaluated

In this section, the committee describes the various aspects of physical activity on which it assesses the association between physical activity and

sitting on the one hand, and the risk of chronic diseases on the other hand: physical activity of different intensities, endurance training, strength training, and sitting. It also addresses methodological issues in RCTs and cohort studies on physical activity and sitting. The Physical Activity Guidelines 2017 Committee has summarized the evaluation of the health effects of physical activity and sitting in two separate documents.

2.1 Physical activity

Within the concept of physical activity, the literature distinguishes between activity of light (1.6-2.9 metabolic equivalent (MET)), moderate (3.0-5.9 MET) and vigorous (≥ 6 MET) intensities. The MET value is based on the amount of energy used per unit of time. Many forms of physical activity include both a strength and an endurance component. RCTs generally study the effects of strength training, endurance training or a combination of these two types of exercise. In some cases, a further distinction is made between, for example, specific forms of strength training, such as bone-strengthening training and balance exercises.

2.2 Sitting

Sitting (sedentary behaviour) includes activities performed in a sitting, reclining or lying posture, with little energy being used (≤ 1.5 MET), excluding sleep. Examples include watching television, reading, sewing, working with a computer, sitting while playing video games or sitting while travelling.⁵ The committee has chosen this term to avoid unnecessary



jargon. The term sedentary lifestyle has also been avoided. This term was used until recently to describe someone who fails to meet the standard for physical activity. Such a person is now referred to as inactive.

2.3 Methodological aspects of RCTs

The strength of RCTs lies in the fact that this kind of study can provide strong evidence of a causal relationship by eliminating confounding effects. There are some points that must be considered when interpreting the findings of RCTs regarding the effect of changes in levels of physical activity and sitting on the risk of chronic diseases.⁶

Firstly, it is important that the description of the RCT clarifies what the intervention consisted of in terms of intensity, frequency and duration. Because it is difficult to quantify the amount of physical activity in interventions that are solely aimed at physical education rather than physical activity, the committee did not consider these.

A second key question is whether or not the intervention that aimed to promote or reduce physical activity or sitting actually achieved the intended effect. There is, for example, a chance that participants who exercised more during the intervention may have ‘compensated’ at other times of the day by engaging in less physical activity than usual. Many RCTs do not report whether the intervention achieved the intended effect on physical activity levels, although this can be checked using questionnaires or accelerometers.⁷ Falck et al.⁷ state that in physical activity interventions involving older persons questionnaires of limited

quality in terms of validity and reproducibility were often used. This means that it is less easy to ascertain whether the total amount of physical activity actually changed on the basis of these questionnaires. Because of the doubt regarding whether the amount of physical activity actually changed, it is more difficult to conclude that, for example, physical activity or sitting does not have any real effect on a particular outcome measure. There is also the possibility that participants change other aspects of their lifestyle, such as their energy intake or dietary pattern. If this is indeed the case, it cannot be excluded that an observed effect occurred due to that change, not due to increased levels of physical activity. However, very little research has been done into the effects of physical activity and sitting under fully controlled conditions. The committee decided to exclude RCTs involving interventions that focused on physical activity or sitting in combination with interventions that targeted, for example, diet or energy intake, because the committee was interested in the specific effects of physical activity and sitting.

One point of consideration with regard to comparing various types of activities (for example, high-intensity interval training versus moderately intensive continuous training) was whether the overall extent of the physical activity is comparable; in other words, whether the activities are isocaloric. Where that is not the case, there is a chance that the results cannot be compared due to differences in the extent of the activities being compared.

Each of the above issues could increase the heterogeneity within the



findings. Real effects may be obscured as a consequence.⁶

2.4 Methodological aspects of cohort studies

For research into the associations between physical activity and sitting down on the one hand and the risk of chronic diseases on the other, the value of cohort research lies in the (potential for) long-term follow-up, the (potentially) large number of participants and the representativeness of the participants of the general population or the relevant population group. There are a number of points to be considered in this context.⁶

For example, definitions and cut-off values for categories of physical activity and sitting vary between cohort studies. To illustrate this point, many studies only ask about leisure-time physical activity, not all physical activity. The committee found that the data remains insufficient to determine whether the associations for leisure-time physical activity are also representative of other forms of physical activity, such as housework, other forms of work or transport. Screen time or time spent watching television are often used as a measure of sitting time. The committee reports the extent of exposure (amount and type of motion) as accurately as possible on which the conclusions regarding physical activity and sitting are based. The varying cut-off values make it difficult to compare studies and can lead to heterogeneity between studies. Real effects may be obscured as a consequence.⁶

In most cohort studies, physical activity and sitting were investigated using a questionnaire to be completed by participants. The quality of those

questionnaires was determined in terms of reproducibility and validity. Many questionnaires regarding physical activity have an acceptable level of reproducibility and, at best, moderate validity.^{8,9} Helmerhorst et al.⁸ describe how the median correlation coefficients for questionnaire reproducibility varied from 0.62 to 0.76. The coefficients for validity ranged from 0.24 to 0.41. The limited validity of questionnaires regarding physical activity may contribute to heterogeneity between cohort studies. As a result, real effects may be underestimated or overestimated.⁶

Meanwhile, some cohort studies involve the use of accelerometers or stable isotopes (double-labelled water) as an 'objective' measurement of physical activity. Because determining physical activity and energy consumption, respectively, is more reliable using these methods than when using questionnaires, the committee will describe the results of the single cohort study using accelerometers or double-labelled water separately. This was a small number of studies, however.

The quality of questionnaires regarding sitting is limited.^{10,11} Lubans et al.¹⁰ conclude that questionnaires that participants are asked to complete themselves provide a reproducible picture of their amount of screen time (watching television, using a computer, tablet, etc.), but validity has not been investigated sufficiently. Accelerometers can reliably categorize 'absence of movement'.

Finally, in cohort studies, confounding can never be completely excluded. It is therefore important that associations are confirmed in RCTs.⁶



03 Outcome measures

This section explains how and why the committee selected particular outcome measures. First of all, chronic diseases and mortality are discussed, followed by risk factors and indicators of fitness.

3.1 Conditions that are central to the Physical Activity Guidelines 2017

The prevention of chronic diseases was a central theme. In studies involving older persons, disability was also included as well as fitness indicators (cardiorespiratory fitness and muscle strength) in both older persons and children.

As hard outcome measures, the committee took the top ten diseases in the Netherlands in terms of mortality, years of life lost and disease burden (coronary heart disease, stroke, heart failure, diabetes mellitus type 2, chronic obstructive pulmonary disease (COPD), breast cancer, colorectal cancer, lung cancer, osteoarthritis, dementia and cognitive decline, and depression and depressive symptoms). It also included premature (or all-cause) mortality and fractures, disabilities in the elderly, injuries and, in children, ADHD symptoms (Table 1). The 2015 Dutch Dietary Guidelines Committee took a similar approach to the selection of hard endpoints.⁴

Table 1. Outcome measures for cohort research and RCTs

Adults	Children and adolescents
Premature mortality	Injuries
Coronary heart disease	Depression and depressive symptoms
Stroke	ADHD symptoms
Heart failure	
Diabetes	
Chronic obstructive pulmonary diseases	Breast cancer
Colorectal cancer	
Lung cancer	
Older persons: disabilities	
Fractures	
Osteoarthritis	
Injuries	
Dementia and cognitive decline	
Depression and depressive symptoms	

3.2 Intermediary outcomes and fitness indicators

The Physical Activity Guidelines 2017 Committee considered not only the hard outcome measures, but also the risk factors for chronic diseases (Table 2). In relation to a number of risk factors, it has been demonstrated that a change leads to a change in disease risk: systolic blood pressure, LDL cholesterol, body weight (in children BMI Z score), and insulin sensitivity^a. These are the risk factors in relation to which the causal relationship with at least one of the following chronic diseases has been demonstrated: coronary heart disease, stroke, heart failure and type 2

^a In terms of glucose clamp method, fasting insulin, HOMA-IR



diabetes mellitus. A detailed substantiation of this can be found in the document regarding the methods of the 2015 Dutch Dietary Guidelines Committee.^{4 a}

In addition to the four causal risk factors, the Committee also looked at a number of intermediate factors and fitness indicators that it considers important in relation to physical activity from a health perspective:

- fat mass
- abdominal fat
- abdominal circumference.

In older persons, the following factors were also considered:

- fat-free mass
- muscle strength
- physical functioning (walking speed, timed up-and-go test and Short Physical Performance Battery test).

In children, the following factors were also considered:

- bone density^b
- cardiorespiratory fitness
- muscle strength.

^a The 2015 Dutch Dietary Guidelines Committee did not evaluate insulin-sensitivity.⁴ Because lower insulin sensitivity is a pathology that results in type 2 diabetes, the committee also viewed insulin-sensitivity as a causal risk factor.

^b Because bone density in older persons is not a good measure of the risk of fractures, this was only considered in relation to children.

Table 2. Outcome measures for RCTs

Adults 18+	Children 0-4 years	Children and adolescents 4-18 years
Systolic blood pressure	BMI	Systolic blood pressure
LDL cholesterol		LDL cholesterol
Insulin sensitivity		BMI Z-score
Weight		Insulin sensitivity
Blood glucose		Blood glucose
Fat mass		Fat mass
Abdominal fat		Bone density
Abdominal circumference		Cardiorespiratory fitness
Older persons: fat-free mass		Muscle strength
Cardiorespiratory fitness		Injuries
Older persons: muscle strength		Depression and depressive symptoms
Older persons: functional performance		ADHD symptoms
Premature mortality		
Coronary heart disease		
Stroke		
Heart failure		
Diabetes		
Chronic obstructive pulmonary diseases		
Breast cancer		
Colorectal cancer		
Lung cancer		
Older persons: disabilities		
Fractures		
Osteoarthritis		
Injuries		
Dementia and cognitive decline		
Depression and depressive symptoms		

Cognition in children falls outside the scope of these recommendations, because the committee does not consider this as a health outcome.



Studies into the short-term or ad-hoc effects of, for example, regular interruptions to sitting behaviour fall outside the scope of the evaluation. Because there are RCTs involving children and adolescents that look at the effect of physical activity and sitting down on one or more intermediate factors or fitness indicators, the committee did not evaluate any cohort studies for these outcome measures because of the stronger level of evidence of RCTs with regard to causality.

04 Literature review for the background documents

In this section, the committee explains its methods in relation to the literature review. It will also consider the types of publications, the publications studied, the various study designs and miscellaneous sources.

4.1 Pooled analyses, meta-analyses and systematic reviews

The committee's literature review predominantly involved pooled analyses, meta-analyses and systematic reviews from prospective research. In pooled analyses and meta-analyses, the findings from multiple original studies with corresponding research questions and approaches are combined into a new risk estimate. Pooled analysis uses individual

personal data from multiple studies, these data are analysed and corrected for confounders in a standardized manner for each of the original studies, and the results are then merged. In meta (regression) analysis, the risk estimates as published are combined. An intermediate form is the harmonized meta-analysis, in which risk estimates from cohorts are merged after they have been harmonized using a standard correction for the same potential confounders. Combining the findings of multiple studies enhances the statistical power and leads to a more accurate assessment of the relationship or effect than in the original studies. By restricting itself to pooled analyses, meta-analyses and systematic reviews, the committee was able to keep the volume of work manageable.

The background documents explain which pooled and meta-analyses were found. Where there was a reason to exclude certain publications, this is indicated. These reasons may relate to methodological factors or the lack of information regarding methods, characteristics or outcomes. Previous publications that included only some of the available research were not considered in cases where a good more recent or more comprehensive publication was available.

Where no meta-analysis or systematic review of RCTs and/or cohort studies were available, but there were good-quality studies, the individual studies were described (for example, RCT regarding the effect of physical activity on the risk of diabetes). In addition, the one cohort study that involved an objective measurement of physical activity has been described separately, because this measurement is more reliable than the



use of questionnaires.

4.2 General population, risk groups and patient groups

The emphasis is on studies that involve the general population. RCTs involving patients have not been included. Because RCTs with hard outcome measures are often carried out among risk groups (those with high blood pressure, high LDL cholesterol, pre-diabetes), studies performed exclusively among high-risk groups (including elevated blood glucose, elevated blood pressure) were included. This is because of the importance of this type of research in assessing the causality of a relationship, as well as the fact that fairly large sections of the population belong to these high-risk groups.

4.3 Types of study

The above description demonstrates that the committee arrived at its conclusions on the basis of background papers that relate to the current state of scientific knowledge in relation to the following types of study:

- RCTs into effects on the incidence of disease/mortality due to a disease
- RCTs into effects on causal risk factors, intermediate factors and fitness indicators.
- Cohort studies into associations with disease and mortality, in which levels of physical activity or sitting were established prior to the diagnosis of the disease or prior to death.

4.4 Sources

For the literature review, the committee supplemented the conclusions of the Australian reports¹²⁻¹⁴, regarding the association between physical activity, sitting and the risk of chronic diseases in adults and children, with insights from more recent scientific publications. The committee describes the findings of the Australian reports, before describing its additional literature review and evaluating its results in the light of the Australian findings and subsequently drawing conclusions. Where the Australian documents do not include any conclusions regarding particular outcome measures, the committee uses the report describing the evidence for US guidelines which is based on research published between 1994 and 2008.¹⁵

The Australian reports focus mainly on prospective and some retrospective cohort studies; cross-sectional studies were not considered.¹²⁻¹⁴

For adults (18-64 years old), the Australian literature review includes meta-analyses and systematic reviews that were published between 2007 and 2012. In the Australian review, these are assessed in the light of the conclusions of previous systematic literature reviews conducted in relation to guidelines in the United States, Canada, the United Kingdom, and Sweden and the World Health Organization guidelines. In these earlier literature studies, cross-sectional research was also summarized, and the Australian report discusses the potential consequences on the final conclusions.¹² The Australian literature review regarding older persons will



not be considered because it dates from 2006.¹⁶

In children, the Australian literature review focuses on studies concerning physical activity, sitting and health conducted among four to eighteen-year-olds. This literature review also includes publications up to 2012.^{13,14}

For the Australian guidelines, no literature review was carried out for children aged 0-4 years.

In addition, the committee considered reports that have been published since the Australian guidelines in order to find relevant publications.¹⁷⁻²⁰

Because these existing reports are based on a wider range of study types than the committee wished to include, a selection was made. The same applies where the committee used the report that describes the evidence for the US guidelines.¹⁵

4.4.1 Search Strategy

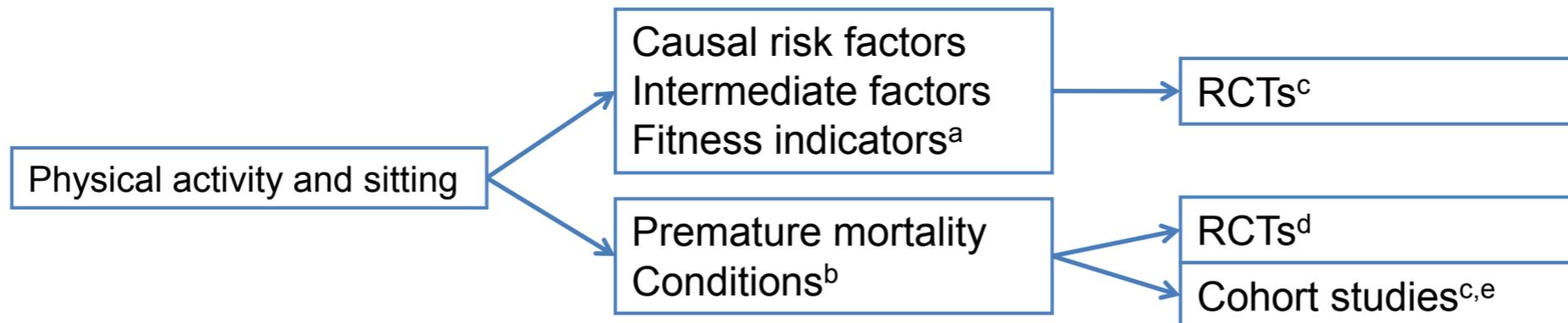
The committee searched for literature in PubMed. The literature review covers publications published until 1 October 2016. The exact search strategies used are explained in both background documents.

The committee occasionally adopted a different method when there were no suitable peer-reviewed meta-analyses or systematic reviews available, but there were however good-quality summary reports at hand. This occurred in relation to physical activity and the risk of injury.

05 Conclusions in background documents

In the background documents, the committee evaluates the current state of scientific knowledge in relation to the effects (in the case of RCTs) of each indicator of physical activity or sitting and association (in the case of cohort research). Below, the committee describes how its conclusions regarding effects and associations were established.





- a. The committee evaluated the effect of physical activity on the following causal risk factors: systolic blood pressure, LDL cholesterol, body weight (adults) and body mass index (children), and insulin sensitivity; the intermediates: blood glucose, fat mass, abdominal fat, abdominal circumference, fat-free mass and bone density; the fitness indicators: cardiorespiratory fitness, physical function and muscle strength.
- b. The committee evaluated the association between physical activity and premature death and the following conditions: coronary heart disease, stroke, heart failure, type 2 diabetes mellitus, chronic obstructive pulmonary disease (COPD), breast cancer, colorectal cancer, lung cancer, physical

disabilities, fractures, osteoarthritis, injuries, dementia and cognitive decline, depression and depressive symptoms, and ADHD symptoms.

- c. The committee based its findings mainly on pooled analyses, meta-analyses, and systematic reviews.
- d. RCTs into the effect on disease are few in number. In view of the importance of such studies for conclusions regarding causality, these RCTs are also described where no meta-analyses or systematic reviews are available.
- e. The term cohort study is used for all types of prospective observational studies.



5.1 Summary of findings in standardized tables

Each individual assessment begins with a summary table which takes a standard form (Table 3).

Table 3. Summary table for each effect or association in the background documents

Summary	Explanation
Selected studies	Here, the committee specifies the number of meta-analyses and/or systematic reviews and the number of RCTs or cohort studies on which the conclusion is based.
Heterogeneity	Yes/no; where 'yes', the committee provides an explanation where possible. For meta-analyses, tests for heterogeneity between the original studies are performed. If the test reveals little or no heterogeneity ($I^2 < 0.25$), the summary table shows 'no'. For moderate ($I^2 0.25-0.50$ and $p < 0.10$) or significant ($I^2 > 0.50$ and $p < 0.10$) heterogeneity, the summary table shows 'yes'. Where a heterogeneity test is not available, the committee assesses the degree of overlap between the confidence intervals from initial studies or meta-analyses and the direction of the effect or risk estimators. The committee distinguished heterogeneity in terms of the size and the direction of the effect or risk estimates.
Strength of effect / relationship	Where a conclusion regarding an effect or association is possible, the committee specifies the effect estimate or risk estimate with a 95% confidence interval, where possible in relation to (change in) physical activity or sitting.
Population studied	In the case of cohort studies, the committee specifies in which continent research took place (Europe, North America, Australia & New Zealand, Asia). Gender is specified where the available research is exclusively carried out in men or women. In the case of RCTs, the committee specifies the high-risk group and age.

5.1.1 Choice from four options for the conclusion of each evaluation

Directly below the summary table is the conclusion, in which the committee chooses between four pre-specified options (Table 4).

Table 4. Formulation of conclusions in the background documents

Option	Formulation of conclusion	Explanation
1	High or low exposure increases or decreases the risk of disease (based on RCTs), or high or low exposure is associated with a higher or lower risk of disease (based on cohort studies). The level of evidence is strong or weak.	For conclusions of this type, the committee specifies the level of evidence based on the availability of research, the presence or absence of heterogeneity in the direction and size of the effect or association, the strength of the effect or association, and any additional considerations that are described in the explanation section. Where the conclusion relates to a specific population or a specific level of exposure, the relevant details are provided. If the level of evidence is strong and there is little heterogeneity in the direction and size of the effect or association, the committee quantifies the effect or association; where there is a strong level of evidence but significant heterogeneity in the size of the effect or association and where there is a weak level of evidence, the conclusion is qualitative.
2	A given effect or association is unlikely.	This applies in cases where there is sufficient research that indicates no effect or association. In the case of intermediate outcome measures, the effect estimator is in the vicinity of zero; in the case of disease or mortality as outcome measure, the relative risk is in the vicinity of 1.00.
3	Evidence for the effect or association is ambiguous.	One or more of the following situations applies: 1) In a meta-analysis, considerable and unexplained heterogeneity has been noted in the direction of the effect or association. 2) There are considerable differences in the effects or associations identified in different intervention or cohort studies.
3)	There is too little research to draw a conclusion about a given effect or association.	One or more of the following situations applies: 1) No more than two original studies have been published 2) All available studies are from one research group and are therefore not independent 3) The available studies are of insufficient quality to make a statement about the association or effect.



The formulation is different for RCTs than for cohort studies: intervention studies allow statements about effects (causality) to be made, while cohort studies only allow statements about associations, relationships and coherence to be made. When referring to an effect or association, the committee indicates whether the level of evidence is considered strong or weak.

The conclusion is followed by an explanatory text in which the committee presents the research that has been evaluated. In that text and the corresponding table(s), the committee presents the research data that form the basis for the summary table.

5.1.2 Decision tree

The committee used the attached decision tree when drawing conclusions about the strength of the evidence. On the basis of its experiences when preparing background papers for the 2015 Dutch Dietary Guidelines, the committee derived the criteria for the required number of studies and participants for each type of conclusion when preparing the background papers for the Physical Activity Guidelines 2017. The conclusion that the evidence is strong or that an effect or association is unlikely implies that there are at least 5 studies involving 150 participants (RCTs) or 500 cases (cohort studies); the conclusion that there is a weak level of evidence implies 3 or 4 studies and at least 90 participants (RCTs) or 300 cases (cohort studies); one or two studies means that the conclusion is that there is too little research. The required number of participants in

individual RCTs naturally depends on the variation in outcome measure and the expected extent of the effect. The experience of the committee is that these cut-off values are helpful in practice. The committee reserved the possibility of deviating from the process described in the case of a smaller numbers of good-quality studies, but in practice this did not happen.

5.1.3 Conclusions with a strong level of evidence

At the end of the two background documents regarding physical activity and sitting, respectively, the committee summarizes the findings with a strong level of evidence for each type of study (RCTs or cohort research). These form the basis from which the guidelines were derived.



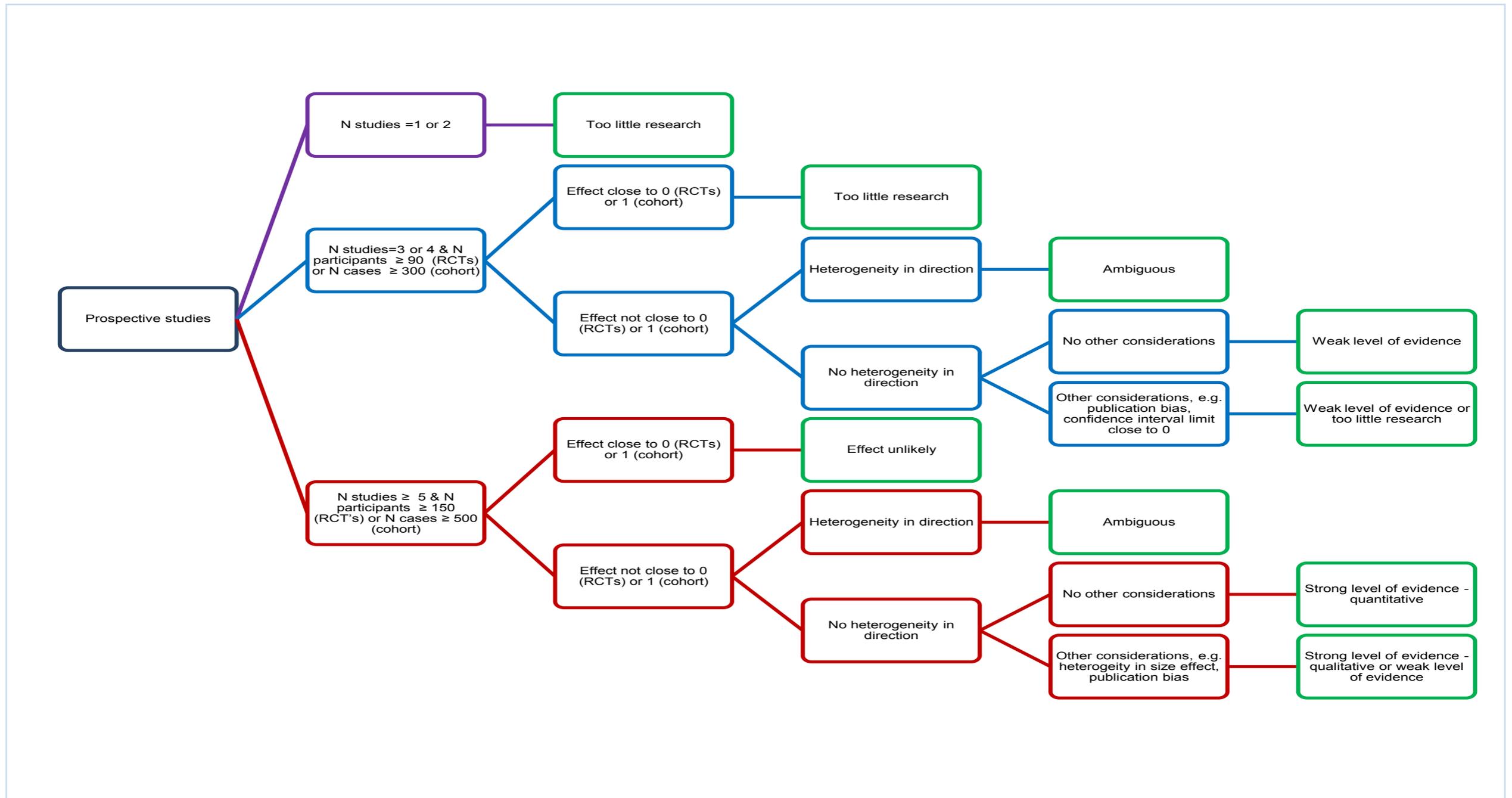


Figure Decision tree for drawing conclusions on effects (RCTs) and associations (cohort studies). For RCTs with risk measures, effect criterion 1 applies instead of 0, analogous to cohort research.



literature

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annex



A definitions

The following list is based on definitions in the German ²¹, Australian ²² and UK Guidelines ²³ and on the US Centers for Disease Control and Prevention ²⁴.

Health

- Within these recommendations, health is defined as the absence of physical and mental chronic diseases.

Physical activity and sitting

- Physical activity: Any physical movement involving skeletal muscles that results in the energy being used. In the context of this report, these are activities involving one or more major muscle groups. Most forms of physical activity involve both an endurance component and a strength component. Areas of physical activity are sleeping, leisure time, school, work, transport and household.
- Balance exercises are static and dynamic exercises aimed at improving balance while someone is standing or moving.
- Bone-strengthening exercises include strength training and activities in which the body supports its own weight, such as jumping, climbing stairs, walking, running and dancing.
- Daily activities: Regular activities in daily life, such as eating, showering, dressing, getting up from a chair and going shopping for

food etc.

- Endurance training, activities where the aim is to increase stamina. Large muscle groups are usually involved, and the activity occurs at a rate that can be sustained for more than a few minutes. Examples include walking, swimming, cycling and dancing.
- Flexibility exercises help to keep joints and muscles flexible and supple.
- Strength training includes activities that improve the strength, capacity, stamina and size of skeletal muscles. Examples are exercises that involve the use of body weight, loose weights (dumbbells) or machines to create resistance. Dynamic strength training affects both muscle strength and length through concentric and eccentric stress. In isometric strength training, a muscle group is used but muscle length does not change or hardly changes.
- Sitting includes activities performed in a sitting, reclining or lying posture, with little energy being used (≤ 1.5 MET), excluding sleep. Examples include watching television, reading, sewing, working with a computer, sitting while playing video games or sitting while travelling.

Intensity

- Intensity is defined as the energy consumption required for an activity, usually expressed in MET, kilojoules (kJ), oxygen uptake (ml O₂ per minute), speed (km/h) or cadence (steps per minute).
- Metabolic equivalent (MET) is a measurement unit that defines the level of physical activity, in multiples of the energy that is required at



rest. One MET is the energy consumption at rest.

- Absolute intensity is divided into light (1.6-2.9 MET), moderate (3.0-5.9 MET) and heavy (≥ 6 MET).
 - Light physical activity consists of activities that involve standing or moving while upright. Energy consumption ranges from 1.6 to 2.9 MET.
 - Moderate physical activity relates to activities performed at an intensity that requires effort, but during which conversation remains possible, such as hiking, cycling and swimming. Energy consumption ranges from 3.0 to 5.9 MET.
 - Heavy physical activity causes much more rapid breathing or shortness of breath depending on fitness levels. Examples include aerobics, running, sports cycling and certain competitive sports. Energy consumption is 6 MET or more.
- Relative intensity is rarely used in epidemiological research on physical activity, but is used by exercise physiologists to express the intensity of physical activity as a percentage of the maximum capacity (% VO₂ max).
- Duration is the time during which a physical activity (number of minutes or walking) is sustained per session or the total time spent on this physical activity within a certain longer period of time (for example, number of minutes sitting or walking per week).
- Frequency refers to the number of occasions per unit of time that a particular physical activity is carried out. This is often expressed in

number of times per day or per week.

- Repetition refers to the number of times that a person repeats a strength-training exercise.



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