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The economic "return on investment" in physical education, physical activity and sport

Final report

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1 Introduction

1.1 Purpose and structure of the report

The purpose of this project is to provide a comprehensive and systematic overview of scientific literature on the 'return on investment' in physical education, physical activity and sport taking a global perspective. Contrary to industries like banking and real estate where the calculation of a return on investment is straighter forward, it is difficult to calculate a 'return on investment' for public investments related to physical education, physical activity, and sport (from now on summarised under the overall term 'physical activity' for abbreviation purposes). Given that most studies examining physical activity have not estimated a monetary return on investment, the overall process of how public investments can be translated into a monetary return on investment is split into three sub-processes. These sub-processes reflect the research areas and relationships that were mainly looked at in previous studies. These sub-processes and research streams, respectively, include the following (see Figure 1):

1 The first stream of research looks at the relationship between different types of **public investments** and physical activity in the population. This stream is split by type of public investment. Specifically, four types of investments are considered: 1. monetary investments and direct public subsidies, 2. provision of infrastructure related to physical education, physical activity, and sport, 3. launching of campaigns, and 4. funding of elite sport.

2 The second stream of research examines **non-monetary outcomes and outputs** of participation in physical activity. These outcomes/outputs can be divided into six main categories: 1. physical health, 2. subjective well-being and mental health, 3. combating of trauma and disasters, 4. integration and social capital, 5. education, and 6. labour market outcomes.

3 The third stream of research investigates **monetary returns** of participation in physical activity. A distinction is made by whether the monetary valuation was conducted at the individual or the community level.

4 The fourth stream of research takes a macro-economic perspective and examines the **economic input-output process** as a whole; yet, this literature is relatively scarce.

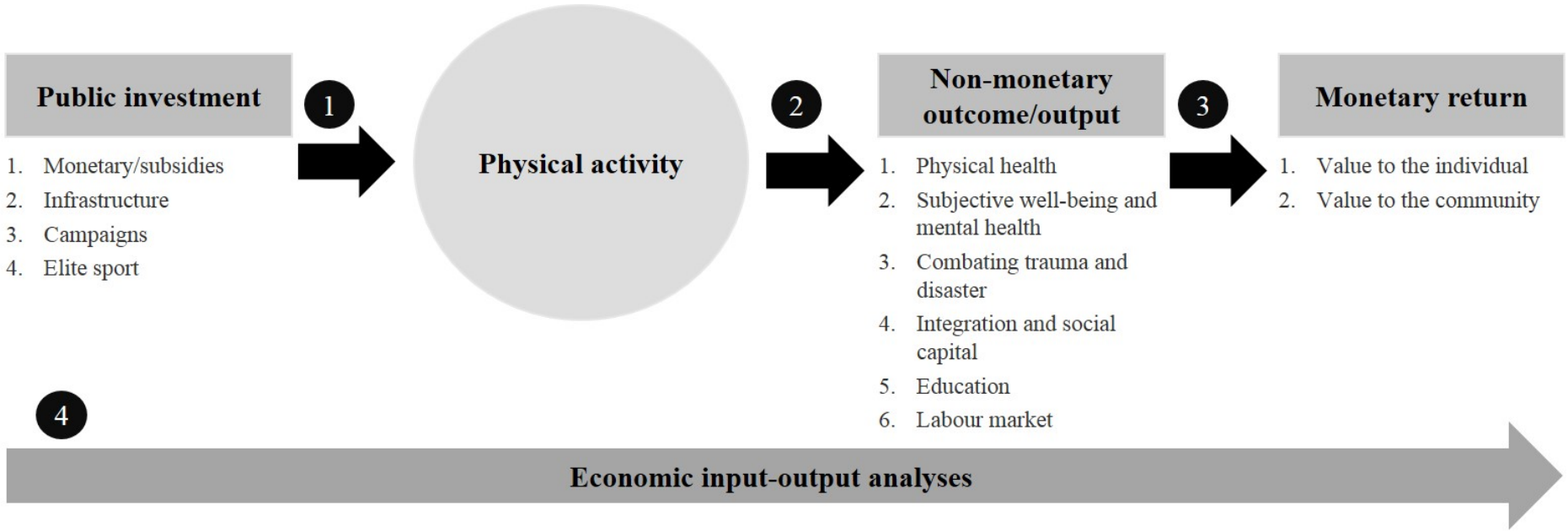

Figure 1: *Framework of the process how public investments in physical activity translate into a monetary return.*

1.2 Search for literature

In order to access a wide array of articles, a comprehensive search of literature was conducted using several databases and search engines. Specifically, the following databases were used: EconBiz, EconLit, MEDLINE, PRE-MEDLINE, BIOSIS, SPORTDiscus, and PsycInfo. Moreover, the reference lists of the articles identified by the search were consulted to check if further studies on a topic were available. Table 1 provides an overview of the search terms.

Table 1: Search terms for the different research areas.

1 Public investment	**2 Non-monetary output/outcome**	**3 Monetary return**	**4 Input-output analyses**
physical activity, sport participation, physical education, government spending, public spending, public investment, public subsidies, facilities, environment, infrastructure, sport participation, urban design, built environment, media campaigns, school campaigns, promoting stair use, community based intervention, community programs, promoting walking, promoting physical activity	physical activity, sport participation physical education, health prevention, health benefits, health effects, cancer coronary heart disease stroke cardivasculare disease diabetes osteoporosis hypertension depression happiness, well-being, life satisfaction, social capital, human capital, integration, multicultural, social, gender, disability, minorities, education, labour market, academic achievement, academic performance, performance at school, employment, unemployment	physical activity, physical education, sport participation, earnings, market effects, income, health care costs, expenditures, economic benefits, health care, health expenditures, costs of inactivity	physical activity, physical education, sport participation, cost effectiveness, input output analysis, economic analysis, cost benefit analyses

The search also identified studies which have conducted a literature review of previous studies in a field. These review studies are excluded from this report because the report focuses on empirical evidence and to avoid redundancies: some empirical studies may also be included in review articles and a double-inclusion may suggest there is more evidence in the field than their actually is.

The scientific evidence is summarised following a typology of regions suggested by the UNESCO (2015). However, for some research fields, empirical evidence was missing for the regions Africa, Asia and the Pacific, the Arab states, and Latin America and the Caribbean. In order to close these gaps, representatives of governmental institutions with sport-related responsibilities were contacted and asked for scientific evidence or case studies. The following institutions were approached: Ministry of Sports (Brazil), Ministry of the Interior (Colombia), Ministry of Sport and Recreation (South Africa), Ministry of Youth and Sport (Zambia), Ministry of for Youth Affairs and Sports (Iran), and Ministry of Youth and Sports (Yemen).

This report includes scientific evidence provided by the FIFA – Medical Assessment and Research Centre (F-MARC).

This review does not claim to be exhaustive, especially for scientific evidence covering the physical and mental health benefits of physical activity.

1.3 Levels of evidence-based research

The quality of data and empirical analysis tools differs among studies examining the returns to investments in physical education, physical activity, and sport. In order to inform the reader about the quality of the summarised studies and the ability to draw generalizations based on the findings, we have developed a set of levels which help to critically appraise the presented evidence.

Several sets of levels of evidence can be found, for example, from the Oxford Centre for Evidence-based Medicine (Centre for Evidence-based Medicine, 2014) and in the publications by Weightman et al. (2005) and Rychetnik et al. (2002). These existing levels of evidence are tailored towards research in medicine and health and focus on the methodological design of the study. Typically, experiments and intervention studies play a critical role in this field of research and this importance is reflected in the proposed levels of evidence.

Yet, the present body of research looking at the return on investments in physical education, physical activity, and sport also includes studies from the social sciences including economics using other methodological designs. These studies often rely on secondary data (i.e., already existing) data and primary data (e.g., survey data, interviews) or a combination of both. Importantly, in these fields not only the methodological design, but also the data analysis and the statistical tests used are relevant for evaluating the quality of research. Therefore, the levels of evidence used to evaluate studies in medicine and health are adjusted for the purpose of comparing those with studies in the social sciences including economics. In doing so the proposed levels of evidence below take into account both the methodological design of the study and the data analysis (Table 2).

Table 2: Levels of evidence-based research.

Level of evidence	**Description**	**Methodological design**	**Data analysis**	**Implications**
1	Causal effects can be adequately identified because of appropriate methodological design and statistical analysis	• Several measurement points, panel data • Intervention and control group • Representative sample	• Multivariate statistical tests • Use of control variables to isolate effects • Panel regression	• Information about overlapping effects and relative importance of effects is available • Projections are possible • High degree of external validity • Generalisations are possible
2	Causal effects can be identified because of methodological design or statistical analysis	Either: • Several measurement points, panel data • Intervention and control group • Representative sample	Or: • Multivariate statistical tests • Use of control variables to isolate effects • Panel regression	• High degree of external validity (when methodological design is appropriate) • Information about overlapping effects and relative importance of effects is available and projections and are possible (when data analysis is appropriate) • Generalisations are possible to some extent
3	Identification of causal effects not possible, only relationships	• Only one measurement point • No control group • Cross-sectional data	• No control variables to isolate effects • Only bivariate statistical tests (e.g., correlation, t-test, one-way analysis of variance) • Descriptive analysis (e.g., mean values or percentages)	• Information about overlapping effects and relative importance of effects is not available • Projections are not possible • Low degree of external validity • Generalisations are hardly possible
4	Case study	• Systematic description of one or several specific cases • Interviews, focus groups, document analysis etc.	• Exploration of main themes and patterns within the data	• Causes and effects cannot be identified • Low degree of external validity • Generalisations are not possible

Level of evidence	Description	Methodological design	Data analysis	Implications
5	Expert opinion	• Collection of qualitative data via interviews, focus groups etc.	• Exploration of main themes and patterns within the data	• Causes and effects cannot be identified • Low degree of external validity • Generalisations are not possible

1.4 Executive summary

This report provides a systematic review of empirical studies examining economic inputs and outputs/outcomes of participation in physical education, physical activity, and sport (summarised under 'physical activity'). The reviewed studies have been evaluated based on different levels of evidence-based research.

Only a few studies have related economic inputs directly to economic outputs. Those who did identified a positive benefit/cost ratio indicating that economic investments in physical activity generated a positive return on investment. The majority of studies have either looked at the effect of different types of public investments on participation in physical activity or on (non)monetary outputs/outcomes of physical activity.

Starting with economic inputs and public investments, respectively, countries with higher government spending on sport, health, and education are more likely to have higher participation rates. The evidence is mixed when looking at the regional level, probably because regions within one country are more homogeneous. Public investments in an activity friendly neighbourhood are positively related with participation in physical activity. Also, the supply of sport infrastructure and facilities, specifically swimming pools, in close proximity to the residents' home significantly increases the population's likelihood of being physically active.

Moreover, both community and school campaigns can also be considered an effective policy tool for increasing participation rates; however, it has not yet been examined whether such participation is sustainable. Elite sport which is financially supported by the federal government in many countries can have an inspirational function for the population, i.e., sporting success, athletes as role models, and hosting major sport events can inspire people to participate themselves. Yet, the empirical evidence is not consistent; some studies documented a significant positive effect of elite sport, while others were not able to identify a measurable inspirational effect.

Previous research has examined non-monetary outputs and outcomes of physical activity with the majority of studies looking at physical health outcomes. Most studies document a positive effect of physical activity on subjective health (i.e., how individuals perceive their health status) and various health parameters. Specifically, physical activity is associated with a reduced incidence of cancer, diabetes, cardiovascular diseases, and osteoporosis. Moreover, physical activity contributes

positively to subjective well-being e.g., self-reported life satisfaction or happiness) and reduces mental health problems (e.g., depression, anxiety disorders) significantly. It can also assist in reducing post-traumatic disorders resulting from military services, natural disasters, and severe diseases.

Participation in physical activity programmes was also found to be beneficial for the integration and social inclusion of ethnic minorities and immigrants as well as for the development of social capital (e.g., social networks, friends, trust). Additionally, research shows that physical activity has a positive impact on educational outcomes (e.g., grades) of pupils and students. Similarly, physical activity is beneficial for labour market outcomes: physically active people utilise health care at work to a lesser extent, are more likely to exit from unemployment, and are less absent from work.

Some studies estimated the monetary return of participation in physical activity to the individual or to the community. On the individual level, research showed that physcially active people tend to earn higher incomes and have lower medical costs. On the community level, previous research focused on the estimation of the economic costs of inactivity and documented that the economic costs of inactivity are substantial, with indirect costs (i.e., productivity losses) typically exceeding the direct costs (i.e., health care costs). Sport-related injuries have largely been excluded from such analyses.

2 Systematic literature review

In each chapter, the literature review is differentiated by the regional focus of the study. The presentation in this report follows the different types of regions in the world suggested by the UNESCO (2015): Africa, Arabia, Asia and the Pacific, Latin America and the Caribbean, Europe, and North America.

2.1 Public investments

2.1.1 Monetary/subsidies

An overview of studies examining the relationship between public funding and participation in physical activity of individuals and participation rates, respectively, is provided in Table 3. Most of these studies have been conducted in Europe. The findings of previous research are mixed: while studies looking at public funding at the national level documented a significant positive effect, studies examining lower levels (e.g., regional level, state level) reported an insignificant effect or had difficulties providing a consistent effect. These differences in findings could be due to greater heterogeneity between countries in terms of the size of public funding, while regions or states within one country may be more homogeneous in this regard. Since previous research has only used average funding over a period of up to five years, it remains unclear after what period funding is effective. Moreover, the mechanism through which public spending affects participation in physical activity remains unclear because only general spending (e.g., sport-related government spending) has been examined which could be used for sport clubs, sport programmes, sport facilities etc. Interestingly, not only sport-related spending (at the national level), but also health and education spending have a positive effect on participation in physical activity. Since there are large differences in countries with regard to the size of government spending and how it is used, and the available infrastructure, the general findings of the available studies can hardly be applied to those UNESCO regions where no scientific evidence could be made available. Therefore, more research is needed on this topic, also with regard to the type of data. Most studies relied on cross-sectional data suggesting that panel data should be made available in future research.

Table 3: Overview of studies examining the relationship between monetary public investments or subsidies and physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
No scientific evidence could be made available		
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Lera-López et al. (2015) *27 European countries* **2**	• Individual cross-sectional data (*n*=25,243) from 2009 (Eurobarometer 72.3) and national level data of n=27 European states • Relationship between government spending (health and education) and physical activity is examined using multi-level models	• Education and health spending has a significant positive effect on participation in sport • Effect of education spending is larger • Health spending will have most effect combined with earlier influences from education spending
Downward et al. (2014) *27 European countries* **2**	• Cross-sectional data (*n*=26,788) from 2009 (Eurobarometer 72.3) • Regression analysis to investigate the correlates of sport participation in Europe	• Significant positive effect of sport-related government spending on the likelihood to participate in sport • Findings are important in the context of possible budget cuts due to the period of austerity in Europe
Kokolakakis et al. (2014) *England* **2**	• Cross-sectional data from 2010/11 for the 354 local authorities in England • Regression analysis to examine how regional factors are related with the percentage of youths and adults (16+)	• Neither local sport funding (from sport lotteries; 2007-2010) nor sport infrastructure were identified as significant predictors of sport participation rates of local authorities

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	participating in sport	• Findings suggest a need for cross-party consensus on sport policy to secure long-term continuity
Van Tuyckom (2011) *27 European countries* **2**	• National level data of *n*=27 European states from 2005 including physical activity participation rates from the survey Eurobarometer 64.3 • Regression analysis to investigate the associations of macro-environmental factors and leisure-time physical activity	• Public sector expenditure on health has a significant positive effect on the percentage of the population being physically active in their leisure-time
North America		
Humphreys & Ruseski (2007) *United States* **2**	• Pooled individual data from the United States for 1998 (*n*=146,260) and 2000 (*n*=175,246) and state and local government spending on parks and recreation for all 50 states • Regression analysis to examine the influence of government spending on parks and recreation on physical activity	• Government spending on parks and recreation only increases the likelihood of outdoor recreation, but not the likelihood of participating in group or individual sports or walking for exercise • Parks and recreation spending has a positive effect on time spent on outdoor recreation and individual sports, but not walking for exercise and group sports

2.1.2 Infrastructure

Table 4 summarises scientific evidence looking at the relationship between the provision of different types of infrastructure and participation in physical activity. Previous research was able to show that an activity-friendly environment and neigbourhood including, for example, bike lanes, walking trails, and environmental attributes (aesthetics, number of shops and parks, quality of facilities) are important predictors of general physical activity. When examining the supply of sport infrastructure within one municipality, research had more difficulties in detecting significant relationships, probably because the supply of sport facilities is less heterogeneous within than between municipalities. Generally speaking, swimming pools, sport fields, fitness centres, and public playgrounds in close proximity to the residents' home were found to be positively associated with participation in physical activity. However, the neighbourhood must be carefully designed since substitution effects were also evident: a greater supply of sport-specific type of facilities reduces the likelihood that people participate in other types of activities, indicating that specific supply has the potential to promote specific types of activities. It can be expected that the general tendencies can also be applied to those UNESCO regions where no scientific evidence could be made available. With regards to the methods used, the majority of studies relied on cross-sectional data which, however, do not allow the examination of developments over time – an aspect which should be considered in future research.

Table 4: Overview of studies examining the relationship between infrastructure and physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Lin & Ting (2014) *Taiwan* **2**	• Cross-sectional survey data in Taipei (*n*=269) from 2010-2011 • Regression analysis to investigate the relationship between built environments and walking and biking (frequency, duration and meeting recommendations) among 12- to 14-years-old adolescents	• Building and road density were positively related to walking and biking • Mixed land use was negatively related to all three measures of physical activity
Inoue et al. (2009) *Japan* **2**	• Cross-sectional survey data (*n*=492) from Tokyo and Himeji from 2003 • Regression analysis to examine the relationship between perceived environment and physical activity and walking time	• High residential density, good access to shops, and presence of sidewalks were positively related to walking • Presence of shops and bike lanes were positively related to physical activity levels
Kamada et al. (2009) *Japan* **2**	• Cross-sectional survey data (*n*=434) in Unnan City from 2006 • Regression analysis of the relationship between environmental correlates and three different categories of physical activity of Japanese women	• Perceived good access to public transport and recreational facilities, presence of bike lanes, and good aesthetics were positively related to physical activity
Pikora et al. (2006) *Australia*	• Cross-sectional survey data (*n*=1,678) from Perth in 2000 and environmental data • Regression analysis to model the relationship between the	• Functional features of the environment were positively correlated with walking for transport and recreation • Destination factors (i.e. shops, public transport) were

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	attributes of the physical environment and self-reported walking	only positively correlated with walking for transport, not for recreation
Giles-Corti & Donovan (2002) *Australia* **2**	• Cross-sectional survey data (*n*=1,803) from Perth in 1995-1996 • Regression analysis to test the influence of spatial access to recreational facilities on physical activity (frequency and duration)	• Respondents in low socio-economic status areas have superior access to many recreational facilities, but were less likely to use them • Perceived access to sidewalks and neighbourhood attractiveness were positively associated with walking and vigorous physical activity
Latin America and the Caribbean		
Amorim et al. (2010) *Brazil* **2**	• Cross-sectional survey data (*n*=972) from Pelotas in 2006 and environmental data • Regression analysis to evaluate the association between the physical and social environment and physical activity (at least 150 minutes per week)	• Subjects living near green areas were more likely to be physically active in their leisure-time • Transport-related physical activity was higher among individuals living in areas with garbage accumulation and lower among those living in areas with difficulties to walk or cycle
Europe		
Wicker et al. (2013) *Germany* **2**	• Cross-sectional survey data from Munich in 2008 (*n*=11,175) and geo-coded infrastructure data of the city Munich (99 districts) • Multi-level models to analyse the impact of infrastructure in close proximity to the residents' homes on sport participation in general and in a sport club	• The supply of sport fields is close proximity to the residents' home is positively associated with sport participation in clubs • Close supply of swimming pools is positively related with sport participation in general
Hallmann et al. (2012) *Germany* **2**	• Cross-sectional telephone survey data of four municipalities (*n*=9,302) in Germany from 2008-2009 and infrastructure data about sport supply by suburb • Multi-level models to analyse the importance of sport infrastructure for different sports (sport activity at least once a week)	• Sport fields have a positive relationship with soccer and tennis • Park areas were positively related to running • Substitution effects were evident (e.g. negative effect of swimming pools on running; negative effect of park area on tennis) suggesting that the composition of sport-

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
		related infrastructure within an area is critical
Navalpotro et al. (2012) *Spain* **2**	• Cross-sectional survey data (*n*=4,529) in 2006 from the Spanish National Survey of Child Health • Regression analysis to evaluate the relation between area-based socioeconomic environment and physical inactivity	• Number of sport facilities and prevalence of physical inactivity was negatively related
Wicker et al. (2012) *Germany* **2**	• Cross-sectional survey data (*n*=6,952) from 2008 and secondary data about sport infrastructure in the 25 Munich suburbs • Multi-level analysis to measure the influence of the supply of sport infrastructure in the respondent's suburb on sport participation (at least 30 minutes week)	• Supply of swimming pools in the respondents' suburb is positively related with sport participation • People are more likely to practice sport in a club when many club programmes and only few programmes from commercial providers and the municipality are available
Hallmann et al. (2011) *Germany* **2**	• Cross-sectional survey data of metropolitan (*n*=11,715) and medium-sized municipalities (*n*=9,302) from 2008 and 2009 combined with sport infrastructure data by urban district • Multi-level analysis to identify the effect of sport supply in municipalities of different size	• Swimming pools are positively associated with physical activity in metropolitan areas • Supply of sport fields has a significant positive impact on sport participation in medium-sized municipalities
Wicker et al. (2009) *Germany* **2**	• Cross-sectional survey data (*n*=2,054) and infrastructure data for the 23 urban districts of Stuttgart from 2007 • Multi-level analysis to examine the relationship between sport infrastructure and regular sport participation (at least once a week)	• Poor supply of gymnasia, sports fields, public playgrounds, and fitness centres influences regular sport participation negatively • Swimming pools have significant positive influence for sport participation of people between 3-18 years old
Haug et al. (2008) *Norway* **2**	• Cross-sectional survey data (*n*=16,471 students) in Norway and infrastructure data of *n*=130 schools from 2004 • Regression analysis to test the influence environmental characteristics on participation in physical activities during school breaks	• Boys and girls of a school with a large number of outdoor facilities were significantly more physically active

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
De Bourdeaudhuij et al. (2005) *Belgium and Portugal* **2**	• Cross-sectional survey data from Portugal (*n*=247) and Belgium (*n*=279) including environmental and psychosocial correlates • Regression analysis to examine the influence of environmental and psychosocial factors on physical activity (minutes per week)	• Walking/cycling for transportation and walking for recreation were positively related to walkability and walking facilities in the neighbourhood
North America		
Buehler & Pucher (2012) *United States* **2**	• Rates of bike-commuters in *n*=90 cities in the United States in 2008 and data about infrastructure • Regression analysis to investigate the relationship between length of bike lanes and paths and rates of bike-commuters	• Cities with a greater supply of bike paths and lanes have significantly higher bike-commute rates
Babey et al. (2008) *United States* **2**	• Cross-sectional survey data (*n*=4,010) from California (2005-2006) • Regression analysis to examine whether the relationship between physical activity and access to parks differs depending on the adolescents' socio-demographics	• Access to a safe park was positively associated with regular physical activity and negatively associated with inactivity for adolescents in urban areas • Park access was not associated with regular physical activity among those living in apartment buildings, unsafe neighbourhoods, and with lower income • The association between park access and physical activity varied by race/ethnicity
Berke et al. (2007) *United States* **2**	• Cross-sectional data (*n*=936) of people aged between 65 to 97 years in Washington from 2002 • Regression analysis to test the associations between walkability score and physical activity	• Higher walkability scores (i.e. aesthetics, convenience to destinations, availability of paths and sidewalks) were associated with significantly more walking
Cohen et al. (2007) *United States* **2**	• Direct observations of park users combined with interviews with *n*=713 park users and *n*=605 area residents in Los Angeles • Regression analysis of the relationship between physical	• Interviewees identified the park as the most common place to exercise • Park use and exercise levels were predicted by proximity of their residence to the park

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	activity (frequency of weekly exercise) and characteristics of area residents	
Powell et al. (2007) *United States* **1**	• Panel survey data (*n*=195,702) for the years 1997 through 2003 were combined with information about physical activity-related facilities • Regression analysis of the association between the availability of commercial physical activity-related facilities and physical activity behaviour (frequency of normal and vigorous activity)	• Significant but small association between appropriate facilities and physical activity (only a small increase of frequent vigorous exercise) • Significant effects especially observed for females and older people
Gordon-Larsen et al. (2006) *United States* **2**	• Geocoded cross-sectional survey data (*n*=20,745) of adolescents from 1994-1995 and physical activity facilities measured by national databases and satellite data • Regression analysis to test the relationship between physical activity related facilities and physical activity (frequency a week)	• Socio-economic status is positively related to the odds of living an area with more than one sport facility • Increasing number of facilities was associated with moderate- to vigorous-intensity physical activity
Roemmich et al. (2006) *United States* **2**	• Cross-sectional experimental data of *n*=59 children from 2003-2004 • Regression analysis to investigate the influence of neighbourhood and home television on physical activity (accelerometer data)	• Neighbourhoods with increased proximity between homes and a greater proportion of park area have a positive influence on children's physical activity
Norman et al. (2006) *United States* **2**	• Cross-sectional survey data (*n*=770) for adolescents between 11 and 15 years from San Diego are combined with community design and recreational facility variables • Regression analysis to examine how recreation and community variables influence physical activity of boys and girls (accelerometer data)	• Recreation facilities and nearby parks correlated positively with girls' physical activity • Retail floor area ratio correlated positively with boys' physical activity
Brownson et al. (2000)	• Cross-sectional telephone survey data (*n*=1,269) to test	• More than half of participants have increased their

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
United States **3**	for the effectiveness of built walking trails in 12 rural counties in Missouri in 1998 • Descriptive analysis to determine patterns of walking, availability of places to walk, use of walking trails	amount of walking since they began using the trail • Walking trails can be beneficial in promoting physical activity among segments of the population, in particular among groups of lower socioeconomic status
Sallis et al.(1990) *United States* **3**	• Cross-sectional survey data (*n*=2,053) and data of *n*=385 exercise facilities in San Diego • Correlation analysis of exercise habits and density of exercise facilities	• Proximity of exercise facilities has a positive influence on frequency of exercise • Persons who have a greater density of pay facilities near their homes are active more than three times a week
Worldwide		
Van Dyck et al. (2014) *United States, Australia, Belgium* **2**	• Pooled cross-sectional survey data (*n*=6,014) from the USA, Australia and Belgium from 2000-2008 • Regression analysis to examine moderating effects of perceived environmental characteristics on physical activity (minutes per week)	• Environmental perceptions were positively associated with physical activity • Associations were strongest among adults with lower scores on psychosocial attributes (i.e. enjoyment of physical activity, perceived barriers, perceived benefits, and perceived social support of family/friends)
Sallis et al. (2009) *Belgium, Brazil, Canada, Colombia, China (Hong Kong), Japan, Lithuania, New Zealand, Norway, Sweden, United States* **2**	• Pooled cross-sectional survey data from eleven countries worldwide (*n*=11,541) from 2002-2003 • Regression analysis to evaluate associations between environmental attributes and frequency and duration of walking as well as moderate and vigorous physical activity	• Five of seven environmental attributes were positively related to physical activity (i.e. sidewalks on most streets, bicycle facilities, low-cost recreational facilities, many shops nearby, transit stop in neighbourhood)

2.1.3 Campaigns

Table 5 provides an overview of studies analysing the relationship between community campaigns and participation in physical activity, while Table 6 summarises previous research specifically looking at the role of school campaigns. Overall, the results of previous research show that physical activity can be promoted by, for example, mass-media campaigns including physical education, social marketing interventions, and campaigns providing free offers of gym classes or supervised physical activity. However, research also shows that the effects can vary depending on the socio-demographic characteristics of the individuals under investigation. Since most studies used control groups and pre-and post-intervention data which are suitable to detect the effect of a specific campaign, uncertainty about the long-term sustainability of the effect of campaigns exists. More research is needed to examine the long-term effects of both community and school campaigns.

Most of the examined campaigns were considered effective and given the solid levels of evidence of previous studies it can be concluded that the general tendencies could also be applied to other regions where no scientific evidence could be made available. However, generalisations must be made with caution since there are large differences between countries in the way campaigns are implemented and communicated (e.g, the role of media differs between countries).

Table 5: Overview of studies examining the relationship between community campaigns and physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Subitha et al. (2013) *India* **2**	• Cross-sectional data (*n*=485) from Tamil Nadu (2008-2010) • Regression analysis of an intervention to promote walking based on social marketing including one-to-one counselling, written materials, and community events	• More than half of the people participated in walking > 4 days a week as a result of the intervention • Age, occupation, and educational status were positively related to participation in the physical activity programme
Sarrafzadegan (2008) *Iran* **2**	• Two intervention counties (*n*=6,175) and one control area (*n*=6,339) where overall ten distinct projects focussing on health promotion and health care treatment took place (2000-2004) • T-tests and analysis of variances were used to test the effect of a community-based lifestyle intervention on diet, physical activity, and smoking	• After four years, physical activity (minutes per week) showed a decreasing trend in all areas, but the drop was significantly smaller in the intervention areas
Elley et al. (2010) *New Zealand* **1**	• Pre- and post- intervention data (intervention: *n*=544; control: *n*=545) of women aged 40-74 • Regression analysis to assess the cost-effectiveness of the Green Prescription including verbal advices and a written exercise prescription intervention	• Programme costs were NZ$687 per person made active and sustained 12 months and NZ$1,407 per person made active and sustained at 24 months
Brown et al. (2006)	• Pre-and post-intervention data (2001 and 2002) in Rockhampton (intervention: *n*=2,339; control: *n*=2,478)	• The downward trend of physical activity in the comparison community was not evident in the

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Australia **1**	• Regression analysis to examine the effectiveness of a multi-strategy physical activity intervention including social marketing and improvements of the local environment	intervention group • Modest increase in physical activity levels for women in the intervention group
Bauman et al. (2003) *New Zealand* **2**	• Four waves of cross-sectional survey data between 1999-2002 (*n*=665; *n*=506; *n*=504; *n*=507) • Regression analysis of a media-led, community-wide intervention campaign for three years including commercials	• Significant increase in people who intend to be more active • No sustained changes in physical activity levels
Wen et al. (2002) *Australia* **3**	• Interviews, focus groups and a pre- and post-intervention survey (*n*=1,762) to evaluate a physical activity intervention in Sydney (1997-1999) • Intervention includes a social marketing campaign promoting walking events, initiation of walking groups, and community activity classes	• Statistically significant reduction in the proportion of sedentary women
Bauman et al. (2001) *Australia* **2**	• Pre- and post-intervention cross-sectional data (*n*=1,185) from New South Wales (1998) • Regression analysis to assess the impact of a mass media campaign including commercials on physical activity (self-reported hours a week)	• People able to recall the media message were more likely to increase their activity a week • Knowledge of appropriate moderate-intensity activity and physical activity self-efficacy increased
Latin America and the Caribbean		
Mendonca et al. (2010) *Brazil* **2**	• Cross-sectional survey data (*n*=2,267) from Aracaju (2008) • Regression analysis to evaluate the associations between supervised intervention offering free gym classes and physical activity (minutes of leisure-time physical activity per week)	• Clear association between having heard from the intervention or having used it and physical activity
Reis et al. (2010)	• Cross-sectional telephone survey data (*n*=2,097) from	• Exposure to physical activity programmes was positively

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Brazil **2**	Curitiba (2008) • Regression analysis to examine the influence of participation and knowledge of a variety of community physical activity programmes on physical activity	associated with leisure time physical activity and walking for leisure • Knowledge and participation in the programme leads to recommended levels of physical activity
Simoes et al. (2009) *Brazil* **2**	• Cross-sectional survey data (*n*=2,047) from Recife (2007) • Regression analysis to evaluate the effects of a community-based intervention which provides supervised leisure-time physical activities to community members	• Prevalence for moderate to high levels of leisure-time physical activity was higher among former and current intervention participants
Europe		
Solomon et al. (2014) *England* **1**	• Experimental design in 128 randomised rural villages in England • Panel survey data (intervention: *n*=4,693; control: *n*=5,719) at five different time points between 2011-2012 • Regression analysis to test the effectiveness of community-level interventions which provided physical activity opportunities over twelve weeks	• Intervention did not increase physical activity • Ineffectiveness may be caused by the low penetration – 16% of participants reported awareness of the intervention and only 4% reported participating in intervention events
Munro et al. (2004) *United Kingdom* **1**	• Pre and post intervention data (intervention: *n*=2,283; control: *n*=4,137) from 2003-2004 • Regression analysis to assess the cost effectiveness) of a population wide public health intervention in 12 general practices in Sheffield	• Patients in intervention practices had a significant lower decline in health status • Incremental costs per quality-adjusted life years amounted to €17,174
De Cocker et al. (2007) *Belgium* **2**	• Pre- and post- intervention survey data in Ghent between 2005 and 2006 (intervention: *n*=872; control: *n*=810) • Independent t-tests and chi-square tests to identify the effect of the one-year physical activity promotion project “10,000 Steps Ghent” including local media campaigns and environmental approaches on physical activity	• Significant increase in the number of people reaching the recommended standards in the intervention group • Significant increase of daily steps only in the intervention group

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Gusi et al. (2008) *Spain* **2**	• Pre and post intervention survey data (intervention: *n*=55; control: *n*=51) of elderly women participating in a 6-month walking-based intervention from 2005 • Analysis of variance to assess the cost utility of the intervention	• Significant positive health effects for BMI, Depression, and Anxiety after six months
Miles et al. (2001) *England* **2**	• Pre- and post- intervention survey data (*n*=2,112) from 1999 • Regression analysis to test physical activity behaviour changes of participants of BBC's "Fighting Fat, Fighting Fit" campaign	• Participants reported significant increases in exercise levels • Particular subgroups such as men and people under 25 may require specifically targeted campaigns
Stevens et al. (1998) *England* **2**	• Pre- and post- intervention data (intervention: *n*=363; control: *n*=351) of inactive people aged 45-74 years • Independent t-test to assess the cost-effectiveness of a primary care based intervention aimed at increasing levels of physical activity	• Costs of moving a person out of the sedentary group were less than £650 • Costs of moving someone to the recommended levels of physical activity were £2,500
North America		
Anderson et al. (2015) *United States* **2**	• Pre- and post-intervention survey data (*n*=95) from 2010-2012 • Paired t-test to examine the effectiveness of interventions including 16 weekly 2-hour-classes, educational activities, group cooking, and physical activities for parents and children	• Adults and children significantly increased their physical activity as a result of the intervention
Neelon et al. (2015) *United States* **1**	• Pre- and post-intervention survey data (intervention: *n*=64; control: *n*=40) in Mebane from 2011 • Regression analysis to examine the effects of interventions including promoting of physical activity through walking and running clubs and installing of sidewalks on physical activity of children (accelerometer	• Children increased their moderate- to vigorous-intensity physical activity

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	data)	
Brown et al. (2014) *Canada* **1**	• Pre- and post- intervention survey data (intervention: *n*=65; control: *n*=109) from 2012 • Regression analysis to test the effectiveness of a "Healthy Active Living" intervention including exposure to information related to a healthy lifestyle and structured activities for first-year-students	• Significant increase of moderate- to vigorous-intensity physical activity • Intervention targeting first-year university students appears to be effective in preserving or enhancing healthy behaviour
Scarinci et al. (2014) *United States* **1**	• Pre- and post-intervention data (intervention: *n*=188; control: *n*=121) • Mixed-effects model analysis of counties to examine efficacy of a community-based intervention to promote healthy eating and physical activity (multiple sessions)	• Interventions group showed a significant increase of physical activity • A 24-months follow-up revealed that the positive changes only maintained for healthy eating behaviour, but not for engagement in physical activity
Craig et al. (2007) *Canada* **2**	• Cross sectional survey data (*n*=9,935) from Canada (2004) • Regression analysis to examine the immediate impact of the "Canada on the Move" initiative to promote walking and physical activity (frequency in the past seven days)	• Evidence of a positive effect from the intervention on walking behaviour
Sevick et al. (2007) *United States* **1**	• Pre- and post- intervention survey data of three groups (phone: *n*=80; print: *n*=81; control: *n*=78) from 2000-2004 • Regression analysis to compare the three groups in terms of change in physical activity at 6 and 12 months	• At six months the cost of moving one person out of sedentary status was $1,290 for the phone group and $756 for the print group. • At twelve months these costs were $3,967 and $955
Reger-Nash et al. (2006) *United States* **1**	• Pre-and post-intervention survey data (intervention: *n*=575; control: *n*=374) from New York in 2003 • Regression analysis to replicate the effects of a "BC Walks" campaign to promote walking among sedentary adults including advertising and community health activities in a larger community	• Significant change from non-active to active walkers • Increase in total weekly walking time • Results were similar compared to the smaller community, although the effects were smaller

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Brownson et al. (2005) *United States* **1**	• Pre- and post-intervention survey data in six intervention communities (*n*=752) and six control communities (*n*=779) to capture changes in walking • Regression analysis of a public health initiative to promote walking including exposure to intervention activities with different dose categories (newsletters, interpersonal activities, and health provider counselling)	• Walking showed some evidence of a positive linear trend across different dose categories • Intervention participants in the moderate/high dose categories were about three times more likely to meet recommended guidelines of walking
Huhman et al. (2005) *United States* **3**	• Pre-and post-intervention survey data (*n*=3,120) • Propensity scoring was used to determine the effects of a mass-media campaign on the levels of physical activity among children	• Levels of reported free-time physical activity increased significantly
Beaudoin et al. (2004) *United States* **1**	• Pre-and post-intervention survey data between 2004 and 2005 (intervention: *n*=1,500; control: *n*=3,137) • Regression analysis to evaluate a mass media campaign's ability to promote walking	• Significant increases in message recall and positive attitudes towards walking • Behaviour did not change significantly
Reger et al. (2002) *United States* **1**	• Pre- and post-intervention telephone data (intervention: *n*=719; control: *n*=753) • Regression analysis to evaluate the mass media campaign "Wheeling Walks" addressed at people between 50 and 65 years	• Significant increase in the number of walkers in the intervention community • Moderate- and vigorous-intensity variables showed no significant change
Sevick et al. (2000) *United States* **3**	• Pre- and post- randomised intervention data of two groups (*n*=235) after 6 and 24 months from 1994 • Analysis of variance to evaluate the project ACTIVE which includes two intervention approaches (lifestyle and structured)	• Lifestyle intervention is more economically efficient in achieving improvements in physical activity and cardiovascular fitness

Table 6: Overview of studies examining the relationship between school campaigns and physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
Naidoo & Coopoo (2012) *South Africa* **3**	• Pre-and post-intervention survey data (*n*=798) from KwaZulu-Natal • T-tests to identify the impact of a physical activity 18-months school-based intervention incorporated within classroom-based lessons	• Significant increase in the number of sporting activities children engaged • Significant increase in flexibility and abdominal strength • Intervention lead to short-term effects on physical activity participation
Harrabi et al. (2010) *Tunisia* **3**	• Pre- and post-intervention survey data from Sousse in 2007 (intervention: *n*=1,965; control: *n*=1,737) • Descriptive analysis of intervention lasting for one school year including different information sessions on physical education	• Physical activity increased in the intervention group • Increase in activity levels of people who were already active for both groups, but higher in the intervention group
Fuller et al. (2010) *South Africa* **2**	• Pre- and post- intervention survey data (intervention: *n*=256; control: *n*=114) from two schools in Khayelitsha from 2007-2009 • T-tests to determine the effect of a football-based health education programme including interventions combining football play with health education	• Significant increase in knowledge about health education among children • Over 90% of children reported positive attitude responses to the programme
Arab States		
Saker & Kerfes (2014) *Algeria* **4**	• Descriptive analysis of the attitude towards physical education from teachers and students (*n*=508)	• Majority of teachers considered the status of physical education lower than other materials • Lack of resources and poor infrastructure were identified as possible reasons for the negative perception
Asia and the Pacific		
Li et al. (2014)	• Pre- and post-intervention survey data (intervention:	• Intervention led to significant increases in the duration of

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
China **2**	*n*=388; control: *n*=533) • Chi-square and t-tests to evaluate the effectiveness of a multi-component intervention including physical education lessons regarding moderate to vigorous physical activity	moderate to vigorous physical activity
Latin America and the Caribbean		
Aburto et al. (2011) *Mexico* **1**	• Pre- post-intervention survey data of 27 schools (intervention: *n*=526; control group: *n*=338) • Regression analysis to test a one-year environmental intervention in primary schools to increase physical activity (steps per day)	• Significant increase in school-day steps, all-day steps, and sit-ups
Colín-Ramírez et al. (2010) *Mexico* **2**	• Pre-and post-intervention survey data of 10 schools in Mexico City (intervention: *n*=245; control: *n*=253) • Chi-square and t-tests to evaluate the impact of an intervention program on the patterns of physical activity • Intervention activities were addressed at the individual, school, and family level	• Significant increase in the performance of moderate physical activity • Intervention was able to modify positively physical activity and reduce time spent on sedentary activities
De Barros et al. (2009) *Brazil* **1**	• Pre-post-intervention data for 20 schools in Recife and Florianopolis (intervention: *n*=1,096; control: *n*=1,166) • Regression analysis to evaluate the effectiveness of an intervention including physical education and personnel training on moderate to vigorous physical activity	• Significant increase in moderate and vigorous physical activity • Prevalence of inactivity decreased • Higher probability of being active at least once a week
Europe		
Haerens et al. (2008) *Belgium* **1**	• Pre-and post-intervention survey data (*n*=2,840) • Regression analysis to examine the mediating effects of changes in psychosocial determinants on physical activity because of a one-year intervention including an environmental and an individual part	• Positive changes in total and school-related physical activity were observed

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	• 15 schools (*n*=2840) were randomly assigned to control and intervention group	
Verstraete et al. (2006) *Belgium* **2**	• Pre-and post-intervention data of seven schools (intervention: *n*=122; control: *n*=113) • Analysis of variance to evaluate the effect of an intervention providing game equipment on moderate to vigorous physical activity	• During lunch break, children's moderate to vigorous physical activity increased in the intervention group
Manios et al. (1998) *Greece* **1**	• Pre-and post-intervention survey data (intervention: *n*=538; control: *n*=424) • Regression analysis to test the effects of a three-year health education intervention on physical activity	• Children's health knowledge increased significantly • Positive influence of the health education intervention on various activity parameters (i.e. sit-ups, sit and reach, handgrip, standing broad jump, endurance) and time spent on physical activity
North America		
Boyle-Holmes et al. (2009) *United States* **1**	• Two-year panel survey data from 16 schools (intervention: *n*=760; control: *n*=704) • Multi-level modeling to examine whether students exposed to a physical education curriculum demonstrated stronger physical activity levels, motor skills, and physical fitness	• Significant effect of curriculum on indicators of motor skill self-efficacy and physical activity levels among the fourth-grade cohort
Donnelly et al. (2009) *United States* **2**	• Pre- and post-intervention data (*n*=814; control: *n*=713) from 24 elementary schools • T-test to determine the effects of curriculum interventions on frequency of physical activity (minutes per day) and fitness parameters	• Students across the curriculum schools reported significant increases in daily physical activity
Reed et al. (2008) *Canada* **2**	• Pre- and post-intervention data from British Columbia (intervention: *n*=178; control: *n*=90) • Analysis of covariance to test the effect of a physically active school model targeting school environment,	• 20% increase in fitness • Physical activity level was slightly higher for the intervention group

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	scheduled physical education, extra-curricular activities, school spirit, family and community, and classroom action	
Going et al. (2003) *United States* **1**	• Pre- and post-intervention data (intervention: *n*=580; control: *n*=1,130) from seven American Indian communities • Mixed-effects model to analyse the effects of an intervention aimed at increasing and emphasising physical education via an increase in physical education classes and activity breaks	• Intervention schools were more active than control schools at three of the four sites • Overall difference was not significant

2.1.4 Elite sport

In most countries, the federal government takes care of the funding of elite sport because international sporting success is stated as a sport policy goal in many countries. Elite sport can also have an inspiring function for the population which is captured in the so called trickle-down effect (Sotiriadou et al., 2008; Frick & Wicker, 2016; Weimar et al., 2015), or synonymously Boris Becker effect (van Bottenburg, 2001) or demonstration effect (Weed, 2009). The trickle-down effect states that "people are inspired by elite sport, sports people or sports events to participate themselves" (Weed, 2009, p. 4). The definition revealed that this effect has three facets, i.e., people can be inspired by (1) elite sporting success, (2) elite athletes and their personalities, and (3) hosting major sport events. The inspirational effect of hosting major sport events which are typically also at least partially funded with taxpayer money is also referred to as the participation legacy of a sport event. From an empirical perspective, it is challenging to provide evidence of the trickle-down effect because participation in sport and physical activity are not only affected by elite sport, but also by various other factors on the individual level (age, gender, income, time, education etc.), community level (infrastructure and capaigns; see 2.1.2 and 2.1.3), and the regional and national level (various types of government spending; see 2.1.1). Thus, empirical studies aiming at providing evidence of the trickle-down effect should be able to isolate the inspirational effect of elite sport by controlling for at least some of the previously noted factors that can also influence individual participation in physical activity. While the inclusion of control factors requires adequate (i.e., multivariate) statistical tests, panel data should be preferred over cross-sectional data to allow analysing casual effects (Weimar et al., 2015).

Table 7 provides an overview of studies examining the relationship between elite sport and individual participation in physical activity. The majority of studies looked at only one facet of the trickle-down effect, typically either at the effect of sporting success or hosting major sport events, probably because these effects are easier to measure than athlete personalities and role models, respectively. Given the methodological challenges associated with such an examination noted above, the empirical evidence is mixed. Particularly studies using only descriptive analyses (e.g., tracking participation rates over time) had difficulties in providing evidence of an inspirational effect of elite sport success and hosting events. Within studies using panel data and multivariate statistical tests, there is mounting empirical evidence supporting the trickle-down effect, but not for all types of successes and events. Notably, some effects have a time-lag, i.e., they only become

evident one or a few years later, potentially leading to paradox or inverse relationships. There are also indications in previous research that children and youths are more likely to be inspired by elite sport than adults. Moreover, there is evidence of a motivational effect of already active people who increase their participation frequency or change the type of activity. Given the mixed evidence in this field, generalisations to those UNESCO regions where no scientific evidence should be made available can only be made with caution. More research is needed to provide robust evidence of the trickle-down effect of elite sport.

Table 7: Overview of studies examining the relationship between elite sport funding and physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Frawley & van den Hoven (2015) *Australia* **4**	• Quantitative data were combined with interviews of football managers representing national governing bodies • Descriptive analysis of the 2006 Football World Cup to investigate the impact on Australian football participation	• Participation rates increased mainly for males and females older than 15 years
Wicker & Sotiriadou (2013) *Australia* **2**	• Pooled cross-sectional survey data from 2005 and 2006 (n=12,993) • Regression analysis to examine the trickle-down effect for hosting the 2006 Commonwealth Games in Melbourne	• Younger people with no formal education and people of Aboriginal or Torres Strait Islander origin are more likely to spend more time participating in sport and taking up a new activity because of the event in Melbourne • Older people, females and the locals are more likely to gain a positive attitude
Veal et al. (2012) *Australia* **3**	• Descriptive analysis of the influence of three major sport events (2000 Olympic Games; 2003 Rugby World Cup; 2006 Commonwealth Games) on participation rates in grassroots sports	• Increase in participation rates of non-Olympic sports • Increase in adults' and children's participation in rugby • No evidence for the Commonwealth Games
Frawley & Cush (2011) *Australia*	• Descriptive analysis of the 2003 Rugby World Cup and its impact on rugby participation measured by membership registrations	• Sport of rugby witnessed an increase in sport registrations • Increase was greater for the junior rugby category

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3		
Hogan & Norton (2000) *Australia* **1**	• Government spending data for 20 years combined with different physical activity datasets (1976-1996) • Regression analysis to determine the relationship between government spending patterns on elite sport, Olympic medals, and physical activity	• No evidence that physical activity participation rates increased in the last two decades • No trickle-down effect of Olympic success on mass sport participation
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Frick & Wicker (2016) *Germany* **1**	• Secondary data on football memberships in Germany from 1950 to 2014 • Regression analysis to examine the effect of national sporting success on percentage change in memberships, number of teams and clubs in the German Football Association	• Only World Cup title wins of the men‘s national team lead to significant increases in club memberships • European Championship titles and title wins of women‘s teams were insignificant
Pappous et al. (2015) *England* **4**	• 15 interviews with officials from national governing bodies to describe the change in membership rates of Judo and Fencing • Qualitative analysis of the 2012 Olympic Games to investigate the impact hosting the Games had on mass sport participation	• Officials reported an overall increase in membership rates for both sports (2007-2013)
Weimar et al. (2015) *Germany* **1**	• Panel data on male memberships in 12 Olympic sports in Germany (1970-2011) • Regression analysis to examine how sporting success, role models, and hosting major sport events affects membership numbers in German sport clubs	• Significant positive effect for hosting a major sport event in the year of the event • One-year lagged effect for role models, but only on junior memberships • Lagged effects for sporting success
Mutter & Pawlowski (2014a)	• Cross-sectional survey data (n=1,413) from 2012 of	• Past success of both female and male German national

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Germany **2**	German amateur football players • Regression analysis to investigate whether the success of professional athletes affects the frequency of football participation	football teams had increased the demand for amateur football only slightly • Present (hypothetical) success of the national teams considerably increases the frequency of football participation
Mutter & Pawlowski (2014b) *Germany* **2**	• Cross-sectional survey data (*n*=863) from 2012 of German amateur triathletes • Regression analysis to investigate if the individually perceived relevance of professional sport increases the frequency of amateur sport participation (hours per week)	• Amateurs who perceive professional sport as being very important participated in triathlon significantly more minutes per week
Mutter & Pawlowski (2014c) *Germany* **2**	• Cross-sectional survey data (*n*=488) from 2012 of German amateur tennis players • Regression analysis to investigate if the individual relevance of professional sport increases the frequency of tennis participation (hours per week)	• Individuals with higher relevance of professional tennis spend significantly more time playing tennis
Ramchandani et al. (2014) *England* **2**	• Cross-sectional survey data of ten sport events in England (*n*=7,458) from 2010-2013 • Regression analysis to identify factors that determine the extent to which spectators attending sport events feel inspired to increase sport participation	• Majority of respondents were inspired by the event • Strength of inspirational effect was significantly negatively related to age and positively related to living locally, British nationality, and exposure to information about sport opportunities • Team sport, non-age restricted and elite events were most effective
De Bosscher et al. (2013) *Flanders* **3**	• Membership numbers of 20 sports • Correlation analysis to examine the relationship between membership data and athletes' success in Flanders from 1992-2010	• Significant positive correlations were only found in four sports (i.e. athletics, gymnastics, judo and tennis) • No consistent relationship between membership levels and success of athletes in the respective sport
Ramchandani & Coleman	• Cross-sectional survey data (*n*=2,312) of spectators	• Two thirds of respondents reported that their event

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
(2012) *United Kingdom* **3**	from three major sport events in 2010 • Independent t-tests and analysis of variance to investigate whether attending one-off sport events inspire audiences to increase their participation in physical activities	experience had inspired them to increase their participation in physical activity • Inspirational effect was highest for 16- to34-year-olds • Information provided about opportunities to be physically active was effective
Hanstad & Skille (2010) *Norway* **3**	• Correlation and qualitative data analysis (documents, interviews) to examine the influence of elite sport on mass sport for Norwegian biathlon	• Positive correlation between Olympic/World Championship medals and number of active participants in biathlon
Feddersen et al. (2009) *Germany* **1**	• Secondary data about tennis membership numbers in Germany from 1974-2008 • Regression analysis to estimate the effect of sport heroes on the membership figures of the German Tennis Association	• A negative effect was observed during the periods of the ascendency of the German star players • Significant negative effect also evident since the declining success and retirement of the star players
North America		
Misener et al. (2015) *Canada* **4**	• Document analysis and 35 interviews to compare two medium-sized sport events for their influence on sport participation outcome (figure skating and athletics)	• Both events were sufficient to engender participation outcomes
Taks et al. (2014) *United States* **4**	• Document analysis and 21 interviews with members of the organisation committee to evaluate sport development outcomes of the 2005 Pan American Junior Athletics Championships in Canada	• Coaching clinic and new facilities were only intended tactics to trigger increases in sport participation • Demonstration effect only for those already involved in sport
Worldwide		
Ruseski & Maresova (2014) 34 *countries* **2**	• Individual cross-sectional data (n=49,730) from the ISSP 2007 survey combined with country-level data factors of n=34 countries • Regression analysis to estimate the effects of country	• Hosting a mega sport event was positively associated with physical activity • Success of the national team in the Athens Olympic Games was negatively related to physical activity

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	specific characteristics capturing economic freedom and national sport policy on physical activity	

2.2 Non-monetary output/outcomes of physical activity

2.2.1 Physical health

This section reviews studies examining the relationship between participation in physical activity and physical health outcomes, both from a general perspective as well as specific diseases. Tis topic has attracted by far the most attention in previous research. Table 8 summarises studies looking at the effect of physical activity on a variety of physical health parameters or on the health status as perceived by the individual. The vast majority of studies documented a positive effect of participation in physical activity on various health parameters and subjective health. Also, a negative effect was found for health care utilisation, i.e., physically active people (have to) utilise health care to a lesser extent. The likelihood of injuries can be reduced through specific prevention programmes.

When examining the effect of physical activity on physical health outcomes, panel data are needed that allow a distinction between causes and effects. This is critical because the opposite relationship has also been evident: healthier people are more likely to be physically active. The potential of reverse causality can (and should) be addressd by using panel data rather than cross-sectional data.

According to the WHO the most relevant health outcomes of physical activity are cancer, diabetes, cardiovascular diseases, and osteoporosis (Bull et al., 2004). For this reason, the effect of physical activity on the incidence of these four diseases is reported separately: Table 9 reports studies specifically looking at the effect of physical activity on cancer, Table 10 lists research analysing the effect on diabetes, Table 11 summarises studies examining the effect on cardiovascular diseases, and Table 12 reports research looking at the effect on osteoporosis. The empirical evidence across tables is relatively consistent: physical activity has a negative impact on the incidence of cancer, diabetes, cardiovascular diseases, and osteoporosis, meaning that physically active people are less likely to develop these diseases. Given the relatively high levels of evidence of these mainly medical studies, these findings can be trusted. For cancer, diabetes, and cardiovascular diseases, studies found that physical activity is not only effective in reducing the risk of developing the respective disease, but also in reducing mortality after diagnosis.

Notably, the effects of physical activity vary depending on the intensity and type of physical activity. Specifically, leisure-time physical activity was found to be more effective than occupational physical activity and higher-intensity activity was considered more effective than lower-intensity activity. The latter was investigated in detail for cancer and studies reported a negative dose-response relationship, i.e., the more intensive and the more frequent an individual's physical activity, the lower the risk of developing the disease and the mortality rate. Regarding osteoporosis, one focus of previous research was on the long-term effects of physical activity which could be confirmed for the various osteoporosis parameters, i.e., physical activity during childhood significantly reduces the incidence of osteoporosis in adulthood. Given the consistency of results in previous research and the relatively high levels of evidence of the empirical studies, the general findings should also be applicable to those UNESCO regions where no scientific evidence could be made available for this report.

Table 8: Overview of studies examining the relationship between physical activity and general physical health outcomes (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
No scientific evidence could be made available		
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Downward et al. (2015) *England* **1**	• Panel survey data (*n*=97) from the Taking Part Survey using monthly averages for the relevant variables from 2005-2013 • Regression analysis to examine the causal relationship between sports participation and subjective health accounting for the London 2012 Olympic Games	• Increases in the level of subjective health requires accelerating, but no effect from the 2012 Olympic Games was revealed • Reductions in the level of health were brought about by increases in sports participation
Ørntoft et al. (2016) *Denmark* **2**	• Pre- and post-intervention survey data of Danish school children aged 10-12 years from 2015 (intervention: *n*=402; control: *n*=144) • Analysis of variance to evaluate whether a modified FIFA 11 Health programme for non-communicable diseases including physical education classes had effects on body composition, blood pressure, and physical fitness	• During the 11-week study period, systolic and mean arterial blood pressure, BMI, and body fat percentage decreased more in the intervention group • Within group improvements were observed in the intervention group for 20m sprint and Yo-Yo intermittent recovery level 1 children's test • Balance and jump performance remained unchanged

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Sundstrup et al. (2016) *Denmark* **1**	• Pre- and post-intervention survey data of untrained old males with an average age of 68 years from 2012-2014 (football training: *n*=10; strength training: *n*=9; control group: *n*=8) • Regression analysis to determine the neuromuscular adaptions to long-term (one year) football and strength training	• Both exercises led to substantial gains in functional ability • Long-term strength training led to increased quadriceps and hamstring strength • Football training only enhanced hamstring strength
Bendiksen et al. (2014) *Denmark* **3**	• Pre- and post-intervention survey data of pupils aged 8-9 years (*n*=93) • Analysis of variance to examine the heart rate response to various types of physical education and the fitness effects of a short-term physical education programme	• Heart rate was significantly higher in ball games compared to circuit training, walking, and Nintendo Wii games • Short-term low-volume ball game physical education intervention improved physical fitness
Krustrup et al. (2014) *Denmark* **2**	• Pre- and post-intervention survey data including echocardiographic variables (intervention: *n*=46; control: *n*=51) • Analysis of variance to investigate the cardiac effects of a 10-week football training intervention	• Significant adaptions were found for left ventricular posterior wall diameter, interventricular septum thickness, global isovolumetric relaxation time, and ventricular systolic ejection fraction • No changes were found for resting heart rate and blood pressure
Schmidt et al. (2014) *Denmark* **2**	• Pre- and post-intervention survey data including cardiovascular function parameter (football training: *n*=9; strength training: *n*=9; control: *n*=8) • Analysis of variance and correlation analysis to examine the effects of one year of football or strength training on cardiovascular function	• Left ventricular internal diastolic diameter, end-diastolic volume, and BMI were higher after 12 months football training with no changes in the strength and control group • Maximum oxygen uptake was higher and resting heart rate was lower after football training compared to the strength and control group
Barene et al. (2013) *Norway*	• Pre- and post-intervention of hospital employees (football group: *n*=37; Zumba group: *n*=35; control:	• Football and Zumba training significantly improved VO_{2max} and significantly decreased total body fat mass

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	*n*=35) • Analysis of variance and correlation analysis to investigate the effect of football and Zumba training on fitness and health indicators	• Football training significantly decreased the body fat percentage and heart rate
Randers et al. (2012) *Denmark* **2**	• Pre- and post-intervention data of homeless men including intensity parameters (intervention: *n*=22; control: *n*=10) • Analysis of variance to examine the effect of 12 weeks of small-sided street soccer and fitness centre training on physical fitness and cardiovascular health profile	• After the intervention , the cycle test performance improved, while fat percentage and LDL cholesterol were lowered • Blood pressure was unaltered
Junge et al. (2010) *Switzerland* **3**	• Cross-sectional survey data (*n*=1,027) of coaches reporting injuries in their team • Descriptive analysis to evaluate the effectiveness of a countrywide campaign to reduce the incidence of football injuries among Swiss amateur players	• Teams performing the programme had an 11.5% lower incidence of match injuries and a 25.3% lower incidence of training injuries • In particular non-contacted injuries were prevented by the programme
Krustrup et al. (2010a) *Denmark* **2**	• Pre- and post-intervention data including blood and muscle analyses of middle-aged males (football training: *n*=14; running training: *n*=13; control: *n*=11) • Analysis of variance to examine muscle adaptions and performance effects over 12 weeks of recreational soccer training in comparison with continuous running	• Recreational soccer stimulated aerobic and anaerobic energy turnover and led to significant cardiovascular and muscular adaptions as well as performance enhancement
Krustrup et al. (2010b) *Denmark* ***2***	• Pre- and post-intervention survey data of untrained premenopausal women (football training: *n*=9; running training: *n*=10; control: *n*=9) • Analysis of variance to examine long-term (16 months) musculoskeletal and cardiac adaptions elicited by recreational football and running	• Significant improvements in muscle function, postural balance, and bone mineral density were only found for long-term recreation football, not for running training and the control group
Randers et al. (2010)	• Pre- and post-intervention data including measures of	• Fat mass, systolic blood pressure were significantly

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Denmark **2**	health parameters after 12 week and 64 weeks (intervention: *n*=10; control: *n*=7) • Analysis of variance to examine whether improvements in the performance and health profile of an intensive 12-week football intervention could be maintained with a reduced training frequency	lower and VO_{2max} was higher after 64 weeks with no difference to 12 weeks • Plantar jump force, 30-m sprint velocity, and muscle glycogen were significantly higher after after 64 weeks than after 12 and 0 weeks
Krustrup et al. (2009) *Denmark* **2**	• Pre- and post-intervention data of healthy, untrained Danish men aged 20-43 years (football training: *n*=13; running: *n*=12; control: *n*=11) • Analysis of variance to examine the effect of regular participation in recreational football (1h training two or three times a week for 12 weeks) on health profiles	• Football training led to an increase in lean body mass, lower extremity bone mass, and fat oxidation and a decrease in LDL-cholesterol compared to the running and control group
Lechner (2009) *Germany* **1**	• Panel survey data (*n*=4,365) from Germany based on the German Socio-Economic Panel study from 1984 to 2006 • Regression analysis to analyse the effects of individual leisure sports participation on long-term labour market variables, health, and subjective well-being	• Significant positive effects from sport participation on physical health (physical role, general health, and weight) • Results were robust and significant for women and men
Soligard et al. (2008) *Denmark* **2**	• Cross-sectional survey data including injury information of female football players aged 13-17 years (intervention: *n*=1,055; control: *n*=837) • Regression analysis to examine the effect of a comprehensive warm-up programme designed to reduce the risk of injuries in female youth football	• During one season, 121 players had injuries in the intervention group and 143 in the control group • Significant lower risk of injuries overall, overuse injuries, and severe injuries in the intervention group • No significant reduction in lower extremity injuries
North America		

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Silvers-Granelli et al. (2015) *United States* **1**	• Pre- and post-intervention survey data of male student athletes aged 18-25 years of 27 teams (intervention: *n*=675; control: *n*=850) • Regression analysis to examine the effect of the FIFA11+ injury prevention programme in men's collegiate Division 1 and Division 2 football (soccer)	• The programme significantly reduced injury rates among male collegiate soccer players by 46.1% • The decreased time loss to injury of 28.6% was not significant
Humphreys et al. (2014) *Canada* **2**	• Cross-sectional survey (*n*=132,221) data from the Canadian Community Health Survey (Cycle 3.1) 2005 • Regression analysis to investigate the relationship between participation in physical activity and health	• Participation in physical activity reduced the reported incidence of diabetes, high blood pressure, heart disease, asthma, and arthritis • Highest frequency (daily) had the smallest effect on reducing the probability of reporting chronic disease
Sari (2014) *Canada* **1**	• Survey panel data (*n*=7,945) from the National Population Health Survey in Canada from 1994-1998 • Regression analysis to examine the effects of sports and exercise on hospital stays for males and females	• Individuals with moderate to higher amount of physical activity stayed 36%-39% less than inactive individuals in hospitals • Effect is substantially larger for people with chronic disease and stroke
McLeod & Ruseski (2013) *Canada* **1**	• Panel survey data from the Canadian National Population Health Survey 1994-2009 (*n*=17,276) • Regression analysis to investigate the longitudinal relationship between participation in physical activity (frequency and intensity) and health outcomes (self-reported health, diabetes, high blood pressure, heart disease, arthritis, asthma, ulcers)	• Participation in physical activity had a modest negative effect on the incidence of high blood pressure, ulcers, arthritis, and heart disease • Participation in physical activity had a relatively large negative effect on the probability of being in fair or poor self-reported health.
Nelson et al. (2009) *United States* **4**	• Panel of experts including expertise in public health, behavioural science, epidemiology, exercise science, medicine, and gerontology • Panel was instructed to base its recommendation to the types and amount of physical activity needed to	• Increase of moderate intensity activity and giving less emphasis to attaining high intensity levels of activity is recommended • Muscle strengthening activity was preferable • Emphasis on individual- and community-level

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	improve and maintain health in older adults	approaches
Sari (2009) *Canada* **1**	• Panel survey data from the Canadian Community Health Survey in 2003 (*n*=84,332) • Regression analysis to estimate utilisation of healthcare services associated with inactivity and to estimate its impact on the Canadian healthcare system	• Hospital stays, physician, and nurse services significantly increased because of physical inactivity • Inactive person spent 38% days more in hospital than an active person, had 5.5% more family physician visits, 13% more specialist services, and 12% more nurse visits
Worldwide		
I-Min Lee et al. (2012) *Worldwide* **3**	• Aggregated survey data from the WHO in 2008 describing the physical inactivity rates in almost every country worldwide • Calculation of population attributable fractions and relative risks of physical inactivity to estimate how much disease could be averted if inactive people become active and to estimate gain in life expectancy	• Physical inactivity caused 6% of coronary heart disease, 7% of breast cancer, 10% colon cancer, and 9% of premature mortality • Elimination of physical inactivity would increase the life expectancy of the world's population by 0.68 years

Table 9: Overview of studies examining the relationship between physical activity and physical health outcomes, specifically cancer (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
Hou et al. (2014) *Nigeria, Cameroon, and Uganda* **1**	• Cross-sectional survey data of *n*=558 cancer patients and *n*=1,014 controls from 2011-2013 including information about physical activity (metabolic equivalent of task/day) • Regression analysis to investigate the link between physical activity and breast cancer risk among indigenous African individuals	• Physical activity reduced breast cancer risk significantly, with a positive dose-response relationship • Negative relationship held for all intensity-levels and domains of physical activity
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Gunnell et al. (2014) *Australia* **1**	• Panel survey data (*n*=2,320) combined with hospital and mortality registry data to identify future cancer events up to 15 years follow up from 1995 • Regression analysis to investigate whether leisure-time physical activity (at least 150 min per week) was associated with reduced incident of fatal cancer	• Leisure-time physical activity reduces the risk of overall-mortality by 22% • No significant relationship between leisure-time physical activity and cancer-specific survival
Chen et al. (2011) *China* **2**	• Panel survey data (*n*=4,826) from 2002-2006 with an average follow-up of 4.3 years of women with stage 1 to 3 breast cancer • Independent t-tests to evaluate differences between exercisers and non-exercisers after breast cancer diagnosis in total mortality	• Exercise during the first 36 months negatively influenced total mortality and disease-specific mortality • Significant negative dose-response relationships between total and disease-specific mortality and exercise duration
Gao et al. (2009)	• Cross-sectional survey case-control data (breast cancer	• Women who work physically had a significantly lower

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
China **1**	cases: *n*=669; control: *n*=682) from 2004-2007 • Regression analysis to evaluate the relationship between body size, physical activity, and risk of breast cancer	risk of breast cancer • Women who participated in recreational physical activity had a significantly lower risk of becoming breast cancer with a negative relationship between exercise time per week and risk of breast cancer
Inoue et al. (2008) *Japan* **2**	• Cross-sectional survey data (*n*=79,771) from 1995-1999 were followed for total cancer incidence (*n*=4,334) through 2004 • Regression analysis to examine the effect of daily total physical activity on subsequent cancer risk	• Increased daily physical activity significantly decreased the risk of cancer in both sexes • Decreased risks were observed for cancers of the colon, liver, pancreas, and stomach
Haydon et al. (2006) *Australia* **1**	• Panel survey data (*n*=41,528) of the Melbourne Collaborative Cohort Study from 1990-1994 of individuals diagnosed with colorectal cancer with follow-up through 2002 • Regression analysis to examine the effect of physical activity and body size on survival after diagnosis with colorectal cancer	• After adjusting for age, sex, and tumour stage, exercisers had a significant improved disease-specific survival • Benefits of exercise were largely confined to stage 2-3 tumours
Lacey Jr. et al. (2001) *China* **1**	• Cross-sectional survey data (cancer cases: *n*=444; controls: *n*=471) from 1993-1995 including information about time spent per week in different physical activities • Regression analysis to investigate the effect of physical activity on the incidence of prostate cancer	• Time energy spent on physical activities were not consistently related to prostate cancer • Relationship did not vary according to age or stage of prostate cancer
Latin America and the Caribbean		
Pena et al. (2013) *Brazil* **1**	• Cross-sectional case control survey data (cancer cases: *n*=106; control: *n*=181) of low-income Brazilian women from 2006 • Regression analysis to examine the relationship	• Sedentary women had higher odds of developing breast cancer

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	between physical activity and the risk of breast cancer	
Europe		
Uth et al. (2016a) *Denmark* **2**	• Pre- and post-intervention data of men with prostate cancer and undergoing androgen deprivation therapy (intervention: *n*=29; control: *n*=28) • Independent t-test and correlation analysis to investigate the short-term effects of football training on bone mass, bone turn-over markers, and postural balance	• After 12 weeks significantly higher total body bone mineral content, leg bone mineral content, and markers of bone formation could be observed in the intervention group • Number of decelerations correlated significantly with the increase in leg bone mineral content
Uth et al. (2016b) *Denmark* ***2***	• Pre- and post-intervention data of men with prostate cancer and undergoing androgen deprivation therapy (intervention: *n*=19; control: *n*=20) • Independent t-test to evaluate the effect of 32 weeks of football training on bone mineral density, bone turnover markers, body composition, and physical functioning	• 32 weeks follow-up measures show significant improvements in hip and femoral shaft bone mineral density, jump height, and stair climbing speed in the intervention group
Uth et al. (2014) *Denmark* **2**	• Pre- and post-intervention data of men with prostate cancer and undergoing androgen deprivation therapy aged 67 years (intervention: *n*=26; control: *n*=23) • Independent t-test to examine the effects of football training with standard care on body composition and functional parameters	• Lean body mass and muscle strength were significantly higher in the intervention group than in the control group
Friedenreich et al. (2006) *Denmark, France, Germany, Greece, Italy, Norway, Spain, Sweden, the Netherlands, United Kingdom*	• Panel survey data (*n*=413,044) of individuals aged 35-70 years from 1992-1998 with an average follow-up of 6.4 years • Regression analysis to investigate the relationship between physical activity (frequency and duration) and the risk of colon and rectal cancer	• Physical activity had a significant negative influence on the risk of colon cancer with a significant negative dose-response relationship • No significant effect for rectal cancer

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
1		
Wannamethee et al. (2001) *United Kingdom* **2**	• Cross-sectional survey data (*n*=7,735) from the British Regional Heart Study (1978-1980) of men aged 40-59 years • Regression analysis to examine the relationship between physical activity and incidence of cancer	• Risk of total cancer was significantly reduced only for men reporting moderately-vigorous or vigorous activity • A significant dose-response reduction in risk of prostate, upper digestive, and stomach cancer for sport activity was observed
Thune et al. (1997) *Norway* **1**	• Panel survey data (*n*=25,624) of women aged 20-54 years from 1974-1983 with follow up through 1994 • Regression analysis to investigate whether everyday exercise is related to the risk of breast cancer	• Higher leisure-time physical activity and physical activity at work reduced the risk of breast cancer significantly
Thune & Lund (1997) *Norway* **1**	• Panel survey data (*n*=81,516) from 1972-1978 with follow-up until 1991 • Regression analysis to determine the influence of physical activity on lung-cancer risk	• Leisure-time physical activity influenced the risk of lung cancer negatively (men exercising at least 4 hours/week had a significant lower risk compared to inactive men) • No consistent relationship was found for women or physical activity at work
North America		
Bradshaw et al. (2014) *United States* **1**	• Panel survey data (*n*=1,423) of women diagnosed with breast cancer from 1996-1997 with follow up data through 2009 • Regression analysis to determine the relationship between physical activity (hours/week) and survival after breast cancer	• Survival was significantly improved among women who were highly active after diagnosis for general and breast cancer-specific mortality • Relationship between physical activity and overall mortality appeared stronger in the first 2 years after diagnosis
Lee et al. (2014) *United States* **1**	• Panel survey data (*n*=1,021) of men diagnosed with cancer from 1988 followed up through 2008 • Regression analysis to determine the relationship between physical activity (kj/week) and cancer survival	• Relative risk of general mortality decreased with increasing physical activity (kj/week) • Higher levels of physical activity were associated with lower rates of deaths from cancer

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Kenfield et al. (2011) *United States* **1**	• Panel survey data (*n*=2,705) from the Health Professional Follow-Up Study including men diagnosed with prostate cancer from 1990 to 2008 • Regression analysis to determine whether higher physical activity after prostate cancer diagnosis decreases risk of overall and prostate cancer-specific death	• Men who were physically active had significantly lower risk of general mortality and prostate cancer-specific mortality • Modest amount of vigorous physical activity (e.g. biking, tennis, jogging, or swimming) of > 3 hours a week significantly improved prostate cancer-specific survival
West-Wright et al. (2009) *United States* **1**	• Panel survey data (*n*=3,539) from the California Teachers Study (1995-1996) of women diagnosed with breast cancer with follow-up through 2006 • Regression analysis to investigate the relationship between long-term physical activity and breast cancer survival	• Women with high or intermediate levels of long-term physical activity had significantly lower risk of breast cancer death • Results were consistent across estrogen receptor status and disease state, but confined for overweight women
Holmes et al. (2005) *United States* **1**	• Panel survey data (*n*=2,987) of female registered nurses diagnosed with breast cancer from 1984-1998 with follow-up through 2002 • Regression analysis to determine whether physical activity (hours/week) among women with breast cancer decreases their risk of death from breast cancer	• Significant risk reduction for physically active women • Benefits of physical activity were particularly apparent among women with hormone-responsive tumors • Greatest benefit occurred for women who performed the equivalent of 3-5 hours per week at an average pace
Adams-Campbell et al. (2001) *United States* **2**	• Cross-sectional survey data (*n*=64,524) from 1995 of black American women aged 21-69 years • Regression analysis to assess the relationship between strenuous physical activity and prevalent breast cancer	• Risk of breast cancer was significantly reduced for physical activity >7h a week • No evidence of a reduction associated with regular exercise in high school
Lee et al. (1999) *United States* **1**	• Panel survey data (*n*=13,906) of Harvard University alumni from 1977 with follow-up through 1993 • Regression analysis to examine the effect of physical activity on the risk of lung cancer by considering specific kinds and intensities of activities	• Walking, climbing stairs, and participating in activities of at least moderate intensity had a significant negative influence on lung cancer risk • Light intensity activities did not predict lung cancer risk

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Giovannucci et al. (1998) *United States* **1**	• Panel survey data (*n*=47,542) of men aged 40-75 years from 1986 with follow-up through 1994 • Regression analysis to examine the relationship between leisure-time physical activity and risk of prostate cancer	• No significant relationship between leisure-time physical activity and total or advanced prostate cancer emerged

Table 10: Overview of studies examining the relationship between physical activity and physical health outcomes, specifically diabetes (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Honda et al. (2015) *Japan* **1**	• Panel survey data (*n*=26,628) of workers aged 30-64 years without diabetes from 2006-2013 • Regression analysis to determine the risk of Type 2 diabetes associated with exercise intensity during leisure, occupational, and commuting physical activity	• Vigorous-intensity exercise significantly reduces the risk of Type 2 diabetes • Occupational physical activity and walking to and from work were not significantly associated with diabetes
Fan et al. (2014) *China* **1**	• Panel survey data (*n*=6,348) from 1998-2008 • Regression analysis to examine the effect of physical activity (hours/day of different intensity on the incident of Type 2 diabetes among middle-aged and older Chinese	• Significant negative relationship between increasing levels of physical activity (metabolic equivalent/task) and risk of diabetes
Xu et al. (2014) *China* **1**	• Panel survey data (*n*=4,550) from 2004-2010 including information about sufficient or insufficient physical activity • Regression analysis to examine the joint effect of physical activity and hypertension on the development of Type 2 diabetes	• Insufficient physical activity was a significant predictor with and without hypertension of Type 2 diabetes
Okada et al. (2000) *Japan*	• Panel survey data (*n*=6,013) of Japanese men aged 35-63 years from 1981-1990 • Analysis of variance to investigate the influence of	• Men who engaged in regular physical activity at least once a week were significantly less likely to develop Type 2 diabetes compared to inactive men

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	leisure-time physical activity at weekends on the risk of developing Type 2 diabetes	• Men who participated in vigorous physical activity once a week at weekends had a lower risk of Type 2 diabetes compared to inactive men
Latin America and the Caribbean		
de Sousa et al. (2014) *Brazil* **2**	• Pre-and post-intervention data of Brazilian Typ 2 diabetes patients aged 48-68 years (football training and diet: *n*=22; diet group: *n*=22) • Independent t-test to evaluate the effect of recreational football training for 12 weeks combined with calorie-restricted diet on aerobic fitness, lipid profile, and insulin resistance indicators	• After 12 weeks VO_{2max} was significantly higher and total cholesterol as well as low-density lipoprotein were significantly lower in the football training group • Fat mass decreased significantly in both groups
Europe		
Schmidt et al. (2013) *Denmark* **2**	• Pre- and post-intervention data of middle-aged men with Type 2 diabetes (intervention: *n*=12; soccer: *n*=9) • Analysis of variance to evaluate the effects of football training on cardiac function, exercise capacity, and blood pressure	• After 24 weeks of football training significant increases in cardiac functions, exercises capacities, and lower blood pressure were observed in the intervention group
Valerio et al. (2007) *Italy* **2**	• Cross-sectional case control survey data (diabetes cases: *n*=138; control: *n*=269) of children from 2002-2003 • Analysis of variance to examine the effect of moderate/vigorous physical activity on the management of Type 1 diabetes	• Children with diabetes spent significantly less time in physical activity compared to the healthy controls • Regular physical activity had a positive effect on metabolic control and lipid profile
Hu et al. (2003) *Finland* **1**	• Panel survey data (*n*=14,290) of individuals aged 35-64 years from 1982-1992 with follow-up through 1998 • Regression analysis to examine the effect of occupational, commuting, and leisure-time physical	• Moderate and high intensity occupational, commuting or leisure-time physical activity significantly reduced the risk of Type 2 diabetes

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	activity on the incidence of Type 2 diabetes	
Defay et al. (2001) France **2**	• Cross-sectional survey data (*n*=2,522) of individuals aged 60 years or more from 1995-1997 • Regression analysis to determine the relationship between BMI, waist circumference, waist-to-hip ratio, physical activity (hours/week), and the risk of Type 2 diabetes	• Physical activity was negatively related to the risk of Type 2 diabetes
Lynch et al. (1996) *Finland* **1**	• Panel survey data (*n*=897) of Finnish men from 1984-1989 with a 4-year follow-up • Regression analysis to examine the association between self-reported levels of the intensity and duration of physical activity and cardiorespiratory fitness and the incidents of diabetes	• Moderately intense physical activities that were undertaken for at least a 40-minute duration per week significantly reduced the risk of diabetes • Less intensive activities were not protective regardless of their duration
North America		
Krishnan et al. (2008) *United States* **1**	• Panel survey data (*n*=45,668) of black women aged 21-69 years followed from 1995 to 2005 • Regression analysis to examine the relationship between physical activity and the risk of Type 2 diabetes	• Vigorous physical activity had a significant negative effect on the risk of Type 2 diabetes
Hsia et al. (2005) *United States* **1**	• Panel survey data (*n*=93,676) of postmenopausal women from 1994-1998 with follow-up through 2002 • Regression analysis to evaluate if physical activity independently predicts Type 2 diabetes risk	• African-American women in higher physical activity categories were significantly less likely to develop diabetes than women in the lowest physical activity category • After adjustment for age and multiple risk factors no significant effect could be observed
Weinstein et al. (2004) *United States*	• Panel survey data (*n*=37,878) of women with an average follow-up of 6.9 years • Regression analysis to examine the relative	• BMI and physical activity were both significant independent predictors of diabetes • Effect of BMI was greater than the effect of physical

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
1	contribution and the joint effect of physical activity and BMI on diabetes	activity in combined analyses
James et al. (1998) *United States* **2**	• Cross-sectional survey data (*n*=916) from the Pitt County Study in North Carolina • Regression analysis to quantify the effect of physical activity on diabetes risk in this population	• Moderate physical activity was strongly and significantly related to reduced risk of diabetes • Diabetes risk was one third for moderately active individuals compared to inactive individuals
Helmrich et al. (1991) *United States* **1**	• Panel survey data (*n*=5,990) of male alumni of the University of Pennsylvania from 1962-1976 • Regression analysis to test whether physical activity (kcal/week) is effective in preventing diabetes	• Leisure-time physical activity was significantly negatively related to the development of diabetes • Each additional 500kcal increment in energy expenditure per week reduced the risk of diabetes by 6%

Table 11: Overview of studies examining the relationship between physical activity and physical health outcomes, specifically cardiovascular diseases (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
Dickie et al. (2014) *South Africa* **3**	• Cross-sectional data (*n*=231) of South African women from 2005 • Analysis of variance to examine differences of body composition and cardio-metabolic risk factors between active and inactive groups	• Active women had significantly lower body weight, measures of insulin resistance, and high-density lipoprotein cholesterol
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Rasiah et al. (2015) *Malaysia* **2**	• Cross-sectional survey data (*n*=7,276) of individuals aged >35 years from 2007-2010 • Regression analysis to investigate the effect of physical exercise on cumulative cardiovascular disease risk factors among three different age groups	• Respondents in the age groups 35-49 and >65 showed a significant negative relationship between physical activity and cumulative cardiovascular disease risk factors • Relationship was not significant in the 50-65 age group
Hu et al. (2014) *Taiwan* **1**	• Panel survey data (*n*=1,706) from the Chin-Shan Community Cardiovascular Cohort Study from 1990 • Regression analysis to investigate the effect of occupational and leisure-time physical activity on the risk of cardiovascular diseases and mortality	• Leisure-time physical activity significantly decreased and occupational physical activity increased the risk of cardiovascular disease • Effect occupational physical activity was only significant for men
Dhaliwal et al. (2013) *Australia* **1**	• Panel survey data (*n*=8,662) from 1989-2004 • Regression analysis to identify whether physical activity showed cardiovascular benefits independent of common risk factors and central obesity	• Recreational physical activity independently predicted reduced cardiovascular mortality over fifteen years • High recreational physical activity group had a 35% lower risk of cardiovascular disease mortality than the low physical activity group

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Boss et al. (2015) *The Netherlands* **1**	• Panel survey data (*n*=10,128) of patients with various manifestations of vascular diseases or risk factors from 1996-2013 • Regression analysis to examine the effect of physical activity on the risk of future vascular events and all-cause mortality	• Higher intensity levels of physical activity significantly reduced the risks of vascular events and all-cause mortality • Reduced risk was observed both in patients with vascular disease and in patients with risk factors
Mohr et al. (2014) *Denmark* **2**	• Pre -and post-intervention data of premenopausal women aged 35-50 years (intervention: *n*=21; control: *n*=20) • Analysis of variance to examine the effects of short-term recreational football training on blood pressure, fat mass, and fitness	• After 15 weeks, systolic and diastolic blood pressure, total body fat mass, total cholesterol, and triglyceride were significantly lower in the intervention group
Randers et al. (2014) *Denmark* **2**	• Cross-sectional survey data of men aged 65-86 years who had been physically active two to three times per week during the last 40-50 years (football: *n*=11; endurance: *n*=8; strength: *n*=7; control: *n*=7) • Analysis of variance to investigate differences in performance variables and indicators of cardiovascular variables between elderly football players and endurance and strength training	• For football players time to exhaustion was longer than in the control and strength training group • Fat percentage was significantly lower for football players than in the control group, but higher than in the strength and endurance training group • Heart rate reserve was significantly higher for football players than for the control and strength training group • VO_{2max} was significantly lower for football players than for the endurance training group
Krustrup et al. (2013) *Denmark* **2**	• Pre- and post-intervention survey data of untrained hypertensive men aged 31-51 years (intervention: *n*=22; control: *n*=11)	• Significant increases occurred in the intervention group for VO_{2max}, relative VO_{2max}, and heart rate • The augmentation index was significantly lower in the

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	• Analysis of variance to investigate the effects of medium-term football training on cardiovascular risk factors	intervention group
Hamer et al. (2012) *England* **2**	• Cross-sectional data (*n*=443) from 2010 combined with information from accelerometers • Regression analysis to determine the relationship between objectively measured physical activity and coronary artery calcium	• No effect of moderate-vigorous physical activity on the presence of coronary artery calcium
Jimènez-Pavón et al. (2013) *Italy, Estonia, Cyprus, Belgium, Sweden, Germany, Hungary, and Spain* **1**	• Panel survey data (*n*=3,120) of children aged 2 to 9 years from 2007-2008 • Regression analysis to evaluate the effect of objectively-measured physical activity on cardiovascular disease risk factors	• For boys <6 years the risks for cardiovascular disease increased in the least active quintile compared to the most active quintile
Hu et al. (2005) *Finland* **1**	• Panel survey data (*n*=47,721) of Finnish individuals aged 25-64 years • Regression analysis and independent t-test to examine the effect of different intensity types of physical activity on total and type-specific stroke risk	• Higher intensity level of leisure time physical activity significantly reduced the risk of all subtypes of stroke • Daily active commuting and occupational physical activity significantly reduced the risk of an ischemic stroke
Pols et al. (1997*)* *The Netherlands* **2**	• Cross-sectional survey data (*n*=4,576) of Dutch women aged 49-70 years from 1993-1996 • Regression analysis to assess the effect of physical activity on the presence of cardiovascular disease risk indicators	• Leisure-time physical activity was negatively related to cardiovascular disease risk indicators • Occupational physical activity and housework had no significant effect on cardiovascular disease risk indicators
North America		
Teramoto et al. (2015) *United States*	• Cross-sectional survey data (*n*=3,913) from 2010 • Regression analysis to examine how leisure-time	• People with cardiovascular disease were twice more likely not to engage in leisure-time physical activity independent of smoking status

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	physical activity affects the prevalence of cardiovascular diseases in relation to smoking	
Berry et al. (2011) *United States* **1**	• Panel survey data (*n*=11,049) from 1990-2006 of men aged 40-69 years who had performed a treadmill test in 1990 • Regression analysis to determine the effect of fitness on lifetime risk of cardiovascular disease	• Low fitness levels had a significant negative effect on higher lifetime risk of cardiovascular disease for each age • Associations were strongest among persons with cardiovascular disease risk factor
Chomistek et al. (2013) *United States* **1**	• Panel survey data (*n*=71,018) of women aged 50-79 years from 1993-2010 • Regression analysis to examine the independent and joint effect of sitting time and physical activity on the risk incident cardiovascular diseases	• Sitting >10 hours/day significantly increased cardiovascular disease risk • Low physical activity was significantly associated with higher cardiovascular disease risk
Williams (2013) *United States* **1**	• Panel survey data (*n*=42,022) from the National Walkers' Health Study (1998-2008) • Regression analysis to assess the dose-response relationship between exercise energy expenditure and cause-specific mortality	• Walking significantly reduced the risk for all cardiovascular diseases
Williams (2009) *United States* **1**	• Panel survey data (*n*=52,058) • Regression analysis to assess the dose-response relationship between vigorous physical activity and the participant-reported physician-diagnosed stroke	• Each km/day decreased the stroke risk by 12% for men and by 11% for women • Men and women who ran >8km/day had a 60% lower risk than those who ran <2km/day
Weinstein et al. (2008) *United States* **1**	• Panel survey data (*n*=38,987) of women without cardiovascular diseases • Regression analysis to determine the combined effect of physical activity and BMI on cardiovascular diseases	• Higher BMI and physical inactivity were each significant individual predictors of cardiovascular disease • Increasing the frequency of walking resulted in significant reductions in cardiovascular disease risk for overweight and obese individuals
Mora et al. (2007) *United States*	• Panel survey data (*n*=27,055) of healthy female healthcare professionals aged >45 years from 1992-	• Risk of cardiovascular disease decreased linearly with higher levels of physical activity (metabolic

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
1	1995 • Regression analysis to determine the mediating effect of cardiovascular risk factors on the relationship between physical activity and cardiovascular disease events	equivalents/task) • Inflammatory factors and blood pressure were significant mediators of the negative relationship between physical activity and risk of cardiovascular disease
Conroy et al. (2005) *United States* **1**	• Panel survey data (*n*=39,875) of women >45 years from 1992-1997 • Regression to analysis examine the relationship between physical activity and coronary heart disease occurring in middle age or older	• The most active women had a 39% lower risk of coronary heart disease compared to the least active women • Physical activity during young adulthood was not significantly associated with risk of coronary heart disease occurring during middle age and older
Braith et al. (1994) *United States* **2**	• Panel survey data (*n*=44) of individuals aged 60-ä70 years who were observed for six months of walking exercise (training at 70% of heart rate maximum: *n*=19; 85% training: *n*=14; control: *n*=11) • Analysis of variance to investigate the effect of exercise intensity on resting blood pressure	• Systolic and diastolic blood pressure decreased significantly after 6 months in both training groups • Resting heart rate decreased significantly to the same magnitude in both training groups after 6 months
Donahue et al. (1988) *United States* **1**	• Panel survey data (*n*=7,644) of men aged 45-69 years from 1965-1968 with follow up after 12 years • Regression analysis to examine the relationship between physical activity (hours/day) and coronary heart diseases for different age groups	• Increased levels of physical activity (hours/day) were negatively related to the risk of coronary heart disease for middle-aged (45-64 years) and elderly men (65-69 years) • For the middle-aged active group the rate of coronary heart disease was 30% lower

Table 12: Overview of studies examining the relationship between physical activity and physical health outcomes, specifically osteoporosis (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Ghobadi & Hoseini (2014) *Iran* **3**	• Cross-sectional survey data (*n*=280) of female university students aged 18-24 years • Correlation analysis to examine the relationship between physical activity levels and risk factors of osteoporosis	• Higher levels of physical activity were negatively correlated with risk factors of osteoporosis
Latin America and the Caribbean		
Daly & Bass (2006) *Australia* **2**	• Cross-sectional survey data (*n*=422) of men aged 50-87 years combined with information about bone material and structure • Regression analysis to examine the relationship between lifetime sport and leisure activity participation on bone material and structural properties	• Long-term regular participation in sport was an important determinant of bone size, quality, and strength, but not of bone material density • Continued participation in weight-bearing exercise in early to mid-adulthood significantly reduced the risk of low bone strength in old age
Europe		
Mohr et al. (2015) *Faroe Islands* **2**	• Pre- and post-intervention data of premenopausal, mildly hypertensive women (football: *n*=21; high-intensity swimming: *n*=21; moderate intensity swimming: *n*=21 control: *n*=20) • Analysis of variance to examine the effects of 15	• 15 weeks of soccer training caused increases in bone turnover markers and leg bone mass • No changes were found for high-intensity or moderate swimming training

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	weeks of football training and of two different swimming protocols on bone turnover	
Helge et al. (2014a) *Denmark* **2**	• Pre-and post-intervention data of elderly man aged 68 years on average with measurement points after 4 and 12 months (football training: *n*=9; resistance training: *n*=9; control: *n*=8) • Analysis of variance to examine the effect of recreational football and resistance training on bone mineral density and bone turnover markers	• Football training led to significant increases in bone mineral density of the proximal femur after 4 and 12 months • Whole body bone mineral density remained unchanged • Resistance training had no effect on bone mineral density
Helge et al. (2014b) *Denmark* **2**	• Pre- and post-intervention data of homeless men (intervention: *n*=22; control: *n*=10) • Independent t-test to investigate the feasibility of street football as a health-enhancing activity for 12 weeks of training	• Significant increases in osteocalcin, postural balance in the right and left leg, and trunk bone mineral density in the intervention group
Nilsson et al. (2012) *Sweden* **1**	• Panel survey data (*n*=1,068) of men with an average age of 24 years • Regression analysis and analysis of variance to determine if an increased amount of physical activity over a 5-year period was associated with increased bone mineral content, areal, and density	• Increased physical activity was a significant predictor of development of areal bone mineral density, volumetric bone mineral density, and cortical bone size among young men
Meyer et al. (2011) *Switzerland* **1**	• Pre- and post-intervention survey data from 28 1st and 5th grade classes (intervention: *n*=297; control: *n*=205) • Regression analysis to determine whether a school-based physical activity programme during one school year including daily physical education and work-outs influences bone mineral content and density	• Children in the intervention group showed significantly increases in bone mineral content of total body, femoral neck, lumbar spine, and in bone mineral density of total body and lumbar spine
Helge et al. (2010)	• Pre- and post-intervention data of untrained Danish	• Total bone mineral density increased significantly in left

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Denmark **2**	premenopausal women (football training: *n*=25; running training: *n*=25; control: *n*=15) • Analysis of variance to investigate whether a 14-week period of regular recreational football or endurance running has an effect on the risk of falls and bone fractures due to gains in muscle function and bone mineral density	and right tibia in the football training and running training, but not in the control group • Peak jump power, hamstring strength increased significantly in the football training, but not in the running training and control group
Tervo et al. (2010) *Sweden* **2**	• Panel survey data of *n*=19 badminton players, *n*=48 ice hockey players, and *n*=25 controls; all 17 years old • Analysis of covariance to investigate the influence of different types of weight bearing physical activity on bone mineral density	• During the active career, badminton players gained significantly more bone mineral density compared to ice hockey players and the control group • After 12 years the positive effects for badminton players sustained
Nilsson et al. (2009) *Sweden* **2**	• Cross-sectional survey data (*n*=1,068) of men including information about bone geometry of tibia and radius • Regression analysis and analysis of variance to investigate if physical activity during growth is associated with cortical bone geometry in currently inactive young men	• Subjects who continued to be active and who had been previously active in sports had wider cortical bone size • Previous sport activity had a significant positive effect on cortical bone size of the tibia
Nilsson et al. (2008) *Sweden* **2**	• Cross-sectional survey data (*n*=498) of 75-year-old men • Regression analysis to determine if physical activity (competitive sports and recreational sports) early in life was associated with bone mineral density in elderly men	• Frequency of competitive sports in the early period (10-35 years) had a significant positive bone mineral density positively • No significant effect for recreational sports
Valdimarsson et al. (2005) *Sweden* **2**	• Panel survey data of *n*=66 Swedish soccer women (control: *n*=39) including follow-up after 8 years • Independent t-tests to evaluate the effect of training	• Players still active at follow-up had significantly a higher bone mineral density • Players retired during the follow-up lost bone mineral

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	and reduced training on bone mineral density	density
Kannus et al. (1995) *Finland* **2**	• Cross-sectional survey data of *n*=105 female Finnish national-level tennis and squash players (control: *n*=50) • Analysis of covariance to determine the effect of biological age at which tennis or squash playing was started on the difference in bone mineral content between the playing and non-playing arm	• Compared with controls, the tennis and squash players had a significantly larger side-to-side differences • Difference in bone mineral content significantly decreases with increasing starting age • Difference was two to four times greater in the players who had started their playing careers before or at menarche
North America		
Duckham et al. (2014) *Canada* **2**	• Panel survey data (*n*=122) from 1991-2011 combined with information about different bone parameters • Analysis of variance to investigate whether physically active adolescents had greater bone size, density, content, and estimated bone strength	• Significant positive effects on tibia bone size, content, and strength for adult males and females who were physically active
Muir et al. (2013) *Canada* **2**	• Cross-sectional survey data (*n*=1,169) of women aged >75 years • Regression analysis to determine the effect of increasing amount of regular physical activity on bone mineral density	• Increase in the amount of physical activity performed each day resulted in a positive effect on bone mineral density at the hip, Ward's triangle, trochanter, and femoral neck
Janz et al. (2010) *United States* **1**	• Panel survey data (*n*=333) of children at ages 5, 8, and 11 years combined with bone parameter information • Regression analysis to examine the effect of early childhood moderate to vigorous physical activity on later bone health	• Higher moderate-vigorous physical activity resulted in significantly greater bone mineral content for all age groups • Consistently higher effect for boys compared to girls
Falk et al. (2010) *Canada* **2**	• Cross-sectional survey data (soccer players: *n*=56; hockey players: *n*=61; control: *n*=65) combined with information of different bone parameter • Analysis of variance to examine differences in bone	• Soccer players had significant more bone strength compared to hockey players and the controls • No significant difference between hockey players and the controls

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	strength between male soccer and hockey players and aged-matched controls	
Fuchs & Snow (2002) *United States* **2**	• Pre- and post-intervention data (intervention: *n*=37; control: *n*=37) of children • Analysis of variance to evaluate the bone response to 7 months of detraining (removing of loading stimulus) after 7 months of high-impact training	• Gains in bone mineral content and bone at the femoral neck were retained after the detraining period

2.2.2 Subjective well-being and mental health

Participation in physical activity does not only affect physical health (i.e., the incidence of various diseases), but also subjective well-being and mental health. Following the WHO (2005), mental health is an integral part of an individual's overall health. Mental health problems typically include depressions and anxiety disorders which can be assessed with clinical measures and questionnaires (Fergusson et al., 2015; Koivumaa-Honkanen et al., 2004). Subjective well-being is defined as "a person's cognitive and affective evaluations of his or her life" (Diener et al., 2002, p. 63). It is thus more of a self-reported measure, i.e., individuals make assessments about their level of life satisfaction and happiness, respectively (Downward & Rasciute, 2011; Huang & Humphreys, 2012; Wicker & Frick, 2015). Previous research has shown that subjective well-being and mental health are positively related (Fergusson et al., 2015; Koivumaa-Honkanen et al., 2004) and that assessing subjective well-being can assist in screening for the development potential of mental health problems (Koivumaa-Honkanen et al., 2001). Thus, subjective well-being can be considered a precondition of mental health.

Table 13 provides an overview of studies analysing the effect of participation in physical activity on subjective well-being and mental health, respectively. The results across studies and countries are conclusive: Participation in physical activity has a significant positive effect on subjective well-being and mental health. This means that physically active people report higher levels of life satisfaction and happiness, and are less likely to develop mental health problems such as depression or anxiety disorders. The beneficial effect of physical activity was also confirmed for both genders and for individuals of all age groups. Given the relatively high levels of evidence of the studies involved, it can be expected that these findings could also be applied to those UNESCO regions where no scientific evidence could be made.

When examining the effect of physical activity on subjective well-being, it must be considered that physical activity and subjective well-being are both correlated with other factors such as individual health status (i.e., physical health parameters). This means that individual health status has a positive effect on both an individual's physical activity level as well as on subjective well-being. This potential endogeneity issue should be and has been addressed by most studies in this review by using instrumental variables, i.e., variables that are correlated with physical activity, but uncorrelated with subjective well-being.

While the relationship between physical activity in general (i.e., whether people are physically active or not) and mental health and subjective well-being has been examined extensively in previous studies, more research is needed regarding the dose-response relationship, i.e., how mental health and subjective well-being varies depending on the frequency, duration, and intensity of participation. Initial results indicate that increased frequency of participation adds to subjective well-being, while vigorous-intensity activity reduces it.

Table 13: Overview of studies examining subjective well-being and mental health outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
Asare & Danquah (2015) *Ghana* **2**	• Cross-sectional survey data of students from junior high schools in Ghana (*n*=296) • Regression analysis to examine the relationship between sedentary behaviour and mental health among African young people	• Physical activity was significantly associated with positive mental health; specifically physical activity led to lower depression and higher self esteem
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Lee & Park (2010) *South Korea* **2**	• Cross-sectional survey data of disabled individuals (*n*=600) • Regression analysis to examine the effects of physical activity or sport participation on happiness of disabled people	• One-level increase in physical activity in the six level score provided the same improvement in life satisfaction as one-quarter of the effect of the employment status change from unemployed to employed
Latin America and the Caribbean		
Pucci et al. (2012) *Brazil* **2**	• Cross-sectional survey data from Curitiba in 2008 (*n*=1,461) • Regression analysis to examine the relationship between leisure-time physical activity (walking, moderate, vigorous, and transport) and psychological quality of life domains	• Consistent association between physical activity levels and the psychological domain was observed for walking and moderate physical activity of women
Europe		
Brunes et al. (2015)	• Panel survey data of students between 12 and 17 years from Trondelag (1995-2001; *n*=1,417)	• Conducting less than 1 day per week physical activity was significantly associated with having lower levels of

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Norway **1**	• Regression analysis to study the effect of physical activity on mental health according to self-reported vision categories among adolescents	well-being • Mental health benefits of conducting weekly physical activity were observed only among those who were more emotionally unstable or introvert at baseline
Brown et al. (2015) *England* **2**	• Cross-sectional survey data from 2010-2012 (*n*=32,707) including participation rates of 39 sport activities • Regression analysis to test whether people participating in cultural leisure activities have higher life satisfaction	• Positive association between participation in moderate and lower intensity sport and life satisfaction • Participation in moderate intensity sport was not associated with the highest level of life satisfaction
Marlier et al. (2015) *Belgium* **2**	• Cross-sectional survey data from people living in disadvantaged communities in Antwerp (*n*=414) from 2013 • Structure equation modelling to uncover how sport participation, physical activity, social capital, and mental health are interrelated	• Sport participation and not total physical activity was associated with better mental health
Staal & Jespersen (2015) *Denmark* **4**	• Semi-structured interviews from 2013 to evaluate a development project in Denmark devoted to enhance the level and quality of exercise and sport activity among young people with mental health problems (*n*=11)	• Physical activity was experienced as a way to discover action opportunities and being good to oneself
Tallner et al. (2015) *Germany* **3**	• Cross-sectional survey data (*n*=265) • Analysis of variance to analyse the relationship between levels of physical activity and health-related quality of life scores among multiple sclerosis patients	• Mental health scores were higher for active patients (e.g. significant differences were found for vitality, general health perception, and social functioning)
Wicker et al. (2015a) *Germany*	• Pre- and post-intervention data (*n*=10,481) across 316 German fitness centres from 2013 including a time-efficient fitness programme	• Total time spent significantly increases satisfaction with health and fitness • Time spent on approach and parking reduces satisfaction

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	• Regression analysis to examine the role of time in explaining the effect of physical activity on satisfaction with health, leisure time, fitness, body and look by considering the composite structure of time needed for participation	with leisure time, time spent on wellness and showering increases it • Time spent on the actual fitness training has no significant effect on any of the satisfaction measures
Wicker et al. (2015b) *Germany* **2**	• Pre- and post-intervention data (n=10,386) across 316 German fitness centres from 2013 • Regression analysis to examine the effect of a 4-week fitness programme on the participants' satisfaction with life and health	• Reported level of satisfaction with life and health were significantly higher after participation in the 4-week fitness program
Wicker & Frick (2015) *28 European Countries* **2**	• Cross-sectional survey data (n=22,971) from 2013 (Eurobarometer 80.2) • Regression analysis to examine the effect of physical activity on subjective well-being by focusing on intensity and duration	• Number of days and the minutes people practised at moderate intensity per week have a significant and positive effect on subjective well-being • Number of days and the minutes people practised with vigorous-intensity activity has a significant and negative impact
Dolan et al. (2014) *25 European Countries* **2**	• Cross-sectional survey data (n=22,971) from 2004 (Eurobarometer 62.0) • Regression analysis to test for causality from regular exercise and physical activity to life satisfaction	• Results indicate that being active increases life satisfaction for both genders, though more for men than women
Ruseski et al. (2014) *Germany* **2**	• Cross-sectional survey data from Rheinberg in 2009 (n=1,238) • Regression analysis to examine the causal relationship between sport participation and self-reported happiness	• Results of the instrumental variable estimation suggest that individuals who practice sport report higher levels of happiness
Scheewe et al. (2013) *The Netherlands*	• Pre- and post-intervention data of schizophrenia patients assigned to either exercise (n=31) or occupational (n=32) therapy from 2007-2010	• Exercise therapy reduced symptoms of schizophrenia, depression, need of care, and increased cardiovascular fitness compared with occupational therapy

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	• Analysis of variance to examine the effect of exercise versus occupational therapy on mental health	
Van Berkel et al. (2013) *The Netherlands* **2**	• Cross-sectional survey data (*n*=257) plus objectively measured physical activity of a subgroup (*n*=100) • Regression analysis to examine the associations between moderate-vigorous physical activity and mental health and work-related well-being	• No significant effect of self-reported and objectively assessed physical activity on mental health and work-related well-being
Yazicioglu et al. (2012) *Turkey* **3**	• Cross-sectional survey data of patients with physical disabilities from 2010-11 (*n*=60) • Independent t-test to compare quality of life scores and life satisfaction between people with physical disabilities who participated in sports and those who did not participate	• Quality of life scores of physical, psychological, and social domain were significantly higher in the physically engaged group • Life satisfaction scores were higher in the physically engaged group
Pawlowski et al. (2011) *19 European countries* **2**	• Cross-sectional survey data obtained in 2007 from the International Social Survey Programme (*n*=19,036) • Regression analysis to explore the age-specific effects of sport participation on subjective well-being	• Sport participation generally contributes to subjective well-being on a European level • Being physically active contributes the more to subjective well-being, the older the individuals are
Rasciute & Downward (2010) *England* **2**	• Cross-sectional survey data from 2005 (*n*=16,627) including participation data of 67 sports activities • Regression analysis to examine the impact of sports participation upon the subjective well-being of individuals	• Cycling for health and recreation and for utilitarian purposes such as travel to work have a negative effect on well-being • Participation in any other type of sport but cycling as well as walking has a significant positive effect on happiness
Lechner (2009) *Germany* **1**	• Survey data from the German Socio-Economic Panel from 1984 to 2006 (*n*=4,365) • Regression analysis to analyse the effects of individual leisure sports participation on long-term labour market variables, health and subjective well-being	• For men their general satisfaction in life is significantly increased in the long run • For women the effect is similar is not significant

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Lampinen et al. (2008) *Finland* **1**	• Panel survey data of adults aged 65+ including measurements in 1988 and 1996 (*n*=663) • Regression analysis to examine the predictive value of physical exercise in relation to depressive symptoms	• Decrease of intensity of physical activity led to more depressive symptoms • Baseline physical activity predicts depressive symptoms after 8 years
Chatzisarantis & Hagger (2007) *England* **3**	• Survey data from students (*n*=118) at two points in time (after two weeks) • Path analysis to test the hypothesis that importance ratings of life aspirations would mediate the effects of participation in sport on psychological well-being	• Mediating effect for the association between sport participation and well-being was found for importance ratings of life aspirations but not for attainment ratings of life aspirations
Stubbe et al. (2007) *The Netherlands* **2**	• Cross-sectional survey data from 2002 (*n*=8,306) • Co-twin control method to investigate the associations between leisure time exercise participation and well-being	• Exercisers were more satisfied with their life and happier than non-exercisers at all ages
De Moor et al. (2006) *The Netherlands* **1**	• Panel survey data (*n*=19,28) of adult twins and their families from the Netherlands Twin Registry (1991-2002) • Multilevel modelling to examine whether regular exercise is associated with anxiety, depression, and personality	• Exercisers were on average significant less anxious, depressed, and neurotic
North America		
Sari & Lechner (2015) *Canada* **1**	• Panel survey data (*n*=2,830) of inactive adults aged 20 to 45 from the National Population Health Survey from 1994-2008 • Regression analysis to examine the long-run health effects of participation in sports and exercise	• Participation in sports and exercise generally improves physical health only for men • Positive health effects are only achieved with a level of physical activity above the current guidelines of international health organisations

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Jewett et al. (2014) *Canada* **1**	• Panel survey data of adolescents reporting participation in school sport in each grade throughout 5 years of secondary school (*n*=853) from 1999-2012 • Regression analysis to examine the association between participation in school sport and mental health in young adulthood	• Involvement in school sport had a significant positive influence on depressive symptoms, lower perceived stress, and higher self-rated mental health in young adulthood
Brunet et al. (2013) *Canada* **1**	• Panel survey data of adolescents aged 12-13 years at baseline (*n*=1,293) from 1999-2009 • Multilevel modelling to assess the longitudinal and cross-sectional associations of past moderate-to-vigorous physical activity and involvement in team sports with depressive symptoms	• Current physical activity, but not past physical activity was significantly related to depressive symptoms during young adulthood • Current and past involvement in team sports were significantly negatively related to depressive symptoms
Huang & Humphreys (2012) *United States* **2**	• Pooled survey data from the years 2005-2009 (*n*=1,589,266) • Regression analysis to investigate the relationship between participation in leisure-time physical activity and self-reported happiness	• Both men and women gain happiness from participation, and men appear to benefit more from participation than women
Wang et al. (2012) *Canada* **1**	• Panel survey data from 1994-2009 (*n*=7,745) • Regression analysis to determine long-term associations between physical activity and happiness	• Physical activity was significantly associated with self-reported happiness in the baseline year • After 2 and 4 year inactive respondents were at greater risk of being unhappy compared to those who were active
Trivedi et al. (2011) *United States* **2**	• Pre- and post-intervention survey data of patients with major depressive disorders including exercise programmes of 12 weeks with different doses (*n*=126) from 2003-2007 • Regression analysis to test the efficacy of aerobic exercise on depression symptoms	• Trend of higher remission rates of depressive disorders in the higher-dose exercise group • Dose (energy expenditure) was positively related to the size of remission rates

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Harris et al. (2006) *United States* **1**	• Panel survey data of depressed adults including measurement points after 1, 4, and 10 years (*n*=424) • Multilevel modelling to examine associations between physical activity, exercise coping, and depression	• More physical activity was associated with significant less concurrent depression • Physical activity counteracted the effects of medical conditions and negative life events on depression
Galper et al. (2006) *United States* **3**	• Cross-sectional survey data (*n*=6,728) including data about relative cardiorespiratory fitness • Analysis of variance to evaluate associations between measures of physical activity and mental health	• For both men and women there was a significant positive relationship between level of fitness and mental health • Significant positive relationship for fitness and general emotional well being
Valois et al. (2004) *United States* **2**	• Cross-sectional survey data from public high schools in South Carolina (*n*=4,758) • Regression analysis of the relationship between perceived life satisfaction and physical activity (i.e., different types of exercise)	• Not exercising for 20 minutes, not performing stretching exercises, not exercising to strengthen tone muscle, spending < 20 minutes actually exercising in physical education class, and not playing on sport teams was associated with reduced life satisfaction
Worldwide		
Pawlowski et al. (2014) *33 countries* **2**	• Cross-sectional survey data obtained in 2007 from the International Social Survey Programme (*n*=34,681) • Regression analysis to investigate the impact of national pride from international sporting success on well-being including participation in physical activity as a control variable	• Participation in physical activity had a significant positive effect on well-being

2.2.3 Combating trauma and disaster

While the previous chapter 2.2.2 looked at mental health and subjective well-being in general, this chapter is specifically dedicated to post-traumatic stress disorders. For example, individuals can be traumatised from military services, natural disasters, and severe diseases. Having said this, post-traumatic stress disorders and its consequences such as depression, anxiety, and suicide risk belong to mental health, but are reported in a separate chapter for the purpose of this report.

Several studies have examined how participation in physical activity can mitigate the adverse effects of trauma and disaster and these are summarised in Table 14. The results are relatively consistent across studies: physical activity has a positive effect on the prevention and reduction of post-traumatic stress disorders and, thus, also reduces the likelihood of developing depression and anxieties as well as the suicide risk. Since many studies used a qualitative research design (e.g., interviews, focus groups), the level of evidence is relatively medium or low in these cases. Yet, studies with higher levels of evidence provided similar findings which should, therefore, also be applicable to those UNESCO regions where no scientific evidence could be made available.

Table 14: Overview of studies examining the role of physical activity in combating trauma and disasters (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
Richards et al. (2014) *Uganda* **2**	• Pre- and post-intervention data of children (11-14 years) participating in a 11-week voluntary competitive sport-for-development football league (*n*=1,462) in Gulu from 2010 • Analysis of variance to examine the effects of the programme on adolescent physical fitness in a post-conflict, low-income setting	• Significant negative effect of participation in the programme on the incidence of depression-like and anxiety-like symptoms for boys • No significant effects for any outcome for girls
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Rosenbaum et al. (2015) *Australia* **1**	• Pre- and post-intervention data (intervention: *n*=39; control: *n*=42) from 2010-2012 • Regression analysis to investigate the impact of a 12-week exercise programme in addition to usual care for post-traumatic stress disorder	• Post-traumatic stress disorder symptoms significantly reduced compared with the usual care group • Significant positive effects in the intervention group for depressive symptoms, waist circumferences, sleep quality, and sedentary time at follow up
Kunz (2009) *Iran* **4**	• Structured interviews from 2005 with coaches and parents to evaluate the project "Sport and play for traumatised children and youth" focussing on the psychological rehabilitation process in post-disaster and post-conflict situations after the earthquake in Bam, Iran	• All parents, coaches observed positive changes in the children's behaviour (e.g. aggression, participation) and group dynamics as a result of participation in the project • Integration effects for children who had problems of interacting with other children
Mahmoudi-Gharaei (2009) *Iran*	• Pre- and post-intervention survey data randomised in four groups (*n*=161)	• No statistically significant reduction in total post-traumatic stress symptoms as a results of sport supportive

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	• Analysis of variance to evaluate the effect of psychological therapies and art/sport supportive intervention for children with post-traumatic stress symptoms after an earthquake in Bam, Iran	therapy • In the control group the post-traumatic stress symptoms increased significantly compared to the sport supportive therapy group
Otter & Currie (2004) *Australia* **4**	• Focus group method including interviews after 10, 25 and 40 weeks (*n*=14) with Vietnam veterans participating in a supervised aerobic exercise class programme	• Lifestyle and psychological changes could be observed (e.g. decreased anger levels, increased mental awareness, energy levels, and daily resilience) as a result of participating in the programme
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Day & Wadey (2016) *England* **4**	• Case study including interviews with seven athletes who acquired disabilities to explore how participation in sport assist an individual in working through experiences in physical trauma	• Sport did provide mastery experiences, enhanced relationships, corporeal understanding and enhanced life philosophies
Carless et al. (2013) *England* **4**	• Narrative life story interviews from 2011 to explore the psychological outcomes of an inclusive adapted sport and adventurous training course for military personnel who have sustained physical and/or psychological disability (*n*=11)	• "Bringing me back to myself" was achieved through returning to activity, rediscovering a sense of purpose and reconnecting to others • "New rooms to explore" was realised through experiencing new activities, being cared for, and being inspired by other people
Liedl et al. (2010) *Germany & Switzerland* **2**	• Pre- and post-intervention data of three groups (*n*=10 in each group) from 2007-2009 • Analysis of variance to examine effects of physical activity within a therapy for traumatised war refugees	• Highest effect of improvement for coping strategies, pain and mental health status and physiological reactivity were reached for the intervention including physical activity
Hefferon et al. (2008) *Scotland*	• Interviews with female breast cancer survivors (*n*=10) to document the experience of post-traumatic growth	• Patients attributed much of their process and outcomes to the experience of participating in a physical activity

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
4	and the role of a group based physical activity intervention	intervention • Intervention turned out to represent a safe environment, positive support system, opportunity to transfer new skills, and heightened health awareness
North America		
D'Andrea et al. (2013) *United States* **2**	• Pre- and post-intervention data of adolescent girls aged 12 to 21 (intervention: *n*=62; control: *n*=26) • Analysis of variance to test the effect of a sport-based intervention "Do the Good" for traumatised adolescents in residential treatment settings	• Positive behaviours (e.g. helping peers, perseverance) were observed as a result of the "Do the Good" intervention • Girls in the intervention group exhibited reductions in restraints and time-outs as well as internalising and externalising symptoms
Davidson et al. (2013) *United States* **3**	• Cross-sectional survey data of military veterans (*n*=346) participating in a 90-day residential rehabilitation programme including physical exercises • Principle component analysis to examine the association between exercise and suicide risk	• Exercise was directly and indirectly negatively associated with suicide risk • Exercise was associated with fewer depressive symptoms and better sleep patterns which were both related to lower suicide risk
Burke & Utley (2012) *United States* **4**	• Interviews and detailed observations from 2011 of physically injured combat veterans' psychosocial response to scaling Mt. Kilimanjaro (*n*=4)	• Themes that were drawn out of the data that were related to the experience of climbing on the mountain and the meanings they attributed to the climb were: Self-determination – striving for mastery , active coping – taking responsibility, social support – working together
Hawkins et al. (2011) *United States* **4**	• Interviews with injured military veterans who have participated in sport activities during and after the U.S. Paralympic Military Sport Camp (*n*=10)	• Prevalent outcomes resulting from the participating in sport activities included positive change in perception of their disability, increased motivation to participate in physical activity, increased social support, increased skills and knowledge related to physical activity, improved health and well-being, increased competence, and improved autonomy

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
LeardMann et al. (2011) *United States* **1**	• Panel data using a baseline and follow-up survey of U.S. military service members (*n*=38,883) from 2001-2010 • Regression analysis to examine the relationship between post-traumatic stress disorder and light/moderate and vigorous physical activity	• Those who reported proportionately less physical activity were more likely to have post-traumatic stress disorder • Vigorous physical activity had the most consistent negative relationship with the incidence post-traumatic stress disorders
Love & Sabiston (2011) *Canada* **2**	• Cross-sectional survey data of cancer survivors (*n*=64) • Regression analysis to investigate social support and enduring distress and the moderating role of physical activity on psychological growth	• For active individuals social support was less important for psychological growth compared to the growth of inactive individuals
Lundberg et al. (2011) *United States* **2**	• Pre- and post-intervention survey data of veterans (*n*=18) from 2008-2009 • Multiple paired t-tests to examine changes in quality of life, mood states, sports related competence after participating in three-week long therapeutic sports programme	• Significant better perception of health, overall quality of life, mood states, and sports related competence after the intervention

2.2.4 Integration and social capital

Table 15 displays studies examining the effect of participation in physical activity on the integration and social inclusion of different types of minority groups, while Table 16 summarises studies looking at various social aspects that can be grouped under the term social capital. According to Putnam (1993, p. 167) social capital "refers to features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions." Following Lin (2001, p. 24), many researchers "share the understanding that social capital consists of resources embedded in social relations and social structure". However, there is no consensus in the literature on the definition of social capital. Orlowski and Wicker (2015) provide a synthesis of previous research and conclude that social capital has two dimensions which contain several facets: the first dimension is connectedness which encompasses formal (e.g., membership in a community sport club, holding a formal voluntary position) and informal participation in civil society (e.g., contacts among people, friends, social network) and the second dimension is trust which includes interpersonal trust (i.e., how people trust other people), institutional trust (i.e., how people trust institutions such as the government, banks, the polics etc.), and trustworthiness (of the individual him-/herself).

The research focus was on the integration and social inclusion of ethnic minorities and immigrants. The majority of studies reported a positive association between participation in joint physical activity programmes and the integration and social inclusion of ethnic minorities and immigrants as well as the development of social capital. Specifically, physical activity was found to be related to different elements of social capital (e.g., trust, political commitment). Yet, the results can vary depending on socio-demographic characteristics such as gender and age. The qualitative research design which was selected by the majority of studies is accompanied by relatively low levels of evidence. Nevertheless, given the consistency in findings and the fact that studies with higher levels of evidence provided similar results, it can be expected that the general tendencies of the findings are also applicable to those UNESCO regions where no scientific evidence could be made available. However, social inclusion and the development of social capital is a local phenomenon and will always depend on the composition of society in the region under investigation.

Table 15: Overview of studies examining integration outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Nathan et al. (2013) *Australia* **3**	• Cross-sectional survey data (*n*=142) from four Australian schools combined with qualitative data from interviews (*n*=79) • Analysis of variance and content analysis to evaluate the impact of a sport-for-development programme "Football United"	• Participants of "Football United" showed significantly higher levels of other-group orientation than the control group • Boys participating in the programme had significantly lower scores on the peer problem scale and significantly higher scores on the prosocial scale than boys from the control group
Spaaij (2012) *Australia* **4**	• Data of a three-year ethnographic study (2008-2010) of Somali people with refugee backgrounds participating in soccer including in-depth interviews (*n*=39) to explore the role of recreational sport for social integration	• Social bonds and bridges developed in the sports context assist in the building of community networks • Negative social encounters resulting from sport participation such as discrimination and aggression can highlight and reinforce group boundaries
Ito et al. (2011) *Japan* **3**	• Cross-sectional survey data (*n*=43) of 25 Brazilian and 18 Japanese children participating in Judo schools plus formal and informal interviews (2007-2008) • Descriptive analysis to examine how judo affected the assimilation of Brazilian immigrants in Japan	• Positive effects for language acquisition and moral education as a result of participating in Judo schools • No changes related to religion
Latin America and the Caribbean		
No scientific evidence could be made available		

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Europe		
Makarova & Herzog (2014 *Switzerland* **2**	• Cross-sectional survey data of first-generation immigrant youths (*n*=454) • Regression analysis to examine the role of sport in immigrant youths integration into a host society	• Sport participation leads to significant more personal contact with Swiss peers during the sporting activities as well as in free time and a higher number of Swiss close friends • Sport participation increases the feeling of being integrated in Switzerland
Walseth (2008) *Norway* **4**	• Interviews with second-generation female immigrants aged between 16 and 25 to determine whether participation in sports leads to the accumulation of social capital for young women with an immigrant background (*n*=15)	• Women bridge and bond social capital within sports clubs • Sports clubs foster the bridging of social capital among immigrants from various ethnic minority backgrounds
Rosenberg et al. (2003) *Israel* **3**	• Cross-sectional survey data of former Soviet Union and Ethiopian immigrant students from 1998-99 (*n*=24) plus focus group interviews (*n*=13) • Descriptive analysis of the survey data and content analysis of the interviews	• Immigrant students indicated that their study of physical education and sport contributed positively to their absorption experiences
Vilhjalmsson & Thorlindsson (1992) *Iceland* **2**	• Cross-sectional survey data from 1989 (*n*=1,131) • Regression analysis to investigate the integrative and physiological effects of sport participation on mental health	• Integrative effect of club sport emerges for life satisfaction and pertains only to positive aspects of well-being and not to negative aspects (e.g. smoking, alcohol)
North America		
Lee et al. (2005) *United States* **4**	• Interviews with Korean American women to examine the cultural meanings of participation in sport (*n*=6)	• Sporting experiences involve a complicated process of identity construction • Sport becomes a focal point of negotiations and compromise with regard to gender relations in terms of traditional Korean values and beliefs

Table 16: Overview of studies examining social capital outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Hoye et al. (2015) *Australia* **2**	• Cross-sectional survey data (*n*=1,833) of adults from Victoria • Regression analysis to explore the relationship between involvement in sports and non-sport community organisations and social connectedness	• Higher involvement in sport organisations increases the level of social connectedness • Tenure and intensity of involvement were no significant predictors of social connectedness scores
Okayasu et al. (2010) *Japan* **3**	• Cross-sectional survey data (*n*=260) of sport practitioners from 2007 • Independent t-test and analysis of variance to investigate the relationship between the location of sport clubs and social capital	• Social capital in comprehensive community sport clubs was higher than in traditional community sport clubs • No conclusive findings regarding location of sport clubs and social capital
Atherley (2006) Australia **4**	• Case study of 25 sporting clubs from Brookton and Pingerelly including questionnaires (*n*=169) and interviews (*n*=20) with sport representatives	• Bonding social capital, including elements of trust and cooperation, were evident at a community social scale • Elements of bridging social capital was found in the amalgamation of football clubs
Tonts (2005) *Australia* **4**	• Case study of the Northern Wheatbelt of Western Australia to examine the link between sport and social capital in a rural region	• Sport is identified as an important arena for the creation and maintenance of social capital • Social capital generated by sport is often fragile, and can lead to social exclusion and marginality for some residents
Latin America and the Caribbean		

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
No scientific evidence could be made available		
Europe		
Ottesen et al. (2010) *Denmark* **4**	• Cross-sectional survey data and information from interviews of inactive women aged 19-47 years (football training: *n*=25; running training: *n*=25) • Descriptive and content analysis to investigate the social adaption effects of a 16-week programme of either recreational football or continuous running training	• I-stories showed themselves to be central to bonding within the two groups and bridging outside the groups • We- and they-stories pointed out the importance of the activity itself for internal bonding • Data indicate that team sports may have an advantage over individual sports in the development of social capital
Numerato (2008) *Czech Republic* **4**	• Multi-sited ethnographic study of three sport governing bodies (handball, football, and sailing) including observations, interviews and document analysis	• Sport governing bodies have been understood as an arena of encounters of various forms of social capital (social capital connected to national associations and social capital based on the strategies of individual actors)
Seippel (2006) *Norway* **2**	• Cross-sectional survey data (*n*=1,695) from the Norwegian part of the Johns Hopkins Comparative Nonprofit Sector Project • Regression analysis to study how voluntary sport organisations operate and what social and political effects they might have through the concept of social capital	• Being a member of a voluntary sport organisation involves social capital which is conducive to generalise trust and political commitment • Effect is smaller for sport organisations than for voluntary organisations
Jarvie (2003) *Scotland* **4**	• Three case studies to examine the relationship between social capital and sports in Scotland	• Unrealistic to expect sport to be totally responsible for sustaining a sense of community or citizenship or even reinforce notions of social capital
North America		
Clopton (2012) *United States*	• Cross-sectional survey data (*n*=570) of student athletes • Analysis of variance to explore the role of gender in	• Female student athletes in team sports reported higher social capital than those in individual sports • Male student athletes reported higher social capital in

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3	social capital outcomes of sport participation	individual-sport settings than in team sports
Perks (2007) *Canada* **3**	• Cross-sectional survey data (*n*=13,000) from the National Survey of Giving, Volunteering and Participating (2000) • Multiple classification analysis to test whether participation in organised youth sport positively predicts the involvement in particular community activities as an adult	• Youth sport participation was positively related to adult involvement in community activities • Positive effects lasted through the lifecycle
Worldwide		
Wang et al. (2012) *Korea, the Netherlands, and United States* **5**	• Cross-sectional data of online focus groups (Netherlands: *n*=30; USA: *n*=19; Korea: *n*=14) • Content analysis to evaluate to what extent people perceive their sport participation structure to provide them with a sense of community	• Sport participation is more conducive to bonding rather than to bridging • Respondent in the Netherlands and Korea noted that the bonding process was accompanied by dependency and emotional support; respondents in the USA emphasised instrumental support

2.2.5 Education

Table 17 gives an overview of studies analysing the relationship between participation in physical activity and educational outomes such as school grades and academic achievements. The empirical evidence is relatively consistent: participation in physical activity is positively associated with educational outcomes. Given the relatively high levels of evidence and the consistency in findings, these general tendencies should also be applicable to those UNESCO regions where no scientific evidence could be made available. The magnitude of the effect varies depending on the socio-demographic characteristics of the individuals and the intensity of the activity with higher-intensity activities being associated with better educational outcomes. For participation frequency, an inverse u-shaped effect was found, i.e., educational benefits are only obtained until a certain frequency level and decrease from that point on (because both physical activity and educational achievements require time). However, more research is needed examining the specific role of participation frequency and type of activity in achieving educational outcomes.

The investigation of educational outcomes of physical activity is accompanied by at least two methodological challenges. The first challenge is the isolation of the physical activity effect because educational outcomes do not only depend on the physical activity level, but also on various other factors on the individual (e.g., motivation, age, gender) and household level (family situation, income, parents' educational background). These factors should (at least partially) be controlled for in the empirical analysis and, in fact, a set of control variables has been used in most previous studies. Second, there is the possibility that pupils and students who are generally more organised and motivated are more likely to participate in physical activity *and* to achieve better grades. Thus, there are individual traits which could explain both educational outcomes and physical activity levels. This potential endogeneity issue should be addressed by using instrumental variables, i.e., variables that are correlated with physical activity, but are uncorrelated with educational outcomes. Yet, the majority of studies have not addressed endogeneity.

Table 17: Overview of studies examining education outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Zhang et al. (2015) *China* **2**	• Cross-sectional survey data from Shanghai in 2009 (*n*=1,470) • Regression analysis to explore whether the association between physical activity and teacher-reported academic performance scores differs by distribution of academic performance scores	• Minimal-intensity physical activity was positively associated with academic performance scores • Magnitude of the association tends to be larger at the lower end of the academic performance distribution
Yu et al. (2006) *Hong Kong* **2**	• Cross-sectional survey data of students between 8 and 12 years (*n*=333) from Hong Kong • Regression analysis to investigate relations among academic achievement, self-esteem, school conduct and physical activity level	• Physical activity was related to neither academic achievement nor school conduct • Physically active boys had significant higher self-esteem
Dwyer et al. (2001) *Australia* **3**	• Cross-sectional survey data of schoolchildren aged between 7 and 15 years from 1985 (*n*=7,961) • Correlation analysis to examine the association between scholastic performance and physical activity of children	• Rating of performance were significantly correlated with physical activity assessed by a questionnaire and by performance tests of endurance and strength
Latin America and the Caribbean		
Rombaldi et al. (2012) *Brazil*	• Birth cohort data from 1993-2008 in Pelotas (*n*=4,452) • Descriptive analysis to evaluate the prospective	• Adolescents in the top quartile of leisure-time physical activity had a higher likelihood of school failure

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3	association between leisure time physical activity practice and incidence of school failure	
Europe		
Cabane et al. (2015) *Germany* **1**	• Survey data from the German Socio-Economic Panel from 2001 to 2012 (*n*=3,835) of 17-year-old children • Regression analysis to examine the effects of spending part of adolescents' leisure time on playing music, doing sports, or both on educational outcomes	• Playing music appears to foster academic performance more likely than doing sports • Doing both activities appeared to be most successful for educational outcomes compared to participating in just one activity
Kantomaa et al. (2015) *Finland* **1**	• Panel survey data from the Northern Finland Birth Cohort from 1986-2002 (*n*=8,061) • Regression analysis to investigate the associations between physical activity and sedentary behaviour with academic achievement	• Physically active and generally active adolescents were about twice as likely to have a high grade point average compared with sedentary people
Booth et al. (2014) *England* **1**	• Panel survey data of children (*n*=4,755) from 1991-1992 • Regression analysis to test the effect of objectively measured physical activity and academic attainment	• Total volume of physical activity had a significant negative influence on academic attainment • Percentage of time spent on moderate-vigorous physical activity increased performance in English assessments • After 5 years a significant positive effect of moderate-vigorous physical activity on mathematic scores occurred
Kantomaa et al. (2013) *Finland* **1**	• Panel survey data from the Northern Finland Birth Cohort from 1986-2002 (*n*=8,061) • Structural equation modelling to test to what extent physical activity, cardiorespiratory fitness, and obesity mediate the association between childhood motor function and adolescents' academic achievement	• Physical activity was associated with a higher grade-point average • Physical activity mediates the negative relationship between compromised motor function in childhood and adolescents' academic achievement •
Kwak et al. (2012) *Sweden*	• Cross-sectional survey data of 9th grade students (*n*=232) • Regression analysis to examine associations between	• Vigorous physical activity of girls was positively associated with academic achievement • Cardiovascular fitness influenced positively the academic

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
2	objectively assessed intensity levels of physical activity and academic achievement	achievement of boys
Pfeifer & Cornelißen (2010) *Germany* **1**	• Panel survey data from the German Socio-Economic Panel from 2000 to 2005 (*n*=6,050) • Regression analysis to examine the impact of practising sports during childhood and adolescence on educational attainment	• Participation in sport activities has a significant positive effect on educational attainment • Probability of attaining the lowest school degree is reduced by 6.6 percentage points for men and 11 percentage points for women if they engage in sport activities
North America		
Lambourne et al. (2013) *United States* **3**	• Cross-sectional survey data including aerobic fitness and daily physical activity assessed through accelerometry (*n*=687) • Structural equation modelling to test the mediating effect of physical activity on academic achievement	• Indirect effect of physical activity via fitness level on math achievement • Neither physical activity nor fitness level were correlated with reading or spelling scores
Van Dusen et al. (2011) *United States* **2**	• Cross-sectional survey data of children from 99 Texas school districts from the 2007-2008 school year (*n*=254,743) • Regression analysis to evaluate the connection between fitness and academic performance	• All fitness variables (e.g. curl-ups, push-ups, cardiovascular fitness) showed significant, positive associations with academic performance
Eide & Ronan (2010) *United States* **1**	• Panel survey data from 1980-1992 (*n*=3,608) • Regression analysis to estimate if sport participation of high school student impacts future earnings and educational attainment	• Positive effect of sport participation on educational attainment and earnings of black male students • No effect for Hispanic males and black or Hispanic females
Rees & Sabia (2010) *United States* **1**	• Panel survey data from the National Longitudinal Study of Adolescent Health of the Carolina population (*n*=11,261) • Regression analysis to examine the effect of sports participation on several measures of academic	• Results indicate that sport participation leads to higher grades and that this benefit is positively related to frequency of participation • Regression results differ depending on estimation method (e.g. fixed effects, instrumental variables) indicating that

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	performance	previous reports of substantial positive academic spillovers associated with sports participation are overstated
Podulka Coe et al. (2006) *United States* **3**	• Panel survey data of 6th grade students from a high school in Michigan (*n*=214) who participated in physical education classes (2002-2003) • Independent t-test to determine the effect of class enrolment and physical activity on academic achievement	• Grades were similar regardless of whether students were enrolled in physical education classes • Students who performed vigorous activity had significantly higher grades
Barron et al. (2000) *United States* **1**	• Panel survey data from two databases of men participating in high school athletics (*n*=1,047; *n*=3,014) • Regression analysis to determine the effect of high school athletic performance on future wages and educational attainment	• Participation in athletics had a significant positive effect on educational attainment • The effect was larger the more intensive the involvement in athletic participation was

2.2.6 Labour market

Table 18 summarises studies analysing the relationship between participation in physical activity and labour market outcomes such as absenteeism from work, exit of unemployment, health care utilisation at work etc. While (higher) income is also a labour market outcome, the respective studies are reported in chapter 2.1.3 under individual *monetary* returns.

The empirical evidence is relatively consistent: participation in physical activity is positively associated with various labour market outcomes. For example, physcially active people showed reduced levels of work absenteeism, (had to) utilise health care services at work to a lesser extent, and were more likely to exit unemployment. Given the relatively high levels of evidence and the consistency in findings, these general tendencies should also be applicable to those UNESCO regions where no scientific evidence could be made available.

Regarding the type of activity, initial results indicate that team sports contribute more to employability than individual sports, but more research is needed in this context. Similarly, further studies are required to examine the role of participation frequency, intensity, and also type of activity in achieving labour market outcomes.

Similar to analysing educational outcomes, the investigation of labour market outcomes of physical activity is accompanied by at least two methodological challenges. The first challenge is the isolation of the physical activity effect because labour market outcomes do not only depend on physical activity, but also on various other individual factors (e.g., qualifications, motivation, age, gender). These factors should (at least partially) be controlled for in the empirical analysis and, in fact, a set of control variables has been used in most previous studies. Second, there is the possibility that individuals who are generally more organised and motivated as well as better educated are more likely to participate in physical activity *and* to achieve better labour market outcomes. Thus, there are individual traits which could explain both labour market outcomes and physical activity levels. This potential endogeneity issue should be addressed by using instrumental variables, i.e., variables that are correlated with physical activity, but are uncorrelated with labour market outcomes. Several studies have addressed this endogeneity issue by using instrumental variables.

Table 18: Overview of studies examining labour market outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
No scientific evidence could be made available		
Latin America and the Caribbean		
Fonseca et al. (2010) *Brazil* **2**	• Cross-sectional survey data (*n*=620) from 2006 • Regression analysis to examine the relationship between physical activity and absenteeism, health care utilisation, and morbidity among Brazilian automotive workers	• Work absenteeism was positively associated with physical activity at work and negative with leisure physical activity excluding sport • Work health care utilisation was negatively associated with physical activity at work and leisure physical activity excluding sports
Europe		
Cabane (2014) *Germany* **1**	• Panel survey data from the German Socio-Economic Panel from 1984 to 2009 (*n*=1,805) • Regression analysis to evaluate the impact of leisure sport participation on unemployment duration	• Weekly sport participation is related to a faster exit from unemployment to employment for women • No effect for men
Lechner & Downward (2013) *England* **1**	• Combination of three surveys leads to panel data from 2004-08 (*n*=79,561) • Regression analysis to examine the association between different types of sport participation on employment and earnings	• Significant positive relationship between different types of sport participation and access to employment • Team sports contribute most to employability • Fitness sport, outdoor sports, and racquet sports were associated with higher earning-increases for men • Outdoor and fitness sports led to higher earnings for

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
		women
Kavetsos (2011) *25 European Countries* **2**	• Cross-sectional data (*n*=11,773) from 2004 (Eurobarometer 62.0) • Regression analysis to estimate the probability of an individual being employed controlling for participation in and frequency of physical activity	• Individuals who are active were more likely to be employed • Probability of employment increased with higher frequency levels of exercise
Cabane (2010) *Germany* **1**	• Survey data from the German Socio-Economic Panel from 1991-2007 of men between 16 and 55 years old (*n*=6,823) • Regression analysis to estimate the effect of sport participation on the job quality (level of autonomy, wage) of people who came back after less than a year	• Significant positive effect of sport participation on both job quality measures (autonomy and wage) • Being physically active was only relevant for people who have completed high school
Rooth (2010) *Sweden* **2**	• Cross-sectional survey data of all males who were 28-38 years old in 2003 with a focus on variation between siblings (*n*=144,671) to capture the long-run effects of physical activity on wages • Experimental approach with fictitious applications for real job opening in 2007 (*n*=8,466) • Regression analysis to determine the signalling value of sport participation	• A one standard deviation higher level of fitness is associated with a 7% increase higher earning • Sibling fixed effects reduced the premium to 4% • Application with sports attached have a 2% point higher probability of being called for an interview • Effects occurred only for individual and not for team sports • Positive effects were found for soccer, golf, and tennis
Hoy et al. (1992) *Denmark* **3**	• Cross-sectional injury data (*n*=715) of Danish soccer players from 1980-81 • Descriptive analysis to determine the financial costs of injuries for society and the individual	• 8% of patients had a loss in income • Average days absence from work due to injury were 5 days
North America		
Cabane & Clark (2015) *United States*	• Panel survey data from the National Longitudinal Study of Adolescent Health from 1994-2008 • Regression analysis to estimate the effect of sport	• Different types of childhood sport activities affect men's and women's adult labour market outcomes – team sport plays a larger role for boys and individual sport for girls

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
1	participation in school on adult labour market outcomes	
Ewing (2007) *United States* **2**	• Cross-sectional survey data from 1990 of men (*n*=1,782) • Regression analysis to examine labour market effects of participation in high school athletics	• Former high school athletes fare better in terms of both components of the compensation structure i.e., wages and fringe benefits (e.g. retirement, profit sharing, medical insurance, dental insurance, paid vacation, parental leave, and sick leave)
Ewing (1998) *United States* **2**	• Cross-sectional survey data of men from the National Longitudinal Survey of Youth data in 1990 (*n*=1,782) • Regression analysis estimate the effect of high school athletic participation on wage and fringe benefits	• Former high school athletes earn more than their non-athlete counterparts • Athletes are significantly more likely to be employed in jobs that offer or provide fringe benefits

2.3 Monetary returns

2.3.1 Value to the individual

Table 19 gives an overview of studies examining individual monetary outcomes such as income and medical costs of participation in physical activity. The empirical evidence is relatively consistent: physical activity has a significant positive effect on individual income and a significant negative effect on individual medical costs. This means that physically active people are tend to earn higher incomes and (have to) spend less on health care. Although the level of evidence of the summarised studies is medium or relatively high, the applicability of these findings to other UNESCO regions where no scientific evidence could be made available is limited given the varying income levels and health care systems among countries.

More detailed analyses reveal that the results for income depend on the individuals' socio-demographic characteristics and various other factors potentially affecting labour market outcomes (see 2.2.6). Moreover, a positive relationship between participation intensity and income was observed. However, more research is needed to clarify the role of participation frequency, duration, intensity, and type of activity in explaining individual monetary returns, i.e., income and specifically medical costs where these aspects have been largely neglected in previous research.

Table 19: Overview of studies examining individual monetary outcomes of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Yang et al. (2011) *Japan* **3**	• Cross-sectional survey data (*n*=483) of individuals 70 years and older including information about physical activity and physical performance from 2002-2008 • Analysis of variance to ascertain the impact of different levels of physical activity (low, moderate, and high) on medical care expenditure by considering physical performance	• Significant differences in medical costs between lowest level of physical activity ($827.3), average level ($711.1), and highest level ($702.0)
Wang et al. (2005) *Japan* **2**	• Cross-sectional survey data (*n*=47,515) of retired employees from the General Motors Corporation who were 65 years and older and received medical care in 2001-2002 • Regression analysis to examine the influence of regular physical activity on health care utilisation and costs	• Moderately active retirees had significantly lower annual health care charges (between $1,177 and $1,456) than their sedentary counterparts • Very active retirees had between $581 and $1,823 lower health care charges compared to their moderately active counterparts
Tsuji et al. (2003) *Japan* **1**	• Panel survey data (*n*=27,431) from the Ohsaki NHI Cohort Study from Japan (1995-98) • Regression analysis to quantify the effect of time spent walking on medical care costs	• Medical costs significantly reduced with longer time spent walking • Per capita medical costs for walking less than 30 minutes per day were £111.80, for those walking between 30 minutes and an hour £108.10, and for people walking more than an hour a day £97.30 per month

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Gablett et al. (2001) *Australia* **3**	• Cross-sectional survey data (*n*=34) of amateur rugby league players from 1999 • Descriptive analysis to determine the severity and cost of injuries in amateur rugby league	• Medians of the direct cost were £28.29 per capita and of indirect cost £77.04 per capita
Latin America and the Caribbean		
Codogno et al. (2015) *Brazil* **2**	• Cross-sectional survey data (*n*=963) from Bauru in 2010 of adults over 50 years • Regression analysis to determine the effect of different domains of physical inactivity (work, sports practice, leisure-time) on direct public health care expenditures	• Higher health care expenditures of medicines were associated with lower physical activity at work and sports • Overall health expenditures were positively related to physical inactivity
Europe		
Downward & Dawson (2015) *England* **2**	• Cross-sectional survey data from 2007-2008 (*n*=14,913) • Regression analysis to value the well-being derived from active leisure (sport participation, low intensity physical activity, moderate intensity)	• Sporting activity of the least intense nature (£45,420 per year) generates the highest overall well-being to the individual • Sporting activity of the most intense nature has the lowest overall value of well-being (£37,300 per year)
Idler et al. (2015) *Germany* **2**	• Cross-sectional survey data (*n*=3,356) of children aged 9 to 12 years from Germany (2005-2009) • Regression analysis to estimate the effect of physical activity (higher vs. lower level of moderate-to-vigorous) on health care utilisation and costs	• No statistically significant results for the association between physical activity, healthcare utilisation, and costs • Annual direct costs amounted to €392 for higher physical activity and €398 for lower levels of physical activity • Annual indirect costs amounted to €138 for higher and €128 for lower level of physical activity
Hyytinen & Lahtonen (2013) *Finland* **1**	• Panel survey data of male twins from Finland (*n*=5,042) from 1972-2004 combined with detailed income data from 1990-2004 • Regression analysis to examine the long-term income effects of physical activity (conditioning, sedentary,	• Long-term income of physically active males is 14-17% higher than that of the less active men

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	and occasional exercisers)	
Downward & Rasciute (2011) *United Kingdom* **2**	• Cross-sectional survey data (*n*=16,627) from the Taking Part Survey from 2005 • Regression analysis to examine the impact of participation and duration of participation in 67 sports on the subjective well-being of individuals and to determine its monetary value	• On average sport participation was valued with £19,000-£23,000 per year • Additional sport participation in relation to the existing portfolio is valued at about £1,600-£3,500 per year
Lechner (2009) *Germany* **1**	• Panel survey data from the German Socio-Economic Panel from 1984-2006 (*n*=4,365) • Regression analysis to determine the effects of individual leisure sports participation on long-term labour market variables, health, and subjective well-being	• After 16 years there is on average a monthly gross earnings gain of about €100 for physically active people • Gains are only significant after about 4 to 6 years; they appear to increase over time
Cumps et al. (2008) *Flanders* **3**	• Individual injury data from insurance companies of (*n*=72) Flemish sports federations combined with direct and indirect cost data from 2003 • Retrospective cohort study to determine estimated injury risks and accompanying socioeconomic costs of sports in Flanders	• Total direct medical cost for Flemish sports participants was $15 million representing 0.08% of the total budget spent on healthcare • Indirect cost was $111 million which was 3.4% of the costs arising from absenteeism from work
Forssblad et al. (2005) *Sweden* **3**	• Individual cross-sectional survey data (*n*=40,229) of four different sports including information about injury diagnosis and costs from insurance companies from 1997 • Descriptive analysis to identify the health costs of knee surgeries related to different sports (football, floor ball, handball, and ice hockey)	• 6,781 surgical procedures related to knees were performed at a cost of SEK39 million • For an arthroscopy with meniscus resection the costs per patient were SEK4,383 and with a one night stay in hospital costs amounted to SEK24,181
de Loës et al. (2000) *Switzerland*	• Cross-sectional survey data (*n*=1,717,307) of participants in the organisation Youth and Sports	• Costs per capita for medical treatment were $1,131 for females and $1,097 for males

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3	during the period 1987-93 • Comparative risk analysis to compare males and females and to estimate the costs of medical treatment	• Female soccer, handball, and ice hockey and male basketball and team handball had the highest costs concerning knee injuries
North America		
Lechner & Sari (2015) *Canada* **1**	• Panel survey data from 1994–2008 (*n*=6,045) • Regression analysis to estimate the effects of individual sports and exercise on individual labour market outcomes	• Significant positive long-run income effects of around 10% to 20% after 8 to 12 years • Activity level above the current recommendation of the WHO for minimum physical activity is required to reap in the long-run benefits
Kosteas (2012) *United States* **1**	• Panel survey data from the National Longitudinal Survey of Youth for the years 1998 and 2000 (*n*=6,190) • Regression analysis to investigate whether engaging in regular exercise leads to higher earnings in the labour market	• Results indicate that regular exercise yields a 6-10% wage increase • Frequent exercise generates the highest impact on wages
Eide & Ronan (2010) *United States* **1**	• Panel survey data from 1980-1992 (*n*=3,608) • Regression analysis to estimate if sport participation of high school student impacts future earnings	• Positive effect of sport participation on earnings of black male students • No effect for Hispanic males or black and Hispanic females
Roux et al. (2008) *United States* **3**	• Pre- and post- intervention data of adults aged 25-64 years in 2004 • Markov modelling to estimate the lifetime costs, health gains, and cost effectiveness of population intervention that promote physical activity among U.S. adults	• Average discounted quality-adjusted life expectancy was calculated to be 14.77 years, and life time costs were approximately $195,000 • Cost-effectiveness ratios ranged between $14,000 and $69,000

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Curtis et al. (2003) *Canada* **2**	• Cross-sectional survey data (*n*=9,393) from the 1997 National Survey of Giving, Volunteering and Participating in Canada • Regression analysis to examine the relationship between participation in organised sport as a youth on earned income in adulthood	• Average income was $5,518 higher for male and $2,111 higher for female sport participants than for non-participants
Barron et al. (2000) *United States* **1**	• Panel survey data from two databases of men participating in high school athletics (*n*=1,047; *n*=3,014) from 1972-1984 • Regression analysis to determine the effect of high school athletic performance on future wages and educational attainment	• Participation in athletics has a significant positive effect on wages • Effect is larger the more intensive the involvement in athletic participation
Long & Caudill (1991) *United States* **1**	• Panel survey data (*n*=9,787) of college freshmen with measurement points in 1971 and 1980 • Regression analysis to estimate the impact of college athletics on individual income	• Only for males a 4% higher income for intercollegiate athletics was observed

2.3.2 Value to the community

Table 20 gives an overview of studies examining monetary outcomes of physical activity to the community. The focus of these studies was on the estimation of the economic costs of inactivity. The estimated costs of injuries caused by sport and physical activity also belong to this chapter, but have been largely neglected in previous research. Ideally, the costs of sport injuries should be subtracted from the costs of inactivity; which has, however, not yet been done in previous research, probably because of data availability issues. It is likely that specific programmes for injury prevention can reduce the costs of sport-related injuries.

The available studies report substantial costs of inactivity for several countries in Asia, Europe, and North America. Research also shows that it is important to differentiate between direct and indirect costs of physical inactivity with the latter typically exceeding the level of direct costs. Direct costs include health care costs caused by inactivity, while indirect costs estimate the value of economic output lost because of illness caused by inactivity. The latter encompasses, for example, work absenteeism and productivity losses. Although the summarised studies have a solid level of evidence, the applicability of these findings to other UNESCO regions where no scientific evidence could be made available is limited given the differences in health care systems among countries.

The most common method used to estimate the economic costs of inactivity was the prevalence based comparative risk assessment. Within this approach, the relative risks of developing specific diseases (e.g., cancer, diabetes, cardiovascular diseases, depression) which are typically related to inactivity are estimated. Thus, the risk of inactive people developing these diseases is compared with the risk of the general population. The resulting relative risk is set in relation to the medical costs of these diseases and extrapolations are made for a specific state or country and a specific period.

Table 20: Overview of studies examining monetary outcomes of physical activity to the community (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Finch et al. (2015) *Australia* **2**	• Cross-sectional survey data (*n*=143,937) from 2004-2010 extracted from the Victorian Admitted Episodes Dataset • Regression analysis to determine the trends in population incidence and burden of all hospital-treated sports injuries in Victoria	• Associated economic burden for all sport injuries was $265 million • $110 million for lower limb injuries and $82 million for knee injuries
Zhang and Chaaban (2013) *China* **3**	• Cross-sectional survey data from the Chinese Behavioural Risk Factors Surveillance Report in 2007 plus cost estimates from the 2003 National Health Service Survey • Prevalence-based comparative risk assessment to estimate the total economic burden of physical inactivity in China	• Physical inactivity contributes between 12% and 19% to the risks associated with the five major non-communicable diseases in China (coronary heart disease, stroke, hypertension, cancer, and Type 2 diabetes) • Physical inactivity is responsible for more than 15% of the medical and non-medical yearly costs of non-communicable diseases
Cadilhac et al. (2011) *Australia* **2**	• Cross-sectional data from Australia in 2004 combined with cost data from the Disease Costs and Impact Study from 2000-2001 • Simulation models to show the effect of a 10% feasible, reduction target for physical inactivity	• 10% reduction of physical inactivity would result in 6,000 fewer incident cases of disease, 2,000 fewer deaths, and 25,000 fewer disability-adjusted life years and provide gains in working days of 114,000 • 10% reduction leads to AU$96 million reduction in health sector costs and AU$12 million in workforce

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
		production
Popkin et al. (2006) *China* **3**	• Cross-sectional survey data from the China Health and Nutrition Survey from 2000 combined with health service cost data from 1998 • Prevalence-based comparative risk assessment to estimate the health care costs related to physical inactivity in China	• The direct dietary and physical activity effects are more than $4.7 billion in 2000 • The diet and physical activity effect via obesity added $1.2 billion
Stephenson et al. (2000) *Australia* **3**	• National prevalence data of inactivity were derived from the Active Australia Survey from 1997 and combined with national health cost data from 1993-1994 • Prevalence-based comparative risk assessment to estimate direct health care costs of illness attributable to physical inactivity in the adult Australian population	• Annual direct health care cost attributable to physical inactivity is around $377 million per year, with $161 million for coronary heart diseases, $28 million for diabetes, $16 million for colon cancer, $101 million for stroke, $16 million for breast cancer, and up to $56 million for depressive disorders
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Maresova (2014) *Czech Republic* **3**	• Cross-sectional survey data from the 2008 Czech republic European Health Interview Survey combined with cost data of different diseases from health insurance companies • Prevalence-based comparative risk assessment to quantify the costs of physical inactivity in the Czech Republic	• Financial costs of physical inactivity to public health insurance companies were almost CZK700 million or 0.4% of total healthcare costs • Physical inactivity caused 2,442 or 2.3% of all deaths in 2008 and 18,065 or 1.2% of all disability-adjusted life years in 2004
Scarborough et al. (2011) *United Kingdom*	• Cross-sectional survey data from the Health Survey for England from 2006 combined with cost data	• Illness costs of £0.9 billion are related to physical inactivity

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3	stemming from the national health system costs by disease category for England from 2006-2007 • Prevalence-based comparative risk assessment to estimate the economic costs of risk factors for chronic disease to the national healthcare system	
Allender et al. (2007) *United Kingdom* **3**	• Data from the WHO for mortality and disability measures from 2002 and for population attributable risks combined with physical inactivity rates from 2003 and health cost data from 1992 • Prevalence-based comparative risk assessment to estimate the economic burden of diseases related to physical inactivity	• Over 35,000 deaths could have been avoided if the population were physically active • Physically inactivity was responsible for 3.1% of morbidity and mortality, contributing over £1 billion to the direct health cost burden
Martin et al. (2001) *Switzerland* **3**	• Cross-sectional survey data from the Health-Enhancing Physical Activity Survey from 1999 • Prevalence-based comparative risk assessment to estimate the costs of physical inactivity and activity	• Inadequate physical inactivity is responsible for direct costs of around CHF1.6 billion • Physical activity leads to 300,000 sporting accidents a year which causes CHF1.1 billion of treatment costs
North America		
Carlson et al. (2015) *United States* **1**	• Panel survey data (n=51,165) from the National Health Interview Survey (2004-2010) combined with expenditure data from the Medical Expenditure Panel Survey (2006-2011) • Regression analysis to estimate the percentage of health care expenditures associated with levels of physical activity	• Inadequate levels of aerobic physical activity were associated with 11.1% of aggregate health care expenditures • A total of $117 billion were related to inadequate levels of physical activity
Janssen (2009) *Canada* **3**	• Cross-sectional survey data from the Canadian Health Measures Survey 2007-2009 and information about relative risks from the existing literature • Prevalence-based comparative risk assessment to	• Estimated direct, indirect, and total health care costs associated with physical inactivity in 2009 were $2.4 billion, $4.3 billion, and $6.8 billion • 3.7% of all directs costs are related to physical inactivity

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
	estimate health care costs of physical inactivity among Canadian adults	
Knowles et al. (2007) *United States* **1**	• Panel survey data (n=2,990) of reported injuries of 12 sports from the North Carolina High School Athletic Injury study from 1996-1999 • Regression analysis to estimate the economic cost of injuries in population of US high school athletes	• Overall costs were $9.9 million in medical costs ($709 per injury), $44.7 million in human capital costs ($2,223 per injury), and $144.6 million in comprehensive costs ($10,432 per injury)
Chenoweth & Leutzinger (2006) *United States* **3**	• Medical and workers' compensation cost data on selected medical conditions obtained from various health plans • Proportionate Risk Factor Cost Appraisal to evaluate how cost data from previously conducted analyses can be used to quantify the costs of physical inactivity among American adults	• Estimated financial burden which includes direct medical care, workers' compensation, and productivity loss costs among seven US states is $93.32 billion for physical inactivity • Physical inactivity costs for all United States adults are estimated at $251.11 billion
Anderson et al. (2005) *United States* **1**	• Panel survey data (n=4,674) of health plan members from 1996-1999 • Regression analysis to estimate the proportion of total health care charges associated with physical inactivity	• Significant effect of physically activity on health care charges only for men • 23.5% of predicted health care charges were associated with physical inactivity, overweight, and obesity
Garrett et al. (2004) *United States* **3**	• Cross-sectional survey data from Minnesota in 2000 combined with medical records from the Blue Cross Programme from 2000 • Prevalence-based comparative risk assessment to estimate the total medical expenditures attributable to physical inactivity patterns among members of a large health plan	• Heart disease was the most expensive outcome of physical inactivity within the health plan population, costing $35.3 million in 2000 • Total health plan expenditures attributable to physical inactivity were $83.6 million ($56 per member)
Katzmarzyk & Janssen (2004) *Canada*	• Cross-sectional survey data from the 2000-2001 Canadian Community Health Survey combined with cost data of the year 1998	• Economic burden of physical inactivity was $5.3 billion ($1.6 billion in direct costs and $3.7 billion in indirect costs)

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
3	• Prevalence-based comparative risk assessment to estimate the direct health care costs attributable to physical inactivity in Canada	• 2.6% of total health care costs in Canada are related to physical inactivity
Katzmarzyk et al. (2000) *Canada* **3**	• Cross-sectional survey data (*n*=1,875) from the Canadian Physical Activity Monitor Survey combined with health care costs from the Canadian Health Expenditures Database from 1999 • Prevalence-based comparative risk assessment to estimate the direct health care costs attributable to physical inactivity in Canada	• $2.1 billion or 2.5% of the total direct health care costs in Canada were attributable to physical inactivity in 1999 • 10% reduction in the prevalence of physical inactivity has the potential to reduce direct health care expenditures by $150 million a year
Colditz (1999) *United States* **3**	• Cross-sectional data from 1995 including information about the prevalence of physical inactivity among US adults combined with cost data for six diseases • Prevalence-based comparative risk assessment to assess the economic costs of inactivity	• Direct costs of lack of physical activity are US$24 billion or 2.4% of the health care expenditures

2.4 Economic input-output analyses

Only a few studies have examined the direct link between economic inputs (e.g., monetary or other investments) and economic outputs (e.g., monetary return on investment). These studies are summarised in Table 21. Most studies have examined the monetary outcomes of physical activity campaigns and infrastructure programmes by comparing costs and benefits. Generally speaking, previous research indicates that the monetary benefits exceed the costs. However, more research is needed in this area, also to allow generalisations to other UNESCO regions where no scientific evidence could be made available.

Table 21: Overview of economic input-output studies of physical activity (by UNESCO region; in non-chronological order).

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Africa		
No scientific evidence could be made available		
Arab States		
No scientific evidence could be made available		
Asia and the Pacific		
Elley et al. (2004) *New Zealand* **2**	• Pre- and post-intervention data (*n*=878) of less active patients aged 40-79 from 2000-2002 • Regression analysis to assess the cost-effectiveness of the Green Prescription a physical activity counselling programme including verbal advices and a written exercise prescription intervention	• Programme-cost per patient was NZ$170 • Monthly cost-effectiveness ratio for total energy expenditure achieved was $11 per kcal/kg/day • If all less-active adults were to receive a Green Prescription, total programme costs would be NZ$150 million to save at least NZ$55 million per year
Latin America and the Caribbean		
No scientific evidence could be made available		
Europe		
Saelensminde (2007) *Norway* **3**	• Travel survey data from 1997-1998 combined with construction costs for walking and cycling tracks • Cost-benefit analysis of walking and cycling tracks in three Norwegian cities	• Net benefit/cost ratios for all three Norwegian cities were positive (Hokksund: 4.09; Hamar: 14.34; Trondheim: 2.94)
Proper et al. (2004) *The Netherlands* **3**	• Pre- and post-intervention data (intervention: *n*=131; control: *n*=168) of civil servants from 2001-2002 • Costs and benefits analysis to evaluate the impact of worksite physical activity counselling	• Intervention costs were €430 per participant and the benefits during the intervention period were €125 • After 9 months the benefits amounted to €635 per patient
North America		

Author (Year) ***Country*** **Level of evidence**	**Methodology**	**Key Findings**
Gotschi (2011) *United States* **3**	• Participation data on bicycling (in miles) combined with cost data of infrastructure projects from 1991-2040 • Costs and benefits analysis to assess how costs of Portland's past and planned investments in bicycling relate to health and other benefits	• By 2040, investments in the range of $138 to $605 million will results in health care cost savings of $388 to $594 million, fuel savings of $143 to $218 million, and savings in the value of statistical lifes of $7 to $12 billion
Wang et al. (2005) *United States* **3**	• Cross-sectional observational data combined with costs of construction of four bicycle/pedestrian trails from 1998 • Cost-effectiveness ratios to estimate the costs required for one unit of physical activity related outcome	• Per capita annual costs of using the trails was $209.28 the per capita annual direct medical benefits of using the trails were $564.41 • Benefit/cost ratio was 2.94
Jones et al. (1994) *United States* **3**	• Panel survey data of 10-year grouped cohorts from 35 to 74 years of age from 1992 • Decision analysis simulation to quantify the cost-benefit relationship of walking to prevent coronary heart disease	• $5.6 billion would be saved annually if 10% of adults began a regular walking programme • $4.3 billion savings is predicted if the entire sedentary population began walking regularly

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