The Impacts of Coronary Heart Disease on Quality of Life:

A Meta-analytic Comparison with Control Groups

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This report is submitted in partial fulfilment of

the degree of Master of Psychology (Health)

School of Psychology

The University of Adelaide

November 2017

Word Count: 4738 (literature review), 5935 (article)

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Quality of Life in Adults with Coronary Heart Disease: A Literature Review

Abstract

Coronary heart disease (CHD) is a leading cause of death and disability worldwide, with significant physical, psychological and social impacts. Medical advances have seen increasing numbers of adults surviving and living with CHD. Reducing disease burden by improving quality of life (QOL) has, therefore, become of increasing importance. QOL for those with CHD is best encapsulated by a biopsychosocial framework such as the International Classification of Functioning, Disability and Health (ICF). This review will map QOL components in the CHD population against the ICF, in order to inform rehabilitation processes and identify areas for future research.

Introduction

Coronary heart disease (CHD), a condition caused by the narrowing and subsequent occlusion of the heart's main blood vessels, is responsible for over one-third of all deaths in people over age 35 (Benjamin et al., 2017). CHD is associated with psychological morbidity in addition to debilitating physical symptoms that impair daily activity (De Smedt et al., 2014; Moser et al., 2010). Negative impacts of CHD extend to social functioning and interpersonal relationships (Dalteg et al., 2011). Of particular concern is the increased risk of suicide for this population, which is estimated to be up to three times that of healthy individuals (Liu et al., 2016).

Quality of Life (QOL), which accounts for an individual's perception of their health status, is becoming increasingly important as a predictor of long-term prognosis, mortality and symptom severity in CHD (Höfer et al., 2014). In recent years, QOL has become recognised as an independent outcome measure, allowing a patient-focused approach to healthcare (Thompson et al., 2016). As a multidimensional construct, QOL is best conceptualised by a biopsychosocial framework such as the International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001). The ICF can, therefore, be used to study QOL changes for those affected by a chronic condition such as CHD (Racca et al., 2015).

This review will examine the CHD and QOL literature, commencing with a summary of CHD, including its symptomology, epidemiology and impacts on QOL. A conceptualisation of QOL, based on the ICF, will then be presented. Finally, methodological limitations of available QOL research in CHD cohorts will be explored and avenues for future research highlighted.

Coronary Heart Disease

Definition and symptomology. Coronary heart disease (CHD), also known as coronary vascular, arteriosclerotic or ischaemic heart disease, is a condition which involves atherosclerosis - a process whereby fatty plaque accumulates in the arterial walls of the heart (Foxwell et al., 2013). CHD is associated with specific clinical syndromes including *angina* and *myocardial infarction.*

Angina refers to chest pain or discomfort that may radiate to other areas of the upper body (Kimble et al., 2011). This occurs when accumulated plaque causes considerable narrowing of a coronary artery, resulting in decreased blood flow to and from the heart (Kimble et al., 2011). Angina is commonly triggered by physical or mental stress, often dissipating after rest. It presents in two forms: *stable angina* occurs in a predictable pattern, often triggered by physical exertional, emotional stress, temperature change or heavy meals (Anderson et al., 2007); *unstable angina* involves unpredictable, prolonged chest pain occurring even at rest or during everyday activity of minimal exertion (Anderson et al., 2007).

Myocardial infarction, colloquially known as a 'heart attack', occurs when an arterial plaque suddenly ruptures, leading to the formation of a blood clot that completely halts blood flow to the heart (Davies, 2000). Myocardial infarction manifests as severe chest pain, including pressure, burning, or squeezing in the centre of the chest (Schenck-Gustafsson, 2012). This discomfort may radiate to one or both arms, shoulders, neck, jaw, stomach or back, and may be accompanied by shortness of breath (dyspnoea), fatigue, cold sweat or nausea. These symptoms can ultimately lead to unconsciousness or death

(Davies, 2000). Unstable angina and myocardial infarction are often referred to as *acute coronary syndromes* (Davies, 2000).

In addition to coronary symptoms, people with CHD often present with comorbid mental and physical conditions. Heart failure, peripheral artery disease, depression and anxiety have been identified as the most disabling comorbidities, significantly reducing QOL in this cohort (Tusek-Bunc and Petek, 2016; Dickens et al., 2012a; Graaff et al., 2002). Gender differences in the presentation of CHD symptoms have also been reported. That is, men are more likely to present with chest pain, left arm pain and diaphoresis while nausea, back and jaw pain, and palpitations are more common in women (Arslanian-Engoren et al., 2006; Berg et al., 2009).

Pathophysiology. CHD is a progressive condition that develops gradually over many years. It is caused by the growth of atherosclerotic plaques in the interior walls of coronary arteries, impeding oxygenated blood flow to the heart. The common pathophysiological history of CHD is coronary atherosclerosis followed by plaque formation (Sayols-Baixeras et al., 2014). Atherosclerosis begins with the migration of lipid and inflammatory cells into the coronary arteries. These plaques progress gradually and cause a remodelling of the vessel wall, leading to increased diameter (Badimon et al., 2012). The lumen of the vessel can be maintained for several years during which the patient may be asymptomatic. Plaque rupture and subsequent myocardial infarction can be exacerbated by risk factors such as high blood pressure, high cholesterol, smoking and diabetes (Ambrose and Singh, 2015).

Epidemiology. Globally, CHD is the most prevalent form of disease affecting the cardiovascular system. It is also responsible for about one-third of all deaths in people over age 35, worldwide (Rosamond et al., 2008; Nichols et al., 2014; Benjamin et al., 2017). The 2017 Heart Disease and Stroke Statistics Update reported that about 16.5 million people over the age of 20 suffer from CHD while the 2013 Global Burden of Disease Study found that approximately 17.3 million deaths worldwide were related to CHD and cardiovascular disease: a 41% increase since 1990 (Benjamin et al., 2017). Men and women aged over 40 have a heightened risk of developing CHD: 49% and 32%, respectively (Lerner and Kannel, 1986; Kannel, 1987).

Similar incidence patterns are seen in Australia, with CHD comprising 49% of all cardiovascular-related deaths (Waters et al., 2013) and accounting for 1.5% of all hospitalisations (AIHW, 2016). The estimated incidence of acute coronary syndromes was 558 per 100,000 and 266 per 100,000 population for men and women, respectively (AIHW, 2014). From 2007 to 2012, there was a decrease in rate of acute coronary syndromes from 534 per 100,000 to 406,000 per 100,000 population (AIHW, 2014). This decline may reflect improvements in medical treatment, including an increase in the availability of antithrombotic medications (Taylor et al., 2006), secondary preventative measures following myocardial infarction, and early treatments for acute coronary syndromes (Wilson & Douglas, 2017). In 2014-15, there was an estimated 643,000 Australians aged 18 or over diagnosed with CHD (3.6% of the adult population). Of these, 281,000 experienced angina while 472,000 suffered myocardial infarction (Australian Bureau of Statistics [ABS], 2015; AIHW, 2014).

Both non-modifiable and modifiable risk factors for developing CHD have been identified. Epidemiological studies have highlighted a higher prevalence among men (5%) than women (2%) (Maas and Appelman, 2010). This risk increases rapidly with age, with people aged 75 and over having a nine-fold increase in risk in comparison to those aged 45-54 (17% and 2%) (AIHW, 2014). Genetic risk factors have also been confirmed with research showing that these account for up to 60% of the variation in CHD risk (Roberts, 2014; Mega et al., 2015). Behavioural and lifestyle risk factors of CHD include physical inactivity, obesity, poor diet, smoking, high blood pressure and unrelieved stress, all of which present potential targets for intervention (Phillips and Klein, 2010; Arsenault et al., 2010; Luiz Ribeiro et al., 2017; Logue et al., 2011; Navar et al., 2016). In addition, a relationship between socio-economic status and cardiac health has been established in industrialised nations. In Australia, those living in rural communities are 1.3 times more likely to die from CHD than their metropolitan counterparts, likely due to reduced health infrastructure, including limited allied health services (National Rural Health Alliance, 2015). Similarly, those from a low socioeconomic background are 2.2 times more likely to develop CHD and 1.4 times more likely to die from it (AIHW, 2014), possibly as a result of limited health literacy combined with reduced capabilities to access health care service (Waters et al., 2013; Loucks et al., 2014).

Economic burden. Global statistics indicate a projected increase in economic costs associated with cardiovascular diseases and CHD. In 2015, the costs associated with CHD management were estimated to be $USD 188 billion – an estimate which is expected to increase to $USD 366 billion by 2035 (American Heart Association, 2016). Indirect costs associated with loss of productivity account for more than half of the total costs

(American Heart Association, 2016). Similarly, in Australia, cardiovascular diseases are responsible for the highest health expenditure and CHD being the single most expensive disease, accounting for $AUD 2028 million (AIHW, 2014). These high costs, combined with the increasing incidence of CHD, highlights the importance of biopsychosocial management and treatment in order to prevent rehospitalisation, enhance physical, occupational and social functioning, which would, in turn, reduce socio-economic burden on the health system (Mampuya, 2012; Shepherd and While, 2012).

Quality of Life and CHD

Definition and impact. In medical settings, *quality of life* (QOL) is defined in a biological way, focusing on the efficiency of vital bodily functions (Mor, 1987). Other definitions have taken a subjective stance, placing emphasis on an individual's satisfaction with life domains that they consider of importance - including matters both related and unrelated to health (Oleson, 1990). The World Health Organisation (WHO, 1995) considers a combination of perceived physical health, psychological state, level of independence, interpersonal relationships and the socio-cultural environment are critical to QOL. In recent years, the emergence of health status measures has led to the introduction of the term *health-related quality of life* (HRQOL), which describes the extent to which the perception of health or changes in health affects an individual's physical, psychological and social functioning (Dickens et al., 2012b; Karimi and Brazier, 2016). Although HRQOL was initially introduced as a distinct concept, research demonstrates significant overlap between HRQOL and QOL, resulting in the two being used interchangeably in the literature (Karimi and Brazier, 2016). For this reason, the

current review will utilise the term QOL to broadly capture the physical, social and emotional wellbeing of the CHD population at large.

People living with CHD suffer from various symptoms which influence their QOL (Moryś et al., 2016). Studies demonstrate that significant functional impairment following CHD events, including reduced mobility, activity and self-care (Xie et al., 2008; De Smedt et al., 2015), can impede ability to engage in everyday life. Research into the psychological consequences of CHD has also demonstrated a high risk of anxiety and depressed mood in this cohort (Moser et al., 2010). These psychological comorbidities have a negative and independent impact on QOL correlates, including treatment adherence (DiMatteo et al., 2000; Ziegelstein et al., 2000), cost of care (Baumeister et al., 2015), and social relationships (Nielsen et al., 2013) which, in turn, have been linked to increased risk of mortality (Compare et al., 2013). The negative impact of CHD extends to interpersonal relationships, with research identifying sexual dysfunction and dissatisfaction as contributing to low mood (Dalteg et al., 2011). In sum, QOL for those with CHD, is a complex construct that requires multidimensional evaluation which extends beyond direct measures of physical wellbeing (i.e. health, life expectancy, causes of death) to focus on psychosocial impacts.

QOL assessment. QOL has received increased recognition as a crucial patient-centred outcome in cardiovascular diseases. This includes the introduction of various instruments with more refined and psychometrically sound representations of QOL in people with CHD. Generic QOL measures, which can be applied to different patient or disease groups, are most commonly used (Thompson et al., 2016) (see Table 1 for details).

The 36-Item Short Form Health Survey (SF-36) is one such measure. Used extensively to quantify health status in clinical populations, including chronic illness and disability (Ware and Sherbourne, 1992), this 36-item tool groups QOL into 8 domains: *physical functioning, vitality, bodily pain, general health, physical role limitations, emotional role limitations, social functioning,* and *mental health*. These domains can be further categorised into two summary scales reflecting physical and mental components (Gierlaszyńska et al., 2016). Normative data for the CHD population is available for the SF-36 (Huber et al., 2016). Consequently, it is deemed a reliable, valid and sensitive measure for this population (Busija et al., 2011).

The 136-item Sickness Impact Profile (SIP) is a behaviourally based measure of health status (Visser et al., 1994). The SIP considers QOL on three dimensions: *physical* (ambulation, mobility, body care), *psychosocial* (social interaction, communication, alertness, emotional behaviour), and *other* (sleep/rest, eating, work, home management, recreational pastimes). Studies support the psychometric properties of these domains for patients with angina (Visser et al., 1994), with adequate discriminant validity for those with myocardial infarction (Visser et al., 1995). However, the three-dimensional factor structure of the SIP (i.e. physical, mental, social) has been debated, with research favouring the use of the total SIP score as a generic estimate of QOL (Dempster and Donnelly, 2000).

Another common measure is the EuroQOL 5-Dimensional questionnaire (EQ-5D; EuroQOL, 1990), which provides one question for each of five health categories: *self-care, mobility, usual activities, anxiety/depression*, and *pain/discomfort.* Answers can be converted into a total utility score to allow comparison across health conditions. The EQ-

5D has demonstrated adequate reliability and validity in populations with cardiovascular disease (Dyer et al., 2010). As answers to the EQ-5D pertain to only the current day, this questionnaire has high sensitivity to short-term changes. However, there is evidence of strong ceiling effects across both domain and index values of the EQ-5D, which suggests that it may not detect clinically significant changes at the higher spectrum of QOL (Gierlaszyńska et al., 2016; Dyer et al., 2010).

Similarly, the World Health Organisation Quality of Life – Brief Version (WHOQOL-BREF) evaluates a respondent's general QOL across four domains: *physical health*, *psychological health*, *social relationships* and *environment*. Studies have suggested adequate reliability and validity of this measure in the general population (Ohaeri and Awadalla, 2009; Izutsu et al., 2005). However, it is argued that the WHOQOL-BREF may not be an adequate measure for different QOL dimensions in populations with CHD (Najafi et al., 2013), despite its suitability as an overall QOL index.

In recent years, a number of self-report instruments have been developed to examine specific aspects of QOL relevant to CHD. This includes the 19-item Seattle Angina Questionnaire (SAQ; Spertus et al., 1995), which quantifies patients' physical limitations caused by angina, the frequency of and recent changes in symptoms, satisfaction with treatment, and the degree to which they perceive their condition to affect QOL (Spertus et al., 1995). All SAQ domains have been deemed psychometrically adequate, with high sensitivity in detecting clinical changes associated with angina. The SAQ has also been utilised to monitor symptom improvements following cardiac surgery (Huber et al., 2007) and during rehabilitation (Tavella and Beltrame, 2012).

Table 1.

Generic vs CHD-specific Measures

	Items	Domains	Research
Generic Measures			
SF-36	36	Physical functioning, role limitation – physical, role limitation – emotional, bodily pain, general health, vitality, social functioning, mental health	(Failde and Ramos, 2000)
WHOQOL-BREF	26	Physical, social, psychological, environmental	(Najafi et al., 2009)
EQ-5D	5	Mobility, self-care, usual activities, pain/discomfort, anxiety/depression	(Dyer et al., 2010)
SIP	68	Biological, psychological, social	(Thompson and Yu, 2003)
15-D	15	Mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort/symptoms, depression, distress, vitality, sexual activity	(De Smedt et al., 2016)
HUI 2	7	Sensation, mobility, emotion. Cognitive, self-care, pain, fertility	(Gencer et al., 2016)
HUI 3	8	Vision, hearing speech, ambulation, dexterity, emotion, cognition, pain	(Gencer et al., 2016)
QWB-SA	71	Mobility, physical activity, social activity, symptoms/problems	(Visser et al., 1994)
CHD-Specific measures			
SAQ	19	physical limitation, anginal stability, anginal frequency, treatment satisfaction and disease perception.	(Dougherty et al., 1998)
MacNew	27	Physical limitations, emotional function, social function	(Dempster et al., 2004)

Abbreviations. SF-36 = 36-item Short Form Health Survey; WHOQOL-BREF = World Health Organisation Quality of Life questionnaire – brief version; EQ-5D = EuroQOL group 5 Dimension Questionnaire; SIP = Sickness Impact Profile; HUI 2 = Health Utilities Index Mark 2; Health Utilities Index Mark 3; QWB-SA = Quality of Well-being Scale – Self-Administered; SAQ = Seattle Angina Questionnaire; MacNew = MacNew Heart Disease Health-Related Quality of Life

The MacNew Heart Disease Health-Related Quality of Life Questionnaire (MacNew), based on the 97-item Quality of Life after Myocardial Infarction Questionnaire (Valenti et al., 1996), is another instrument designed to evaluate how QOL is affected by CHD and its treatment. This 27-item measure assesses QOL in three domains: *physical limitation, emotional function* and *social function.* Studies support the reliability and validity of the MacNew in assessing QOL in people with cardiac symptoms. In addition, research shows that it is responsive and sensitive to changes in QOL following CHD rehabilitation (Alphin et al., 2015; Höfer et al., 2012).

In sum, numerous QOL assessment tools are available for clinical and research purposes; however there are conceptual discrepancies between these measures (Karimi and Brazier, 2016). For example, the SF-36 focuses on physical capacity and psychosocial functioning whereas the WHOQOL-BREF incorporates an environmental component (Hand, 2016). Additionally, the SF-36 and EQ-5D define psychological functioning in terms of mood whereas the WHOQOL-BREF additionally assesses cognitive functioning. Some QOL measures are based on the relationships between multiple items intended to measure one or more domains (e.g. SIP), whereas others are based on the use of single items to measure well-being (e.g. EQ-5D). The use of generic versus disease-specific QOL instruments is also contentious, with suggestion that generic QOL instruments, which generate a total QOL index (e.g. SF-36) have limited sensitivity to capture small changes within and between patients (Coons et al., 2000; Richardson et al., 2015; De Smedt et al., 2016). Despite these discrepancies, the available measures usefully complement an existing detailed scheme for the classification of disability: the International Classification of Functioning, Disability and Health, or ICF (WHO, 2001).

QOL and the ICF

Definition. QOL, as a multidimensional construct, is best conceptualised by a framework such as the International Classification of Functioning, Disability and Health (ICF; WHO, 2001). The ICF was developed by the WHO as a theoretical framework to provide an international standardised 'language' on health status and functioning. Today, the ICF is used as a multidisciplinary framework to help inform data collection, analyse participant responses, guide clinical assessment, assist in rehabilitation goal-setting and provide a person-centred comprehensive understanding of complex health conditions (Alford et al., 2015; Castaneda et al., 2014).

The ICF highlights a paradigm shift in the way health and disability are understood and measured (Kostanjsek, 2011). Traditionally, 'health' was classified as the opposite of death and disease, reflected by mortality and morbidity measures (Kostanjsek, 2011). 'Disability' was considered a separate entity, defined as medical conditions involving bodily impairments or an imposed restriction on an individual that prevents engagement with daily activities (Kostanjsek, 2011). The ICF presents these two concepts on a single spectrum, integrating biological, psychological, social and environmental factors. In acknowledgement of the unique features and challenges of specific health conditions, such as CHD, ICF Core Sets have been developed (Cieza et al., 2004). These core sets include a comprehensive and abbreviated list of relevant concepts that need to be considered in multidisciplinary assessment (Castaneda et al., 2014).

The ICF views QOL as a complex and changing construct involving a dynamic interaction between four domains. Specifically, *body structures and function* interact with limitations and restrictions in *activities and participation*. Both of these domains are determined by

contextual variables – namely, one's social and attitudinal *environment* alongside individual or *personal factors* (e.g. age, gender, values, beliefs, lifestyle etc.). Figure 1 illustrates the interactions among these domains in the context of CHD. Application of the ICF to the understanding of QOL has been previously reviewed, with research indicating its use in rehabilitation settings to summarise patient presentations (Bakas et al., 2012; Huber et al., 2010; Racca et al., 2015). Individual studies have also mapped features of disease-specific QOL measures onto the ICF, highlighting sufficient common content among these tools (Schiariti et al., 2011; Cieza and Stucki, 2005; Geyh et al., 2007; Silva et al., 2013). In relation to CHD, 75% of the concepts extracted from outcomes measures have been found to correspond with the ICF domains (Wolff et al., 2004).

Body Structures and Functions. This domain refers to physiological and emotional processes within the human body affected by CHD. A wealth of research has established significant relationships between QOL and *exercise tolerance functions* (Bocalini et al., 2008), *sensation of pain* (Niv and Kreitler, 2001) and *energy and drive functions* (Schalock, 2004) in other chronic illness and disability groups (e.g. chronic pain). However, only single studies have reported positive associations between physical pain, life dissatisfaction and CHD specifically (Valkamo et al., 2003; Parsons et al., 2015) (Lee et al., 2017). In contrast, *emotional functions* have a recurring focus in the CHD literature. Indeed, studies report the importance of depressed mood and anxiety symptoms in the aetiology, development, duration and outcome of CHD (Albus, 2010; Khayyam-Nekouei et al., 2013; Davidson and Mostofsky, 2010; Eng et al., 2011). Individuals reporting low mood have twice the rate of reported angina and triple the reported physical

limitations than those without (Rumsfeld et al., 2003). Similarly anxiety has been associated with adverse cardiac events including the exacerbation of atherosclerosis (Rosenbloom et al., 2009) and arrhythmia (Buckley and Shivkumar, 2016). Meta-analyses of prospective cohort studies have since established depression (Gan et al., 2014) and anxiety (Roest et al., 2010) as independent risk factors and negative prognosis indicators for CHD and myocardial infarction.

The limited research comparing the relative physical and mental health impacts of CHD as compared to control groups is, however, conflicting. Pettersen et al. (2008) reported clinically significant reductions for persons with CHD in comparison to national norms on most SF-36 subscales, whereas Soto Torres et al. (2004), using the same measure, identified comparable ratings for *physical functioning*, *general health* and *mental health*. Another study by Bradshaw et al. (2006), which also implemented the SF-36, only identified significant differences in *physical functioning*, *vitality* and *emotional role limitations* between their CHD cohort and population norms.

These discrepant findings may, in part, reflect limitations associated with generic QOL measures and the use of population norms for comparisons. The utility of generic QOL instruments, which are often utilised in CHD comparative studies, has been questioned (Coons et al., 2000; Richardson et al., 2015). In particular, generic measures which generate a total QOL index, such as the SF-36, may have limited sensitivity to capture small changes within and between patients (De Smedt et al., 2016). In addition, normative data associated with such measures often represent the performance of a defined population at a specific point in time. Consequently, it may not account for sociodemographic factors (i.e. age, economic status, education) across different

populations in addition to changes in these populations over time (De Smedt et al., 2015). For example, in a number of countries, normative data for the SF-36, a common QOL measure, has only been developed in recent years (Khader et al., 2011; Jorngarden et al., 2006). Moreover, recent research has found that normative data for the SF-36 has displayed changes over time, with recent item means differing significantly from that of earlier norms (Garratt and Stavem, 2017).

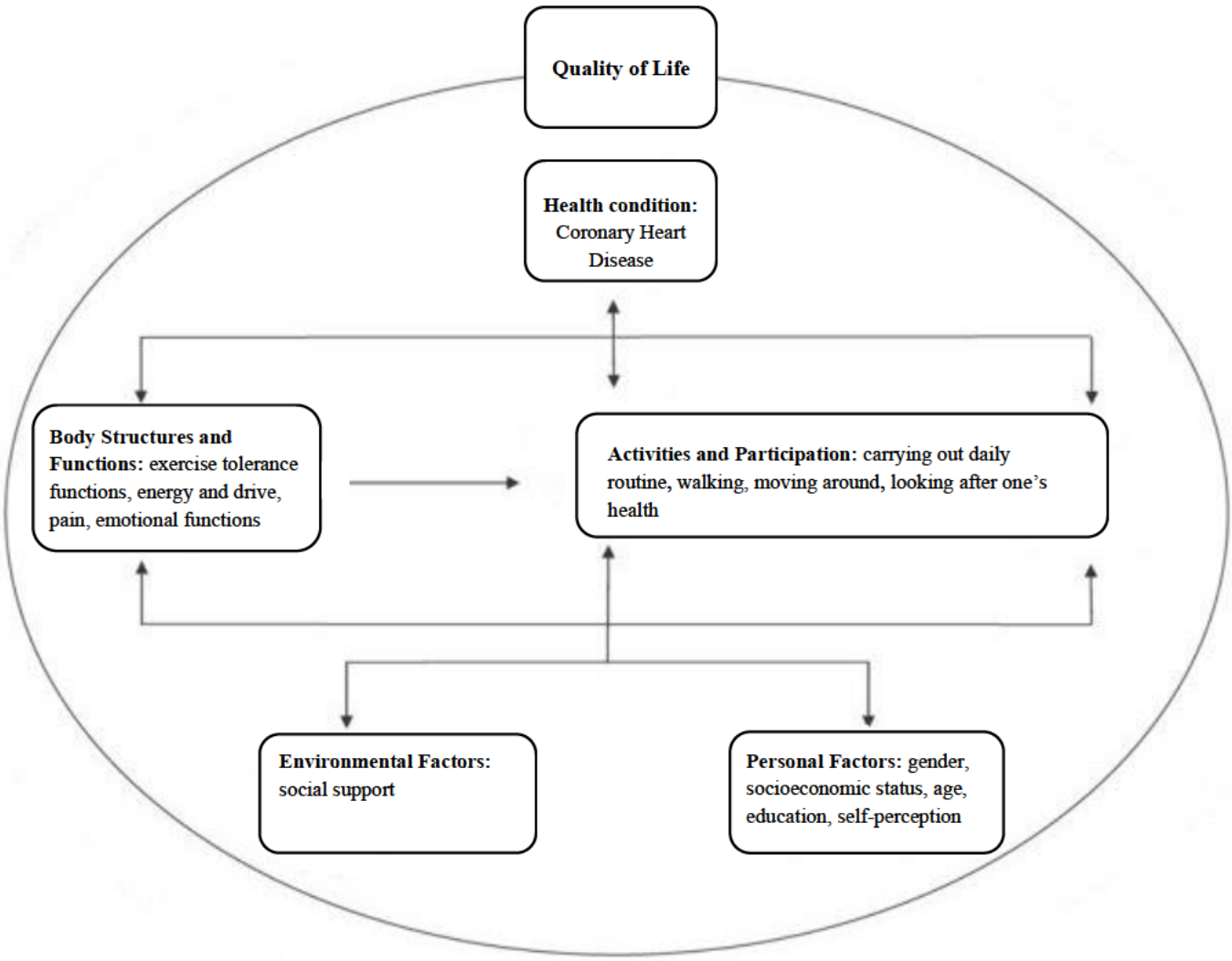

Figure 1. Quality of Life in Coronary Heart Disease: The International Classification of Functioning and Disability Adapted from McDougall, Wright, Schmidt, Miller & Lowry, 2011

The discrepancies in QOL findings also need to be considered in the context of sample characteristics, including comorbidity and severity of CHD symptoms. Specifically, patients with CHD often present with more than one comorbid condition (e.g. cerebrovascular disease, peripheral artery disease or heart failure) in addition to anxiety and depression (Dickens et al., 2014), all of which contribute to reduced QOL. However, CHD studies do not consistently report these comorbidities, making it difficult to account for their effects when exploring the specific impacts of CHD. In addition, CHD studies have utilised different control groups. This includes chronic illness and disability groups as widespread as Parkinson's Disease (Ferrucci et al., 2000), dyslipidaemia (Lalonde et al., 2001), panic disorder (Srivastava et al., 2017) and peripheral artery disease (de Graaff et al., 2002). These distinct health conditions may vary in risk factors, physical symptoms and psychological challenges that make it difficult to compare data generated across different studies (Megari, 2013).

Activity and Participation. This domain describes functional status and engagement with life. The CHD literature has consistently reported limitations in carrying out daily routine as a result of clinical symptoms such as shortness of breath and fatigue (Duruturk et al., 2015). Individuals who experience acute angina have limited physical capacity which prevents engagement with daily activities (Britton et al., 2012). Restrictions include functional activities such as walking across a room and moving from a bed to chair, with up to 28% of individuals reporting severe problems in mobility (Schweikert et al., 2009). Such limitations have significant effects on the individual, their families and society. This lack of physical activity contributes to increases in body weight (Britton et al., 2012), which has been identified as a main

predictor of low QOL (Schweikert et al., 2009). Decreased ability to look after one's health has also been reported, with research identifying poor diet in individuals following CHD diagnosis and treatment (Ma et al., 2008; Coyan et al., 2014).

Limitations in this literature are, however, associated with the instruments utilised to measure engagement and participation in activities. In particular, two of the most commonly utilised measures, the Participation Scale (P-scale) (van Brakel et al., 2006) and World Health Organization Disability Assessment Schedule II (WHODAS-II) (WHO, 1988), assess related but different constructs (Richardson et al., 2015). The P-scale is based on the nine participation domains of the ICF: *learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal interactions and relationships, major life areas and community*, and *social and civic life* (van Brakel et al, 2006). In comparison, the WHODAS-II, although grounded in the ICF, includes *cognition – understanding and communicating*, as a domain (Richardson et al, 2015). Moreover, generic QOL instruments may evaluate aspects of the 'activities and participation' domain but do not encapsulate all components (Perenboom and Chorus, 2003). This suggests a need to compare ICF domain-specific content of QOL measures in addition to examining QOL tools individually, and where possible, in relation to their specific subscales (Stevanovic et al., 2016).

Environmental Factors. This domain encompasses the physical, social and attitudinal surroundings in which individuals conduct their lives. The CHD literature has focused primarily on social support as a construct, with studies identifying a strong

positive rehabilitation between perceived social support and enhanced coping (Roohafza et al., 2012; Kähkönen et al., 2017; Leifheit-Limson et al., 2012). Environmental mechanisms that link social support and cardiovascular symptoms include connections with friends and family, engagement in physical exercise (Lindsay Smith et al., 2017) and healthy eating (Luszczynska and Cieslak, 2009). Social support has also been associated with reduced psychological distress and minimised cardiovascular reactivity to stressful events (Roohafza et al., 2012; Nausheen et al., 2007). Conversely, the absence of social or marital support are significant predictors for poor prognosis in cardiac patients, independent of other risk factors (Compare et al. 2013).

There is, however, heterogeneity in the way that social support is operationalised in cardiac rehabilitation. For example, some instruments (e.g. the SF-36) focus on social capabilities and functioning whereas others (e.g. WHOQOL-BREF) address satisfaction with social relations (Huang et al., 2006). In their systematic comparison of six instruments that assess ICF environmental components, Alvarelhao et al. (2012) found that measures differed in both the content and type of assessment: some explore the presence or absence of environmental factors whilst others assess the intensity of the impact of these factors. These findings highlight the need for further research to support the measurement of environmental factors in the CHD cohort. This includes a need to identify which ICF environmental categories have been explored in this literature in addition to those categories that are yet to be captured.

Personal Factors. This domain refers to an individual's background, including factors that are not directly part of a health condition (WHO, 2012). Although, due to individual and cultural variations, this component is yet to be classified into specific

categories in the ICF, relevant factors to CHD include gender, race, age, fitness, lifestyle, coping styles and education. Gender differences in QOL have been highlighted in the CHD literature with studies reporting that females experience more physical and mental impairment following diagnosis than males (Gijsberts et al., 2015; Ford et al., 2008). Low socioeconomic background, lower level of education and older age groups have also been associated with reduced QOL following coronary procedures (Daoulah et al., 2017; Barbareschi et al., 2009). The extent to which these personal factors affect QOL in the CHD population as compared to controls groups is yet to be investigated.

Summary

In summary, the impact of CHD on QOL has been examined by a multitude of studies, utilising multifaceted measures. The ICF provides a biopsychosocial framework with which to analyse this literature, helping to identify QOL domains that are most affected by CHD. However, it is important that research examines domain-specific differences in QOL whilst also accounting for variation in the QOL measures utilised. Ideally, a quantitative examination of QOL differences between CHD cohorts and comparison groups, including the general population and other chronic illness groups, is needed to clarify the relative impacts of CHD on QOL. This pooled data would help inform subsequent treatment and direct rehabilitation processes towards areas that require most intervention for this population (Franzen-Dahlin et al., 2010).

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Article

Title

Quality of Life and Coronary Heart Disease: A Meta-analytic Comparison with Control Groups

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Author note: This article is intended for submission to the Journal of Health Psychology which adheres to the SAGE Harvard reference style. The attached article meets the thesis requirement of 6,000 words but exceeds the maximum word limit required for article submission. The journal guideline is for a maximum of 6,000, including references and an allowance of 500 words per table and figure, although longer articles may be considered at the discretion of the Editor.

Abstract

Quality of life (QOL) is an important outcome measure in adults with coronary heart disease (CHD). However, research investigating the relative impacts of CHD on QOL is characterised by inconsistencies in QOL measurement and the use of comparison groups. Framed by the International Classification of Functioning Disability and Health, a meta-analysis of 14 studies assessing QOL in 4,040 adults with CHD compared with 48,270 individuals from the general population or 434 persons with another health conditions, was performed. Single studies identified lower self-reported ratings for those with CHD across QOL domains; however pooled effect estimates were not significant. Further research is needed to confirm these results and determine longitudinal changes in QOL following CHD.

Keywords

Coronary heart disease, Quality of life, Control groups, General population, Chronic conditions

Introduction

Coronary heart disease (CHD) is a condition caused by the accumulation of atherosclerotic plaque in the interior walls of coronary arteries, resulting in decreased blood flow to the heart. CHD is responsible for about one-third of all deaths in people over age 35 worldwide (Benjamin et al., 2017; Nichols et al., 2014; Rosamond et al., 2008). This condition not only represents a significant disease burden in western societies but has also been identified as a growing epidemic in low and middle-income countries (Gaziano et al., 2010). The disease burden of CHD is amplified by its significant health management costs, estimated to be $USD 188 billion or $AUD 2028 million (Nelson & Whitsel, 2016; AIHW, 2014). These estimates are likely to increase exponentially due to the rapidly ageing population and increasing incidence of CHD risk factors, namely diabetes and obesity (Pandya et al., 2013). In sum, CHD is one of the greatest health-related challenges facing patients, health professionals and the broader society.

The burden of illness caused by CHD, including its socioeconomic and personal impact, is often estimated using quality of life (QOL) measures. The World Health Organisation (WHO, 1995) defines QOL as an individual's perception of their life across broad domains including physical health, psychological state, level of independence, interpersonal relationships and the socio-cultural environment. A related concept is health-related quality of life (HRQOL), which refers to the perception of health or changes in health that affects an individual's physical, psychological and social functioning (Dickens et al., 2012; Karimi and Brazier, 2016). Research has indicated significant overlap between these two constructs, with evidence of their interchangeability (Karimi and Brazier, 2016). For this reason, the term QOL will be used

hereafter to broadly capture the physical, social and emotional wellbeing of the CHD population at large.

Investigations of specific QOL dimensions for adults diagnosed with CHD have revealed discrepancies across studies. These may, in part, reflect the multidimensional nature of QOL. Available QOL measures vary in the number and type of domains incorporated (e.g. nine subdomains in Short Form Health Survey [SF-36] vs. three domains in World Health Organisation Quality of Life – Brief Version [WHOQOL-BREF]; Table 1). Conceptual differences are also evident (e.g. 'psychological functioning' is defined as mood in the EuroQol-5D [EQ-5D] but also encompasses cognitive function and self-esteem in the WHOQOL-BREF). Notably, the aforementioned measures represent generic QOL tools, which are useful to generate general health profiles and compare different CHD interventions but may under-estimate QOL changes of particular importance to those with CHD (De Smedt et al., 2016). To address this criticism, researchers have developed disease-specific instruments, such as the Seattle Angina Questionnaire (Spertus et al., 1995) to capture particular aspects of CHD (e.g. myocardial infarction, angina), although these instruments are less frequently utilised in CHD research (Ware et al., 2016).

[insert Table 1 here]

These measurement discrepancies highlight the need to organise the existing information on QOL and CHD against an evidence-based framework. One such framework is the International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001). The ICF was developed by the WHO to provide an

international standardised ‘language’ on health status and functioning. It focuses on the dynamic interaction between four domains. Specifically, *body structures and function* - or the physiological and emotional processes that occur within the human body, interact with functional limitations and restrictions in life *activities* and subsequent *participation* levels (Figure 1). These domains are determined by contextual variables – namely, one’s social and attitudinal *environment* alongside individual or *personal* variables (e.g. age, gender, beliefs etc.).

[insert Figure 1 here]

Operationalising QOL against the ICF not only helps to profile the functioning of people with CHD but also highlights areas for future research. For example, *exercise tolerance functions* (Bocalini et al., 2008), *energy and drive functions* (Schalock, 2004) and *sensation of pain* (Niv and Kreitler, 2001), all classified under *body structures and functions,* have been identified as key QOL issues for those with a chronic illness; however, research on these areas is largely characterised by single studies. *Emotional functions* also correlate significantly with QOL, with studies reporting the negative impact of depressed mood and anxiety symptoms in CHD aetiology, development, duration and patient outcome (Albus, 2010; Khayyam-Nekouei et al., 2013; Eng et al., 2011; Gu et al., 2016; Watkins et al., 2013). The relative mental and physical health impacts experienced by people with CHD however, remain unclear as the data comparing QOL between this cohort and control groups is conflicting. For example, Pettersen et al. (2008) reported clinically significant reductions for persons with CHD in comparison to national norms across most of the SF-36 subscales, whereas Soto Torres et al. (2004), using the same measure, reported comparable (non-significant) group ratings for the *physical functioning*, *general health perception* and *mental health* subscales.

These discrepancies may reflect the use of referenced population norms as comparative data. Generally, such data represent the performance of a defined population at a specific point in time, which may not account for sociodemographic factors (e.g. age, economic status, education) across different populations in addition to sociodemographic changes in these populations over time (De Smedt et al., 2015). Indeed, Pettersen et al. (2008) noted that SF-36 national norms were not available for subjects over 80 years old, which may have contributed to an overestimated mean difference between their CHD and normative samples within this age group. Moreover, normative values developed for the SF-36 have changed over time, with a recent study identifying that item means for a Norwegian population were lower (in relation to *physical functioning*, *physical role limitations*, *emotional role limitations,* and *general health*) and higher (in relation to *vitality*, *mental health*) on certain subscales in comparison to earlier norms (Garratt and Stavem, 2017).

The negative impact of CHD extends to *intimate relationships* (classified as *activities and participation*), with research identifying sexual dysfunction and dissatisfaction as contributing to low mood and reduced QOL (Dalteg et al., 2011). However, this data is largely based on single-CHD samples, thus the relative impacts of CHD on interpersonal functioning remain unclear. Limitations in *carrying out daily routine* and *moving around* also correlate with CHD symptoms, such as shortness of breath and fatigue (Duruturk et al., 2015) – although this is not a consistent finding. For example, De Smedt et al. (2015) reported significantly impaired mobility among their sample with CHD whereas Schweikert et al. (2009) reported improved mobility in people with CHD compared to the general population. This finding may, again, be partly

explained by the use of reference norms (in this case, the EQ-5D) that have not been standardised across different populations.

The measurement of *environmental* QOL components for those with CHD also requires attention. Studies have identified a strong positive association between perceived social support and enhanced coping. However, social support has been operationalised in different ways. Some studies have examined the amount of support received from friends, immediate family and health professionals, (Roohafza et al., 2012; Kähkönen et al., 2017; Leifheit-Limson et al., 2012) while others have focussed on one's ability to engage in interpersonal relationships (Floud et al., 2016; Sundquist et al., 2004). In addition, some instruments (e.g. the SF-36) focus on social capabilities and functioning whereas others (e.g. WHOQOL-BREF) address satisfaction with social relations (Huang et al., 2006). These conceptual differences highlight the need to examine individual subscales across available social support measures to avoid confounding the measurement of environmental barriers and facilitators.

To ensure a comprehensive understanding of how contextual factors contribute to QOL following CHD diagnosis, it is also important to consider factors that are not directly part of an individual's physical health condition (WHO, 2012). Although *personal factors* is yet to be classified by the ICF, psychological factors relevant to CHD include an individual's *self-perception* and *self-esteem* (Grotkamp et al., 2012). Indeed, a positive health perception and sense of control at time of discharge has been associated with high QOL three years post-discharge from cardiac rehabilitation (Lau-Walker et al., 2009). This highlights the importance of individual, personal variables in self-management and treatment adherence (DiMatteo et al., 2007; Redman, 2005; Grotkamp et al., 2012).

In summary, the CHD literature is characterised by conceptual differences in both QOL as a construct and the instruments utilised. In addition, the use of normative QOL comparisons confounds the available data. The distinct impact of CHD on QOL therefore remains unclear. This information is critical in order to identify targets for CHD treatment and rehabilitation (Franzen-Dahlin et al., 2010). The current meta-analysis addresses these research gaps by utilising the ICF as a framework to map QOL components relevant to CHD, thus guiding the selection of appropriate clinical measures. The primary research question for this meta-analysis is: *To what degree do adults with CHD differ across QOL domains and subdomains, as defined by the ICF, in comparison to peers sourced from the general population or those living with other chronic health conditions*?

Method

Literature Search

A comprehensive search of the Embase, PsycINFO and PubMed databases was undertaken to obtain studies that examined QOL in persons with CHD relative to an independent control group (e.g. general population or other health condition group). Databases were searched from inception (Embase 1947; PsycINFO 1967; Pubmed 1996) to July 2017. In accordance with the PRISMA guidelines (Moher et al., 2009), the search strategy involved a list of key search terms relating to CHD (e.g. 'coronary heart disease', 'coronary occlusion') and QOL (e.g. 'quality of life, 'life quality'), with terms specifically tailored to the Emtree (Embase), Thesaurus (PsycINFO), and MeSH (Pubmed) vocabulary (see Table A, Supplementary Material). Search terms and procedures were checked for accuracy by a research librarian. In addition, the reference lists of eligible

studies and relevant CHD reviews were hand-searched (Foxwell et al., 2013; Dickens et al., 2012a). Although this process did not lead to the discovery of any new studies, it helped to ensure that all relevant papers were identified.

Eligibility Criteria and Study Selection

For a study to be included in this meta-analysis, it needed to: (a) recruit an adult sample (i.e. ages ≥ 18 years) with CHD, as determined by medical examination (e.g. electrocardiography, CT angiography), clinical interview (e.g. Braunwald clinical classification) (Calton et al., 1998), or patient reported information (e.g. symptom checklist). Studies also had to utilise (b) an independent group design, whereby individuals with CHD were compared to a control groups (i.e. individuals from the general population or those with other health conditions), in addition to (c) a validated QOL measure (see Table 1) (Thompson and Yu, 2003). Finally, studies had to (d) provide quantitative, parametric data to calculate standardised mean group differences in the form of Hedges' *g* (e.g. means, standard deviations); and (e) be published in English to ensure methodological rigour (Jüni et al., 2002). This included journal articles and protocol studies. Conference abstracts were included, provided that they reported sufficient parametric data for meta-analysis. Studies were ineligible if they included: (a) a range of chronic diseases and disabilities (e.g. CHD, obstructive pulmonary disease), where the data for participants with CHD could not be separately extracted; or (b) utilised normative QOL data as a comparison group, which may not necessarily control for potential sample confounds (e.g. age, sex) (Kendall et al., 1999). Authors of one article (Ferrucci et al., 2000) were contacted to obtain further data.

The initial literature search produced 10,777 potentially relevant studies, from which 1453 duplicates were identified and removed. The titles and abstracts of the remaining 9324 studies were re-screened against the eligibility criteria, resulting in 24 potentially eligible studies. Two reviewers (D.D. and P. J. T.) checked this subset of 24 studies and inter-rater agreement was unanimous. During this process, an additional 10 studies which utilised normative QOL data were excluded. The final sample therefore comprised of 14 independent studies, with no overlapping data identified (see Figure 2).

[insert Figure 2 here]

Data Collection and Preparation

In accordance with the PRISMA guidelines (Moher et al., 2009) a data extraction sheet was purposely constructed to collate key information from each study. This included: (a) study details (e.g. year, author); (b) demographic data (e.g. participants' age, relationship status); (c) sample characteristics (e.g. control group, recruitment source); (d) effect size data (i.e. means, SDs, sample Ns) and (e) QOL measure (e.g. SF-36). To facilitate data interpretation, individual measures were grouped according to the four ICF domains: *body functions and structures, activities and participation, environmental factors* and *personal factors* (see Table B, Supplementary Materials). Each domain comprises of chapters, which are further broken down into subdomains (Figure 3) (Geyh et al., 2007). The methodology outlined by Cieza et al. (2002) was used to identify and link QOL measures to the ICF. Details of this mapping process are summarised in Table C (see Supplementary Materials). Composite measures, which incorporate multiple ICF domains (e.g. SF-36 mental health component) were grouped and summarised separately to ensure that all relevant data were considered.

[insert Figure 3 here]

Study Evaluation

The conclusions of a meta-analysis are highly dependent on the quality of studies identified to estimate pooled effects (Greco et al., 2013). The methodological quality, or internal validity, of included studies was therefore evaluated using the *QualSyst* (Kmet, Lee & Cook, 2004). This 14-item tool examines the extent to which study design, conduct and analyses contribute to potential sources of error and bias in research. Each item, per study, was rated as 'Yes' (score of 2; criteria adequately addressed), 'Partial' (score of 1; criteria partially addressed), or 'No' (score of 0; criteria not addressed'). Three criteria specific to intervention studies - *Random allocation, Blinding of Investigators* and *Blinding of Subjects*, were not applicable to the observational data in this meta-analysis and were therefore removed. Two scores were calculated: a summary score for each study (score range: 0 to 22), reflecting the extent to which studies fulfilled each criteria, and the percentage of studies receiving scores of 2, 1, and 0 for each item. The author (J.L.) completed this quality appraisal.

Statistical Analysis

Effect size data was entered into and analysed using Comprehensive Meta-Analysis Software (CMA, Version 3, Englewood, NJ: Biostat Inc.). Standardised mean differences were calculated to estimate the extent to which CHD and control groups (i.e. general population or other health condition group) differed in self-reported QOL. Given the dissimilarity in sample sizes within and between studies, Hedges' *g*, which utilises a standard deviation weighted by sample size, was the most suitable estimate (Ellis, 2010).

Cohen's (1991) guidelines were used for the interpretation of *g*, whereby a small effect ≥ 0.2, a moderate effect ≥ 0.5, and a large effect ≥ 0.8.

The calculation and interpretation of *g* involved several steps. First, studies that used the same QOL measure were pooled. Second, effect estimates were grouped according to the ICF domain and subdomain they represented. If a study reported multiple effect estimates within a subdomain (e.g. SF-36 subscales of bodily pain and vitality for *body structure and functions*), a mean *g* was computed for that study prior to pooling. Pooled estimates were also weighted by the inverse of the variance (*dw*), or inverse of the standard error, which accounts for an upward bias associated with standardised mean differences based on small sample sizes (Borenstein, Hedges, Higgins & Rothstein, 2009). For ease of data interpretation, the direction of *g* was standardised so that a negative value reflected lower QOL among people with CHD in comparison to controls. Forest plots were generated to illustrate the distribution of effect sizes. The precision or accuracy of both individual and weighted effect sizes was determined by calculating ninety-five percent confidence intervals (95% CIs), with *p* values also calculated to determine the statistical significance of *g*. CIs provide a range of plausible values within which the true population mean difference lies while a *p* value < 0.05 is considered to be significant (Ellis, 2010).

A common limitation of meta-analysis is the 'file drawer' problem; a type of publication bias. Specifically, a meta-analysis which relies on published data may magnify the true effect estimate given that published data tends to rely on positive, significant results rather than negative or inconclusive results (Rosenthal, 1979). To account for this, fail-safe *N* statistics (N_{fs}) were calculated for both individual and weighted effect sizes. This statistic, based on the formula recommended by Lipsey and

Wilson (2001), provides an estimation of the number of unpublished studies with small effect sizes (i.e. g = 0.2) required to invalidate the calculated weighted effect size. In general, the larger the N_{fs} value, the more confidence one may have in the results (Zakzanis, 2001). In this meta-analysis, a N_{fs} was considered adequate if it exceeded the number of studies associated with an effect size.

It is also important to consider the level of heterogeneity in a meta-analysis. This was captured by the I^2 statistic, which reflects the percentage of variation across studies resulting from inter-study heterogeneity, rather than simple sampling error (Bowater & Escarela, 2013). An I^2 greater than 40% indicates moderate methodological/sample heterogeneity, with values over 70% suggesting substantial heterogeneity (Higgins & Green, 2011).

A random-effects model, which estimates the mean of a distribution of effects, was used for these analyses. This model accounts for the differences between studies caused by sampling error and study design (Borenstein, Hedges, Higgins & Rothstein, 2010). The use of such a model is warranted as there is heterogeneity in QOL as a construct (Karimi & Brazier, 2016). In addition, the CHD population is characterised by various comorbidities (Tusek-Bunc and Petek, 2016) and diverse sociodemographic backgrounds (Thornley et al., 2011).

The results of this meta-analysis were interpreted using a combination of these statistics. Specifically, differences in QOL ratings between the CHD and control groups were deemed significant if the weighted effect size: (a) was medium ($g \geq 0.50$) to large ($g \geq 0.80$); (b) associated with a 95% CI which did not include the value of zero; (c) $p <$

0.05; and (d) the N_{fs} score suggested that the findings were unlikely to be influenced by publication bias (i.e. *Nfs* > *Nstudies*).

Results

Study Characteristics

All 14 independent studies included in this meta-analysis were observational in design. This included 11 journal articles and three conference abstracts (Altintas et al., 2015; Lee et al., 2010; Tavella et al., 2011) published from 1997 to 2017. These studies originated from Asia ($N_{studies}$ = 4), Europe ($N_{studies}$ = 6), Canada ($N_{studies}$ = 1), Australia ($N_{studies}$ = 1) and the United States of America ($N_{studies}$ = 1). Alonso et al.'s pan-European study (2004) involved eight participating countries (see Table D in Supplementary Material for details). Three studies contributed to 64% of the sample with CHD (Lee et al., 2015; Tavella et al., 2011; Alonso et al., 2004), providing 13 out of 32 effect sizes. All studies recruited participants from single sources (i.e. single hospitals/clinics) with half being outpatients from the general community ($N_{studies}$ = 7) and half being hospital inpatients ($N_{studies}$ = 7).

Sample Characteristics

CHD groups. The 14 studies included in this review examined a pooled sample of 4,040 participants with CHD (see Table 2). Consistent with global data (Benjamin et al., 2017), there was a higher proportion of males (58%) than females (42%) with CHD, with an overall mean age of 60.3 years (SD = 4.6). The average employment rate was 54%, although this was based on limited data ($N_{studies}$ = 2). Additional health information

was not routinely reported. Only Lee et al. (2015) reported time since diagnosis whilst two studies (Lalonde et al., 2001; Lee et al., 2015) reported existing medical comorbidities (e.g. major depression, diabetes). Three studies (Claesson et al., 2003; Lalonde et al., 2001; Noelle et al., 2009) reported medication data (i.e. psychotropic or cardiovascular-related medications).

Control groups. The 14 studies contributed a total, pooled sample of 48,704 controls (Table 2). This comprised of 48,270 individuals described as the 'general community' population ($N_{studies}$ = 13), with six studies specifying that their control group comprised of 'healthy controls' ($N_{studies}$ = 7). Four studies also included comparisons with 434 participants living with another chronic medical condition: Parkinson 's disease, Peripheral Artery Disease, Panic Disorder Related Chest Pain or Dyslipidaemia. Routine sociodemographic information (e.g. relationship, education, employment status) was inconsistently reported and/or defined. Three studies (Westin et al., 1997; Unsar et al., 2007; Srivastava et al., 2017) controlled for potential sample confounds by matching participants on key characteristics (i.e. age, gender).

Group differences. The comparability of the CHD and control groups on key sample parameters was examined. There were significant group differences in age (t (18) = 4.17, p = .0006): participants with CHD were older than the general population. Differences in gender representation was also significant: the CHD group comprised a higher ratio of males than either control group (general population: $\chi^2(1) = 74.02$, p <.0001; other condition: $\chi^2(1) = 14.68$, p = .0001).

[insert Table 2 here]

Quality Appraisal

The average quality assessment score was 17.7 (SD = 5.34) out of a possible 22. Scores varied from a low 5 (Altintas et al., 2015) to a maximum of 22 (Alonso et al., 2004; Noelle et al., 2009; Seo et al., 2015), representing differences in data quality (Figure 4). For the most part, studies provided a clear description of their *objectives* (Criterion 1: 86% fulfilled), *experimental design* (Criterion 2: 93% fulfilled) and *method of comparison* (Criterion 3: 79% fulfilled). Specifically, selection bias was minimised with recruitment of both outpatients and inpatients occurring via telephone, mail and at medical or research clinics. Key participant *characteristics* (e.g. socioeconomic status) that can help to confirm the generalisability of findings were, however, not routinely described (Criterion 4: 57% fulfilled), with only 21% of studies outlining exclusion criteria (e.g. those with a history of severe mental disorder). Not all studies clearly defined and justified the use of their *outcome measures* (Criterion 5: 65% fulfilled). Importantly, the majority of studies had a sufficiently powered *sample size* to detect significant group differences (Criterion 6: 65% fulfilled); although there was potential attrition bias as only 36% of the studies reported response rates or the management of missing data. Most studies specified and justified their statistical *analyses* (e.g. adjusting for age; Criterion 7: 65% fulfilled), and provided *estimates of variance* (e.g. standard deviations; Criterion 8: 65% fulfilled). Potential *sample confounds* were controlled by either recruiting (age and gender) matched controls or presenting data from subgroup analyses (Criterion 9: 79% fulfilled). Finally, most studies sufficiently explained significant and non-significant *results* (Criterion 10: 72% fulfilled) in addition to explaining how *conclusions,* including clinical implications, were *supported* (Criterion

11: 93% fulfilled). In sum, internal validity of studies varied along a continuum of high to low, with the majority attempting to minimise potential methodological biases.

[insert Figure 4 here]

Differences in composite QOL scores between CHD and General Population

Eleven studies provided composite QOL scores, using nine individual measures that integrated various ICF domains and subdomains. The findings are summarised in Table 3, with effect sizes rank ordered from highest to lowest. Clinically significant and moderate to large group differences were noted: participants with CHD experienced reduced physical and psychological functioning compared to the general population. The largest mean difference was associated with the Quality of Life Questionnaire (QL; Westin, 1997), which assesses gastrointestinal, respiratory, neurological and muscular symptoms in addition to general health (e.g. appetite, body temperature). Interestingly, pooled effect sizes for the most commonly utilised measure, the SF-36 physical and mental component indices, did not yield significant findings and were characterised by substantial heterogeneity (I^2 > 70%). The remaining measures, Health Utility Index (HUI), WHOQOL-BREF, and National Institute of Health – Post-CABG Study - Quality of Life measure (NIH) were associated with small effects; findings that were also compromised by publication bias.

[insert Table 3 here]

Differences in QOL between CHD and General Population by ICF Domain

Body Structures and Functions. Eight individual studies, utilising three QOL scales or subscales, examined group differences in physical, cognitive and emotional

functioning (Table 4). The largest, clinically significant finding was associated with *heart functions*: those with CHD reported increased heart arrhythmia in comparison to controls. Individual studies also identified significant and large group differences for *emotional functions* and the *sensation of pain*, that is, individuals with CHD experienced higher levels of anxiety and depression in addition to thoracic pain. There was, however, considerable variation across different subscales with effect sizes ranging from small (SF-36) to large (WHOQOL-BREF). This variation was confirmed by the substantial heterogeneity index (I^2 > 70%). It is important to note that these latter findings were largely based on single studies, potentially resulting in spurious results.

[insert Table 4 here]

Activities and participation. Eight studies, utilising three different QOL measures, examined the impact of CHD on this domain (Table 5). Based on a single study, the largest mean difference was associated with *intimate relationships*: those with CHD reported reduced sexual interest compared to controls. The remaining subdomains, *recreation and leisure*, *moving around* and *carrying out daily routine*, were associated with small to medium group differences: those with CHD consistently reported more limitations on their daily activities (e.g. socialising, self-care). Significant between-study variation in effect estimates was noted with substantial heterogeneity identified. Specifically, the WHOQOL-BREF Social and Physical subscales, which assess relationship engagement and the impact of physical constraints respectively, yielded the largest effect estimates ($g \geq 1.1$). However, the generalisability of this data is questionable as it was based on a small cohort of adults with CHD ($N_{participants}$ = 40). Similarly, the ability to *carry out daily routine,* as assessed by the SF-36 produced varying results.

Those with CHD reported reduced capacity to perform daily activities (physical role limitations) in comparison to the general population, yet minimal difference in relation to activity limitations caused by psychological symptoms (emotional role limitations) ($p > 0.05$).

[insert Table 5 here]

Environmental Factors. Only Srivastava et al. (2017) explored group differences in the living physical environment, general environment (e.g. noise, air pollution), financial stability, recreation, transportation, and availability and accessibility of health and social services (as measured by the WHOQOL-BREF). Comparable QOL group ratings were noted for this domain ($g = 0.047$ [CI: -0.448, 0.355] $p > 0.05$, *Nf*s = 0).

Personal factors. Six studies investigated the personal impact of CHD on *self-perception* and *general health perception* (Table 6). Only Westin et al. (1997) reported a significant mean difference: those with CHD experienced lower self-esteem compared to peers sourced from the general population. Individuals with CHD also had lower expectations of their current and future health (as measured by the SF-36), although this was associated with a small effect size.

[insert Table 6 here]

Differences in QOL between CHD and other conditions

Four studies compared QOL between adults with CHD and adults with another health condition (Table 7). Those with CHD reported significantly higher QOL than peers with a progressive neurological condition, Parkinson's disease. Participants with CHD also reported higher QOL than those with Peripheral Artery Disease, a condition that

increases the risk of CHD. Comparable QOL ratings were noted in relation to other controls - panic disorder-related chest pain, and Dyslipidaemia; a condition involving abnormally elevated lipids in the blood stream. The generalisability of these findings is, however, questionable, given the limited dataset.

[insert Table 7 here]

Discussion

Key Findings

Framed by the ICF, QOL data from 14 independent studies, involving a pooled sample of 4,040 persons with CHD and 48,704 comparative controls, were analysed. Despite wide-ranging group differences across ICF subdomains, effect estimates were all unanimously in a negative direction: with single studies identifying significantly lower QOL among those with CHD. However, pooled estimates, where available, were generally non-significant, suggesting that impaired QOL is not necessarily reduced when compared with controls. Firm conclusions cannot be drawn in relation to the QOL impact of CHD relative to other health conditions given the limited available data in this area.

The finding that persons with CHD noted greater *body structures and functions* impairment (i.e. physical and mental health impairments) in comparison to healthy peers, particularly in relation to heart functions, thoracic pain, depression and anxiety, is to be expected as these have been identified as direct consequences of CHD (Khayyam-Nekouei et al., 2013; Tusek-Bunc and Petek, 2016). The small to large group differences noted for the *activities and participation* domain may, however, reflect conceptual differences between QOL measures. This included objective QOL concepts in the SF-36

(e.g. “Does your health limit you in bathing and dressing yourself?”) and subjective perceptions covered by the WHOQOL-BREF (e.g. “How satisfied are you with your ability to perform your daily living activities?”) (Huang et al., 2006; Hand, 2016). Given that cardiac symptoms and medication can directly affect sexual function (Dalteg et al., 2011), it is also not surprising that participants with CHD also reported difficulties in their *intimate relationships*. However, the higher level of mobility impairment (i.e. *moving around*) noted in this CHD sample, does conflict with Schweikert et al. (2009)’s findings. This may reflect potential selection bias in the latter study, which recruited participants who had previously undergone intervention and may have benefited from secondary prevention measures (e.g. physical exercise). Time since diagnosis may also explain this discrepancy, with research indicating a reduction in mobility problems over time (Le Grande et al., 2006a). This important contextual information was not routinely reported by included studies in this meta-analysis, preventing further investigation.

The current findings also highlight the need for further research in relation to the impact of the social *environment*, alongside *personal factors* on QOL for those with CHD. Preliminary research has identified a gap between the needs of people with CHD, including the importance of companionship, and the availability and accessibility of health services (Asadi-Lari et al., 2003). Specifically, those with lower socio-economic status also access health care services less frequently (Schröder et al., 2015). In addition, age and gender have been identified as influential factors, with older female individuals reporting poor QOL following CHD diagnosis in addition to a higher need for social support (Ford et al., 2008; Bak and Marcisz, 2014). Addressing these research issues will help tailor CHD interventions specifically to vulnerable individuals and/or communities.

Clinical Implications

The current findings highlight the need to consider an array of biopsychosocial factors in the management and treatment of CHD. Ideally, this holistic approach should begin soon after diagnosis. Indeed, Tully (2013) noted that the trajectories of recovery for individual patients need to be considered in the assessment process, given that physical QOL components often improve in a steady, linear direction whereas mental QOL components show early improvements that dissipate over time (Le Grande et al., 2006). It is also recommended that validated generic (e.g. SF-36) and CHD-specific (e.g. SAQ) measures be used in combination to obtain an initial understanding of patients' QOL concerns (Gierlaszyńska et al., 2016; Thompson et al., 2016). This can be supplemented with ICF-based tools such as the 'Rehabilitation Problem-Solving Form' (RPSF) (Steiner et al., 2002), which allows detailed assessment integrating both the patient's perspective and the professional views of clinicians. These tools ensure a holistic understanding, allowing clinicians to better tailor their interventions to individual needs.

It follows that multi-disciplinary interventions are essential in cardiac rehabilitation. This might include a program such as the 'Lifestyle Change Program' (LSCP) (Kreikebaum et al., 2011), which targets factors shown to affect physical (e.g. cholesterol levels) and mental functioning (e.g. perceived stress) following CHD (Davidson, 2012; Chida and Steptoe, 2009; Compare et al., 2013; Morris, 2001). The LSCP is a three-month intervention, including three weekly sessions that integrate monitored exercise, cooking classes, educational lectures, group support, stress management classes, music therapy and spirituality classes. Preliminary findings

indicated a significant decrease in mean scores on physical (i.e. cholesterol) and psychological (i.e. depression, perceived stress) symptoms (Kreikebaum et al., 2011).

Cognitive-behavioural approaches (CBT) have also demonstrated efficacy with this population (Ski et al., 2016; Lv et al., 2016; Talebi Amri et al., 2015). Psychological symptoms have been associated with decreased attendance and participation in cardiac rehabilitation (Broadbent et al., 2006; Prugger et al., 2017; McGrady et al., 2009). CBT targets symptoms of anxiety and depression which, in turn, enhance motivation and reduce misconceptions about the safety of physical activity. In addition, CBT can help to encourage productive behaviours for those with a chronic condition such as CHD, by reducing dysfunctional cognitions and increasing self-efficacy (Talebi Amri et al., 2015; Rutledge et al., 2013). It is recommended that effective CBT interventions are long-term (6-12 months), conducted in groups, and integrate specific behaviour change techniques (Gulliksson et al., 2011; Aghaei et al., 2015). For those with CHD, this might include relaxation, meditation and biofeedback training to lower blood pressure and decrease behavioural and emotional reactivity, ultimately reducing psychophysiological burden on the cardiovascular system (Nekouei et al., 2012).

The current study also identified issues around intimacy and sexual functioning in the CHD population, which research has associated with reduced self-esteem, relationship dissatisfaction, depression, and decreased QOL (Nascimento et al., 2013; Lai et al., 2011; Kriston et al., 2010; Steptoe et al., 2016). Issues with sexual functioning not only affect adults with CHD but also their partners (Steptoe et al., 2016). Steinke et al. (2013) recommends various standardised tools for sexual assessment in this population with a specific focus on sexual concerns, interest in sexual activity and level of previous sexual

engagement. Mc Sharry et al. (2016) have also suggested the implementation of systematic sexual counselling guidelines to assist health care professionals; however, there continues to be a gap between the attitudes of medical and health care practitioners and their professional responsibility to address patients' sexual issues (Kalka et al., 2013; Salehian et al., 2017).

Study limitations

The findings of this meta-analysis need to be considered in the context of methodological limitations that arose during data selection and analysis. In particular, analysis of potential socio-contextual and medical moderators was not possible given that the majority of studies did not report key sample characteristics. Notably, any subgroup analyses would not have been sufficiently powered to detect true QOL differences, given the small number of studies included in this review (Sedgwick, 2013). Further CHD research should explore the potential impact of female gender (Ford et al., 2008), lower socioeconomic status (Barbareschi et al., 2009) in addition to physical (e.g. peripheral artery disease) and psychological (e.g. depression) comorbidities (Tusek-Bunc and Petek, 2016; Eng et al., 2011) on QOL in people with CHD.

In addition, findings from the current study were based on cross-sectional data, preventing exploration of changes in QOL across the trajectory of CHD. Research suggests that QOL ratings vary across the spectrum of CHD care, from the early stages of diagnosis to acute care following surgical treatment and community rehabilitation (Strine et al., 2008; Busija et al., 2017; Wikman et al., 2011; Singh et al., 2017). Moreover, QOL domains are impacted differently across time, with the most severe mental health outcomes evident soon after CHD diagnosis (Le Grande et al., 2006; Martin

et al., 2007). Temporal relationships have also been noted between reduced self-esteem and the later development of mood difficulties in this cohort (Pawlowska et al., 2006; Carvalho et al., 2016), alongside lack of improvement in general health perceptions (Kiebzak et al., 2002; Soto Torres et al., 2004). Longitudinal research is, therefore, needed to investigate the changes in these QOL correlates and identify targets for intervention at different timeframes across the trajectory of CHD.

Conclusion

This meta-analysis is the first to collate existing data comparing QOL ratings in the CHD population with control groups. Single studies confirm that the repercussions of CHD impact both physical and mental health functioning, helping to establish priorities for intervention. The findings support the need for multidisciplinary assessment and intervention in cardiac rehabilitation to enhance QOL, with potential positive effects on treatment adherence, self-management and social re-engagement. Future research is needed to confirm these findings and determine whether these QOL impacts change over time.

Acknowledgements

I would like to express my gratitude to my supervisors, Dr Diana Dorstyn and Dr Phil Tully, who have shared their knowledge throughout this process. I sincerely appreciate your patience, support and guidance. Your expertise will continue to inspire me in the years to come.

I would also like to extend my gratitude to Maureen Bell, the University's research librarian, for your assistance with database searches and construction of logical grids in early stages of research.

My sincere thanks to Professor Anna Chur-Hansen and Dr Helen Winefield for their support and encouragement, especially towards the final stages of this project, when additional challenges and time constraints created immense pressure.

Lastly, my gratitude goes to my family and partner, Thai Trinh, who have provided their support. Completion of this project would have been difficult without your humour, care and encouragement.

Declaration of conflicting interests

The Author declares that there is no conflict of interest

Funding acknowledgement

The research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Figures

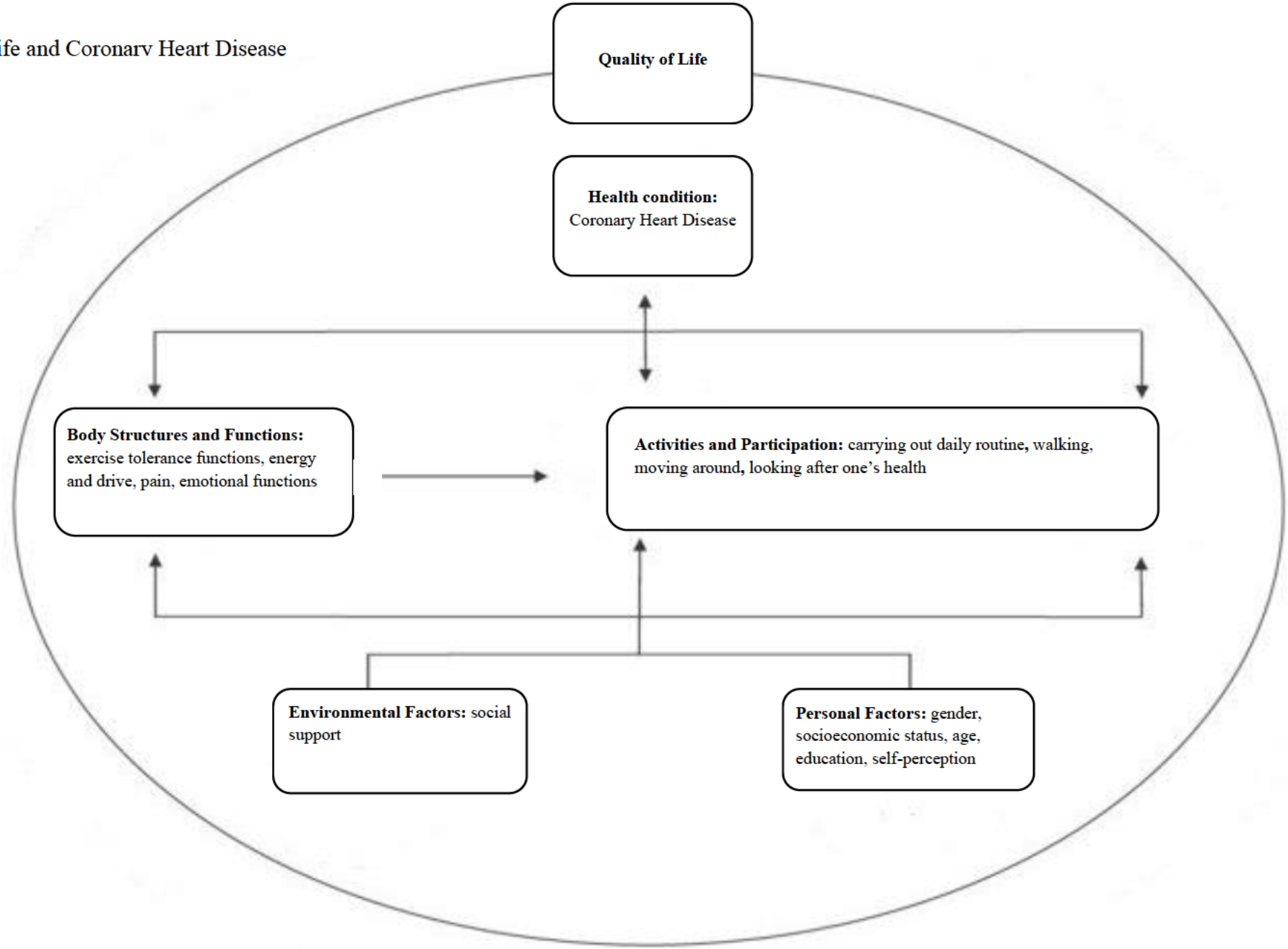


Figure 1. Quality of life in Coronary Heart Disease: The International Classification of Functioning and Disability

Adapted from McDougall, Wright, Schmidt, Miller & Lowry, 2011

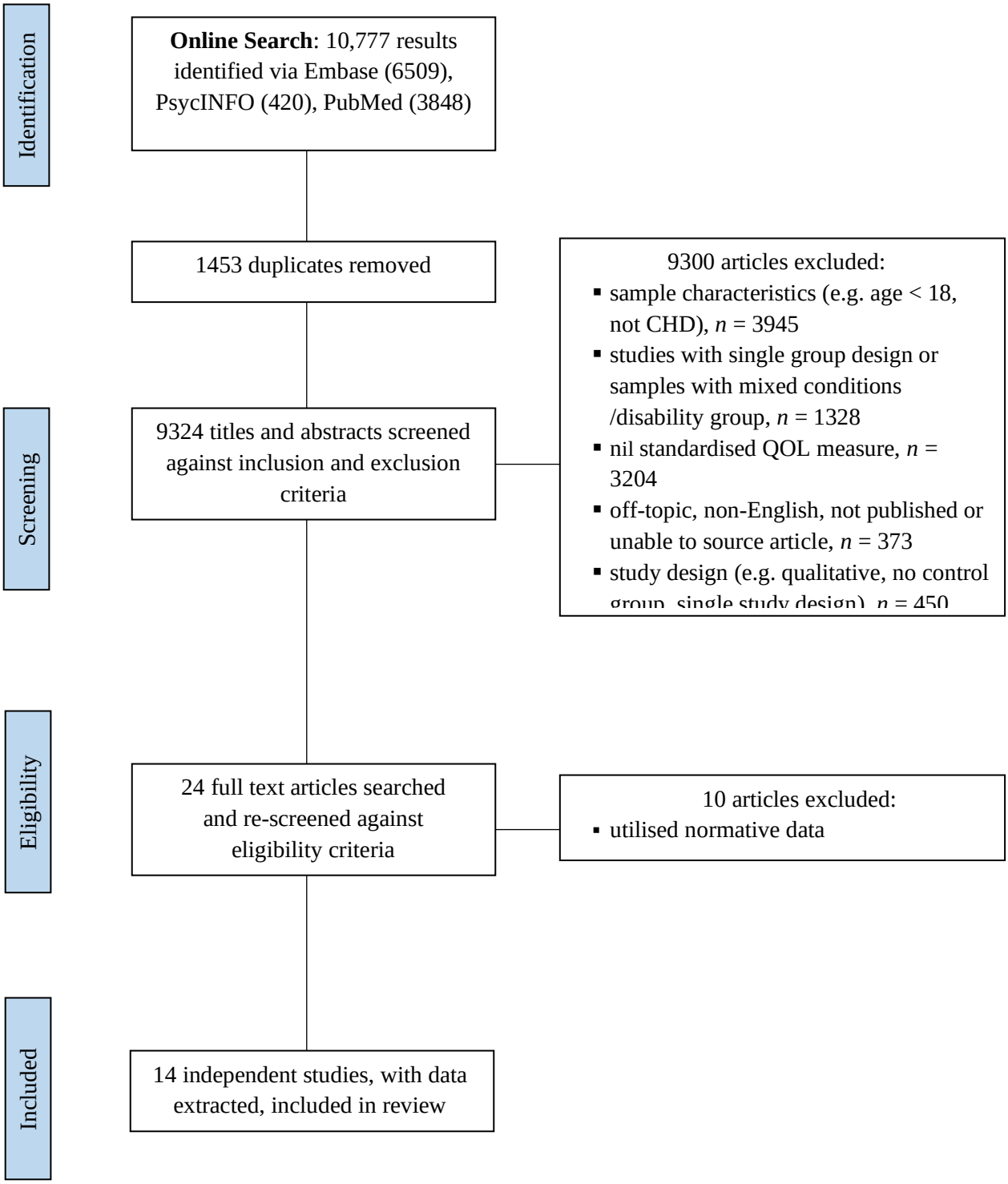


Figure 2. Flow diagram of study selection process.

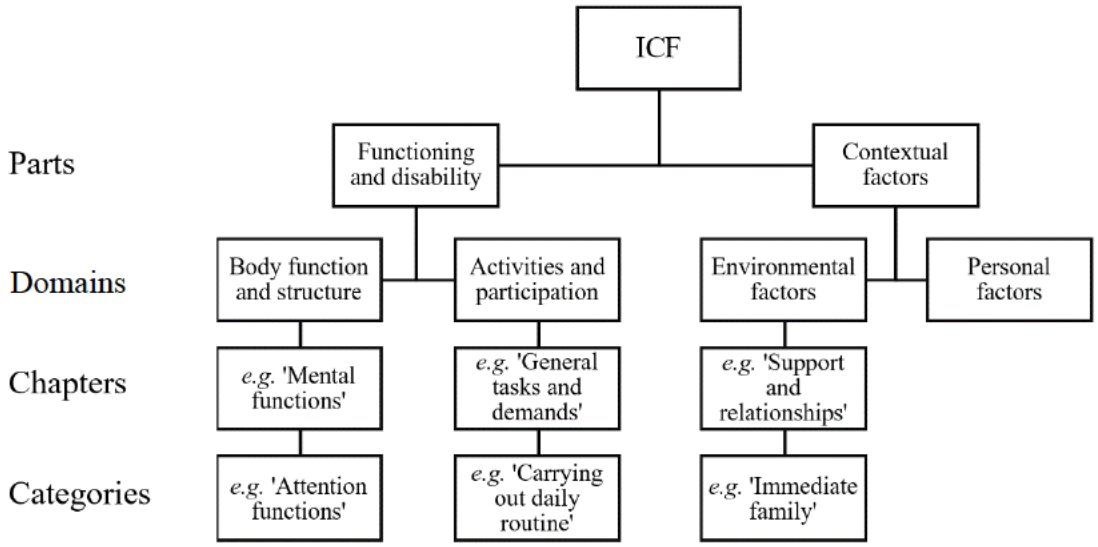


Figure 3. ICF domains, chapters and categories

Adapted from the World health Organisation (2013)

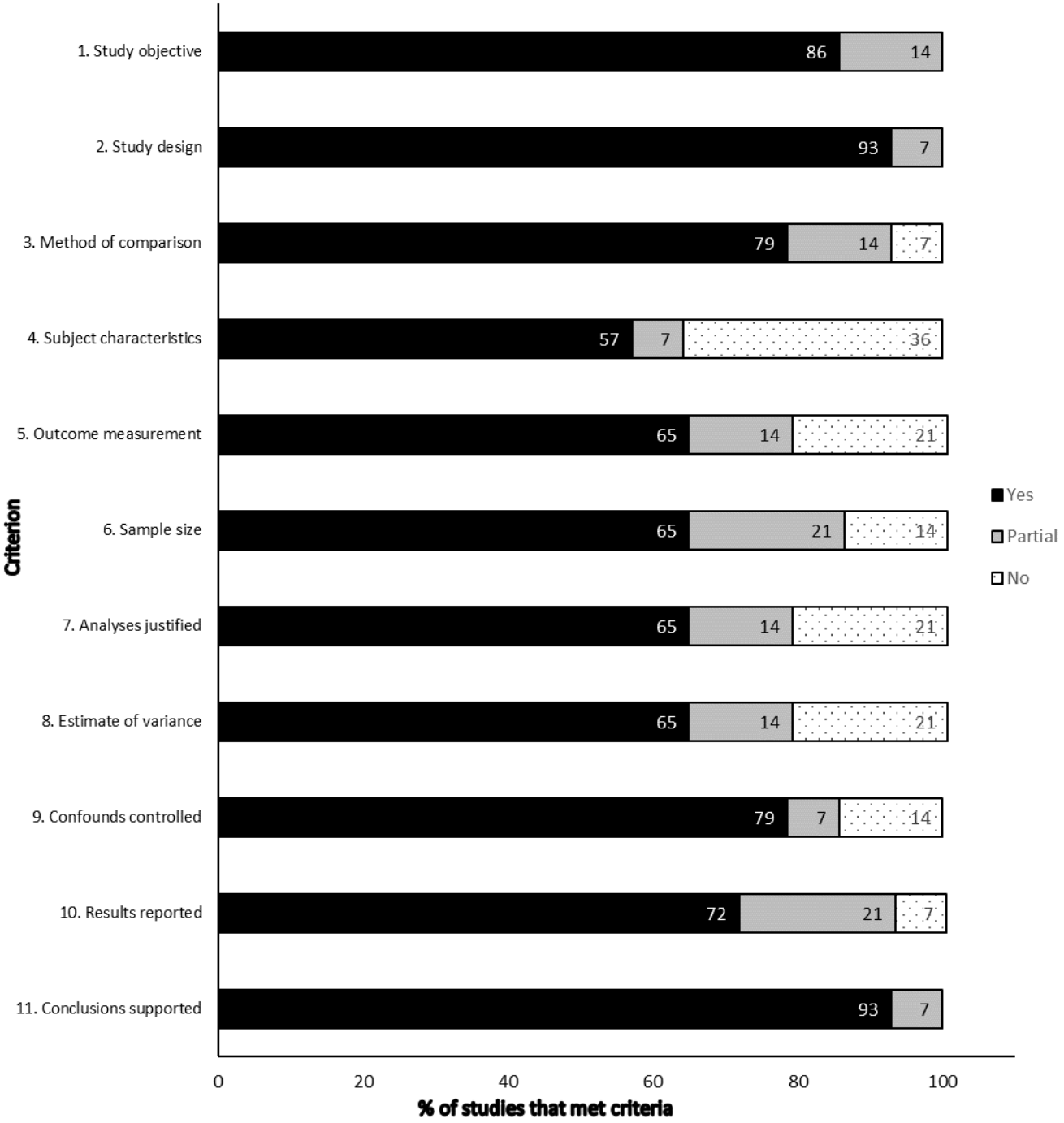


Figure 4. Quality rating of studies based on the *Checklist for Assessing the Quality of Quantitative Studies* (Kmet, Lee & Cook, 2004)

Tables

Table 1. Generic vs CHD-specific Measures

	Items	Domains	Research
Generic Measures			
SF-36	36	Physical functioning, role limitation – physical, role limitation – emotional, bodily pain, general health, vitality, social functioning, mental health	(Failde and Ramos, 2000)
WHOQOL-BREF	26	Physical, social, psychological, environmental	(Najafi et al., 2009)
EQ-5D	5	Mobility, self-care, usual activities, pain/discomfort, anxiety/depression	(Dyer et al., 2010)
SIP	68	Biological, psychological, social	(Thompson and Yu, 2003)
15-D	15	Mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort/symptoms, depression, distress, vitality, sexual activity	(De Smedt et al., 2016)
HUI 2	7	Sensation, mobility, emotion. Cognitive, self-care, pain, fertility	(Gencer et al., 2016)
HUI 3	8	Vision, hearing speech, ambulation, dexterity, emotion, cognition, pain	(Gencer et al., 2016)
QWB-SA	71	Mobility, physical activity, social activity, symptoms/problems	(Visser et al., 1994)
CHD-Specific measures			
SAQ	19	physical limitation, anginal stability, anginal frequency, treatment satisfaction and disease perception.	(Dougherty et al., 1998)
MacNew	27	Physical limitations, emotional function, social function	(Dempster et al., 2004)

Abbreviations. SF-36 = 36-item Short Form Health Survey; WHOQOL-BREF = World Health Organisation Quality of Life questionnaire – brief version; EQ-5D = EuroQOL group 5 Dimension Questionnaire; SIP = Sickness Impact Profile; HUI 2 = Health Utilities Index Mark 2; Health Utilities Index Mark 3; QWB-SA = Quality of Well-being Scale – Self-Administered; SAQ = Seattle Angina Questionnaire; MacNew = MacNew Heart Disease Health-Related Quality of Life Questionnaire

Table 2. Sample characteristics for participants ($N_{participants}$ = 52744, $N_{studies}$ = 14)

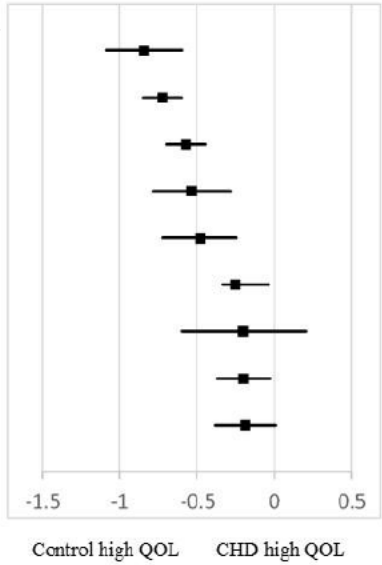
Variable	Total sample		CHD		General Population		Other Conditions	
	$N_{participants}$ (%)	$N_{studies}$	$N_{participants}$ (%)	$N_{studies}$	$N_{participants}$ (%)	$N_{studies}$	$N_{participants}$ (%)	$N_{studies}$
Sample size	52744 (100)	14	4040 (7)	13	48270 (92)	12	434 (46)	4
Age (in years)*	57.9 (5.8)*	14	60.3 (4.6)*	12	51.4 (4.8)*	8	62.2 (13.3)*	4
Gender								
Female	18083 (51)	7	880 (42)	9	17019 (52)	7	184 (42)	4
Male	17321 (49)	7	1213 (58)	9	15858 (48)	7	250 (58)	4
Relationship status								
Married/Partnered	20644 (69)	3	679 (76)	3	19965 (69)	3	-	-
Single/Divorced/Widowed	9318 (31)	3	220 (24)	3	9098 (31)	3	-	-
Employment Status								
Employed	217 (64)	2	76 (54)	2	102 (65)	2	39 (98)	1
Unemployed	120 (36)	2	64 (46)	2	55 (35)	2	1 (2)	1
Time since diagnosis (in years)*	959 (21)	2	6.8 (0.3)*	1	-	-	5 (5)*	1
Comorbidities							-	-
Other	315 (31)	2	315 (31)	2	-	-	-	-
No other	697 (69)	2	697 (69)	2	-	-	-	-
Recruitment Source								
Community-based	34381 (66)	6	1631 (40)	6	32750 (68)	6	291	2
Rehabilitation Centre/Hospital	569 (1)	4	503 (12)	4	63 (1)	1	89	1

Abbreviations. *N*participants = number of participants providing data. *N*studies = number of studies providing data. *CHD* = coronary heart disease.

Figures presented are *N* (%) except where indicated by * to be *M* (*SD)*.

Table 3. QOL composite scores: Standardised mean differences across individual and pooled measures

QOL measure	ICF Domains	$N_{studies}$	$N_{participants}$		g	g_w	95% CI		p	Nfs	I^2
			CHD	General			Lower	Upper			
QL general health	BF	1	266	88	-0.843*		-1.092	-0.595	0.000	3	
HALex	AP, PF	1	265	3350	-0.724*		-0.851	-0.598	0.000	3	
QWB - SA	BF, AP	1	265	3350	-0.571*		-0.697	-0.446	0.000	2	
EQ-5D	BF, AP	2	973	32251		-0.534*	-0.785	-0.282	0.000	3	91.60
SF-36 physical	BF, AP	6	2524	18143		-0.482	-0.722	-0.242	0.000	8	95.16
HUI-2/HUI 3	BF, AP	1	265	3350	-0.338		-0.042	-0.249	0.000	1	
WHOQOL-BREF	BF, PF	1	40	57	-0.199		-0.601	0.209	0.333	0	
SF-36 mental	BF, AP	6	2524	18143		-0.197	-0.367	-0.027	0.023	0	90.06
NIH	BF, AP, EF	1	198	206	- 0.184		-0.379	0.012	0.065	0	

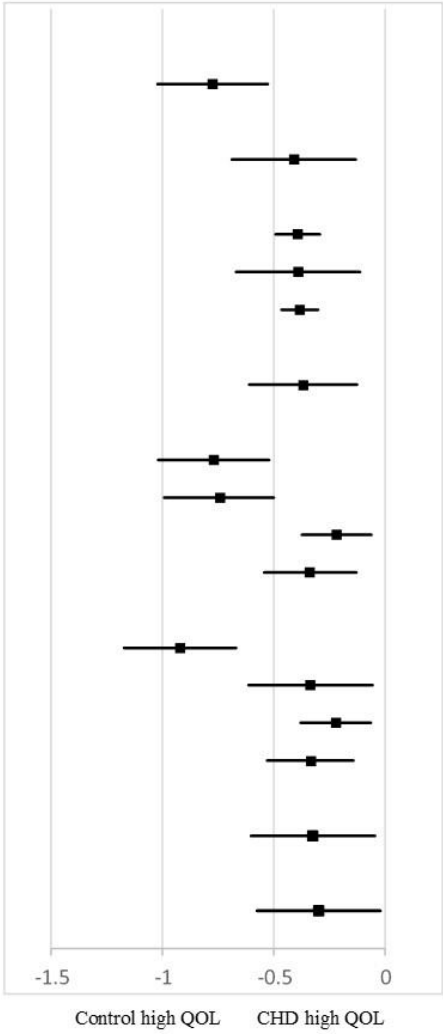


Abbreviations *N*participants = number of participants providing data. *N*studies = number of studies providing data; *CHD* = coronary heart disease; *General* = general population; BF = body functions; AP = activities and participation; PF = personal factors; EF = environmental factors; g = Hedges' g effect; CI = 95% confidence interval (with upper and lower limits), $p = p$ value associated with individual effect estimate, *Nfs* = fail safe N. * effect size met criteria for this review: $g \geq 0.50$; 95% CIs did not span zero; $p < 0.05$; *Nfs* > *N*studies

Measures abbreviations: QL = Quality of Life Questionnaire; HALex = Health and Activities Limitation Index; QWB-SA = Quality of Well-being Scale – Self-Administered; EQ-5D = EuroQol Group – health-related quality of life measure; HUI 2 = Health Utilities Index Mark 2; Health Utilities Index Mark 3; WHOQOL-BREF = World Health Organisation Quality of Life questionnaire – brief version; SF – 36 = 36-item Short Form Health Survey; NIH = National Institute of Health – Post-CABG Study measure

Table 4. Standardised mean differences across individual and pooled measures for ICF 'Body Structures and Functions' domain

Subdomain/ Measure	Subscale	$N_{studies}$	$N_{participants}$		g	g_w	95% CI		p	Nfs	I^2
			CHD	General			Lower	Upper			
Heart functions											
QL	arrhythmia	**1**	**266**	**88**	**-0.774***		**-1.021**	**-0.527**	**0.000**	**3**	
Memory functions											
15D	mental	**1**	**100**	**100**	**-0.410**		**-0.689**	**-0.131**	**0.000**	**1**	
Energy and drive											
SF-36	vitality	6	1605	12488		-0.392	-0.492	-0.293	0.000	6	32.06
15D	vitality	1	100	100	-0.391		-0.670	-0.113	0.000	1	
	Total	**7**	**1705**	**12588**		**-0.384**	**-0.465**	**-0.302**	**0.000**	**6**	**19.68**
Respiration functions											
QL	breathlessness	**1**	**266**	**88**	**-0.368**		**-0.610**	**-0.126**	**0.003**	**1**	
Emotional functions											
QL	anxiety	1	266	88	-0.770*		-1.018	-0.523	0.000	3	
QL	depression	1	266	88	-0.746*		-0.993	-0.500	0.000	3	
SF-36	mental health	5	1572	12453		-0.219	-0.374	-0.063	0.006	0	70.19
	Total	**7**	**1838**	**12541**		**-0.338**	**-0.543**	**-0.130**	**0.001**	**5**	**87.77**
Sensation of pain											
QL	thoracic pain	1	266	88	-0.921*		-1.171	-0.671	0.000	4	
15D	discomfort	1	100	100	-0.336		-0.614	-0.058	0.018	1	
SF-36	bodily pain	5	1572	12453		-0.221	-0.379	-0.064	0.006	1	70.34
	Total	**7**	**1938**	**12641**		**-0.338**	**-0.531**	**-0.144**	**0.001**	**5**	**85.23**
Hearing functions											
15D	hearing	**1**	**100**	**100**	**-0.325**		**-0.603**	**-0.047**	**0.022**	**1**	
Continence											
15D	elimination	**1**	**100**	**100**	**-0.299**		**-0.577**	**-0.021**	**0.035**	**0**	

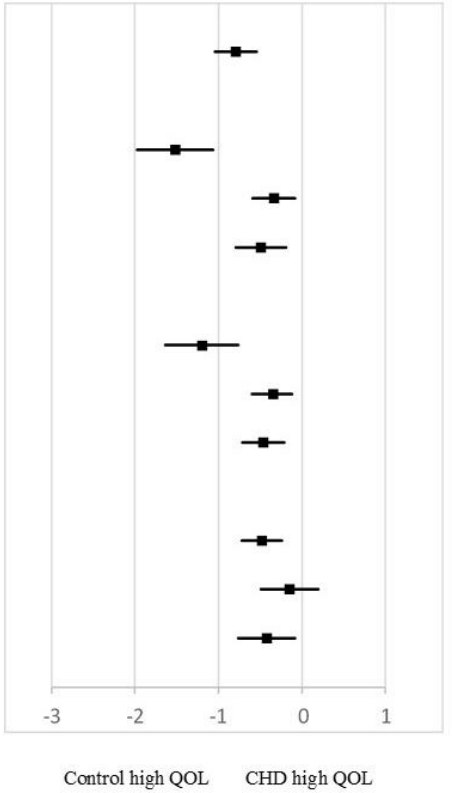


Abbreviations. *N*participants = number of participants providing data. *N*studies = number of studies providing data; *CHD* = coronary heart disease*; General* = general population; Hedges' *g* effect estimate; CI = 95% confidence interval (with upper and lower limits), *p* = *p* value associated with individual effect estimate, *Nfs* = fail safe N, * effect size met criteria for this review: $g \geq 0.50$; 95% CIs did not span zero; $p < 0.05$; *Nfs* > *N*studies

Measures abbreviations: QL = Quality of Life Questionnaire; 15D = The Health Related Quality of Life Instrument – 15 dimensions; SF – 36 = 36-item Short Form Health Survey

Table 5. Standardised mean differences across individual and pooled measures for ICF 'Activities and Participation' domain

Subdomain /Measure	Subscale	$N_{studies}$	$N_{participants}$		g	g_w	95% CI		p-value	Nfs	I^2
			CHD	General			Lower	Upper			
Intimate relationships											
QL	Sex life	**1**	**266**	**88**	**-0.792***		**-1.039**	**-0.544**	**0.000**	**3**	
Recreation and leisure											
WHOQOL	Social	1	40	57	-1.518		-1.972	-1.063	0.000	0	
SF-36	SF	5	1572	12453		-0.336	-0.593	-0.079	0.010	3	89.61
	Total	**6**	**1612**	**12510**		**-0.490**	**-0.789**	**-0.192**	**0.001**	**9**	**92.43**
Moving around											
WHOQOL	Physical	1	40	57	-1.199*		-1.634	-0.764	0.000	5	
SF-36	PF	5	1572	123453		-0.360	-0.599	-0.121	0.003	4	87.66
	Total	**6**	**1612**	**12510**		**-0.462**	**-0.716**	**-0.208**	**0.000**	**8**	**89.18**
Carrying out daily routine											
SF-36	PRL	6	1605	12488		-0.480	-0.718	-0.242	0.000	8	87.32
SF-36	ERL	6	1605	12488		-0.149	-0.494	0.196	0.397	0	94.31
	Total	**6**	**1605**	**12488**		**-0.421**	**-0.760**	**-0.082**	**0.015**	**7**	**90.85**

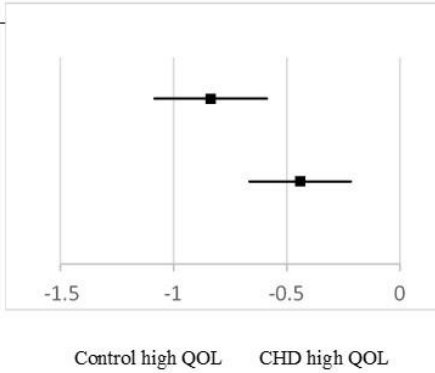


Abbreviations. *N*participants = number of participants providing data. *N*studies = number of studies providing data; *CHD* = coronary heart disease*; General* = general population; *g* = Hedges' *g* effect estimate; CI = 95% confidence interval (with upper and lower limits), *p* = *p* value associated with individual effect estimate, *Nfs* = fail safe N, * effect size met criteria for this review: $g \geq 0.50$; 95% CIs did not span zero; $p < 0.05$; *Nfs* > *N*studies

Measures abbreviations: QL = Quality of Life Questionnaire; WHOQOL-BREF = World Health Organisation Quality of Life questionnaire – brief version; SF – 36 = 36-item Short Form Health Survey; Social = Social Relationships; SF = Social Functioning; PH = Physical Functioning; PRL = Physical Role Limitations; ERL = Emotional Role Limitations

Table 6. Standardised mean differences across individual and pooled measures for ICF 'Personal Factors' domain

Subdomain/ Measure	Subscale	$N_{studies}$	$N_{participants}$		g	g_w	95% CI		p	Nfs	I^2
			CHD	General			Lower	Upper			
Self-perception											
QL	self-esteem	1	266	88	-0.836*		-1.084	-0.587	0.000	3	
General health perception											
SF-36	general health	5	1572	123453		-0.440	-0.664	-0.217	0.000	6	85.59

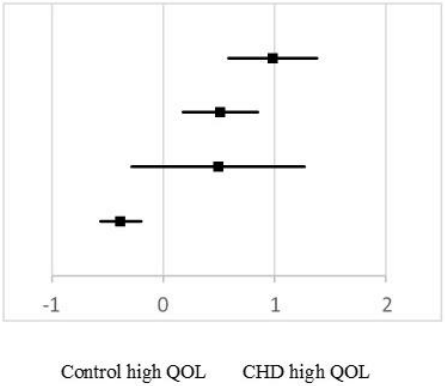


Abbreviations. *N*participants = number of participants providing data. *N*studies = number of studies providing data; *CHD* = coronary heart disease*; General* = general population; *g* = Hedges' *g* effect estimate; CI = 95% confidence interval (with upper and lower limits), *p* = *p* value associated with individual effect estimate, *Nfs* = fail safe N, * effect size met criteria for this review: $g \geq 0.50$; 95% CIs did not span zero; $p < 0.05$; *Nfs* > *N*studies

Measures abbreviations: QL = Quality of Life Questionnaire; SF – 36 = 36-item Short Form Health Survey

Table 7. Standardised mean differences for QOL scores: CHD vs Other Health Condition

Measure	$N_{studies}$	$N_{participants}$		Comparison	g_w	CI		p-value	Nfs
		CHD	Other			Lower	Upper		
SIP	1	54	54	Parkinson's	0.982*	0.585	1.378	0.000	4
SF-36	1	89	89	Peripheral Artery	0.510*	0.174	0.846	0.003	2
WHOQOL-BREF	1	40	40	Panic	0.491	-0.286	1.268	0.215	2
SF-36	1	320	251	Dyslipidaemia	- 0.388	-0.567	-0.200	0.000	1



Abbreviations: *N* participants = number of participants; *N*studies = number of studies providing data; *CHD* = coronary heart disease; *Other* = Other health condition; Parkinson's = Parkinson's Disease; Peripheral Artery = Peripheral Artery Disease; Panic = Panic Disorder Related Chest pain; CI = 95% confidence interval (with upper and lower limits), $p = p$ value associated with individual effect estimate, *Nfs* = fail safe N.* effect size met criteria for this review: $g \geq 0.50$; 95% CIs did not span zero; $p < 0.05$; *Nfs* > *N*studies

Measures abbreviations: SIP = Sickness Impact Profile; WHOQOL - BREF = World Health Organisation Quality of Life questionnaire – brief version; SF – 36 = 36-item Short Form Health Survey

Online Supplementary Materials

Table A: Search strategies for electronic databases

PubMed

AND →

Quality of life	Coronary heart disease
"quality of life"[mh] OR quality of life[tw] OR life quality[tw] OR life quality[tw]	"coronary disease"[mh:noexp] OR coronary disease [tw] OR coronary disease*[tw] OR coronary heart disease[tw] OR coronary heart disease*[tw] OR CHD[tw] OR ischemic heart disease[tw] or coronary artery disease[tw] OR coronary occlusion[tw] OR coronary stenosis[tw] OR coronary restenosis[tw]

PsycINFO

AND →

Quality of life	Coronary heart disease
exp quality of life OR quality of life.ti,ab OR quality of life.mp OR life quality.ti,ab	coronary heart disease.tw OR coronary heart disease.ti,ab OR CHD.ti,ab OR ischemic heart disease.ti,ab OR coronary artery disease.ti,ab OR coronary occlusion.ti,ab OR coronary stenosis.ti,ab OR coronary restenosis.ti,ab

Embase

AND →

Quality of life	Coronary heart disease
'quality of life':de OR 'quality of life':ab,ti OR 'life quality':ab,ti	'ischemic heart disease'/de OR 'ischemic heart disease':ab,ti OR 'coronary heart disease*':ab,ti OR 'coronary disease*':ab,ti OR 'CHD':ab,ti OR 'coronary artery disease':ab,ti OR 'coronary occlusion':ab,ti OR 'coronary stenosis':ab,ti OR 'coronary restenosis':ab,ti

Table B: Components of ICF domains

ICF Domain	Definition	Components
Body Structures and Functions	'Body structures' refer to anatomical parts of the body including organ, limbs and their components. 'Body functions' refer to physiological functions of body systems, which includes psychological functions.	Energy and drive functions Sleep functions Sensation of pain Heart functions Blood vessel functions Blood pressure functions Sensations associated with cardiovascular and respiratory functions Muscle power functions Muscle endurance functions
Activities and Participation	'Activities' describe the completion of a task or action by an individual. 'Participation' describe engagement in a life situation.	Carrying out daily routine Walking Moving around Looking after one's health Acquisition of goods and services Family relationships Intimate relationships Remunerative employment
Environmental Factors	'Environmental factors' include physical, social and attitudinal environment in which individuals live.	Products/substances for personal consumption Immediate Family Friends Acquaintances, peers, colleagues, neighbours and community members Health professionals, Individual attitudes of immediate family members Social security services, systems and policies
Personal Factors	These are not currently classified in the ICF but can encompass individual characteristics that are not directly part of a health condition.	Gender Age Race Education

Table C: Mapping of QOL measures

Measure/Item Number	Domain	ICF code/s
SF-36		
Physical Functioning		
The following items are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?		
3. **Vigorous activities,** such as running, lifting heavy objects, participating in strenuous sports	d	455, 430, 920
4. **Moderate activities,** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	d	445, 445, 920
5. Lifting or carrying groceries	d	430
6. Climbing **several** flights of stairs	d	455
7. Climbing **one** flight of stairs	d	455
8. Bending, kneeling, or stooping	d	410
9. Walking **more than a mile**	d	450
10. Walking **several blocks**	d	450
11. Walking **one block**	d	450
12. Bathing or dressing yourself	d	510, 540
Role Limitation – Physical		
During the **past 4 weeks,** have you had any of the following problems with your work or other regular daily activities **as a result of your physical health?**		
13. Cut down the **amount of time** you spent on work or other activities	d	230
14. **Accomplished less** than you would like	d	230
15. Were limited in the **kind** of work or other activities	d	230
16. Had **difficulty** performing the work or other activities (for example, it took extra effort)	d	230
Role Limitations – Emotional		
During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?		
17. Cut down the **amount of time** you spent on work or other activities	d	230
18. **Accomplished less** than you would like	d	230
19. Didn't do work or other activities as **carefully** as usual	d	230
Vitality		
How much of the time during the past 4 weeks...		
23. Did you feel full of pep?	b	152
27. Did you have a lot of energy?	b	130
29. Did you feel worn out?	b	130
31. Did you feel tired?	b	130

Mental Health		
24. Have you been a very nervous person?	b	152
25. Have you felt so down in the dumps that nothing could cheer you up?	b	152
26. Have you felt calm and peaceful?	b	152
28. Have you felt downhearted and blue?	b	152
30. Have you been a happy person?	b	152
Social Functioning		
20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	b d	152 920
32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?	b d	152 920
Pain		
21. How much bodily pain have you had during the past 4 weeks?	b	280
22. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	b d	280 859, 649
General health		
1. In general, would you say your health is:	nd	
33. I seem to get sick a little easier than other people	nd	
34. I am as healthy as anybody I know	nd	
35. I expect my health to get worse	nd	
36. My health is excellent	nd	

Measure/Item Number	Domain	ICF code
WHOQOL-BREF		
Physical Health		
To what extent do you feel that physical pain prevents you from doing what you need to do?	b d	280 230
How much do you need any medical treatment to function in your daily life?	d d	570 230
Do you have enough energy for everyday life?	b d	120 230
How well are you able to get around?	d	450, 455, 460
How satisfied are you with your sleep	nd	
How satisfied are you with your ability to perform your daily living activities?	nd	
How satisfied are you with your capacity for work?	nd	
Psychological		
How much do you enjoy life?	nd	
To what extent do you feel your life to be meaningful?	nd	
How well are you able to concentrate?	b	140
Are you able to accept your bodily appearance?	nd	
How satisfied are you with yourself?	nd	
How often do you have negative feelings such as blue mood, despair, anxiety, depression?	b	152
Social		
How satisfied are you with your personal relationships?	d	770
How satisfied are you with your sex life?	d	770
How satisfied are with the support you get from your friends?	e	575
Environment		
How safe do you feel in your daily life?	e	545
How healthy is your physical environment?	e	298, 260
Have you enough money to meet your needs?	e	165
How available to you is the information that you need in your daily-to-day life?	e	535
To what extent do you have the opportunity for leisure activities?	d	920
How satisfied are you with the condition of your living place?	e	155
How satisfied are you with your access to health services?	e	580
How satisfied are you with your transport?	e	540
Overall Quality of Life and General health		
How would you rate your quality of life?	nd-QOL	
How satisfied are you with your health?	nd-GH	

Measure/Item Number	Domain	ICF code
15-D		
Hearing		
I can hear normally, i.e. normal speech (with or without a hearing aid).	b	230
I hear normal speech with a little difficulty.	b	230
I hear normal speech with considerable difficulty; in conversation I need voices to be louder than normal.	b	230
I hear even loud voices poorly; I am almost deaf.	b	230
I am completely deaf.	b	230
Excretion		
My bladder and bowel work normally and without problems.	b	525, 620
I have slight problems with my bladder and/or bowel function, e.g. difficulties with urination, or loose or hard bowels.	b	525, 620
I have marked problems with my bladder and/or bowel function, e.g. occasional 'accidents', or severe constipation or diarrhea.	b	525, 620
I have serious problems with my bladder and/or bowel function, e.g. routine 'accidents', or need of catheterization or enemas.	b	525, 620
I have no control over my bladder and/or bowel function.	b	525, 620
Mental Function		
I am able to think clearly and logically, and my memory functions well	b	144
I have slight difficulties in thinking clearly and logically, or my memory sometimes fails me.	b	144
I have marked difficulties in thinking clearly and logically, or my memory is somewhat impaired.	b	144
I have great difficulties in thinking clearly and logically, or my memory is seriously impaired.	b	144
I am permanently confused and disoriented in place and time.	b	114
Discomfort		
I have no physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	b	280
I have mild physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	b	280
I have marked physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	b	280
I have severe physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	b	280
I have unbearable physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	b	280
Vitality		
I feel healthy and energetic.	b	130
I feel slightly weary, tired or feeble.	b	130
I feel moderately weary, tired or feeble.	b	130
I feel very weary, tired or feeble, almost exhausted.	b	130
I feel extremely weary, tired or feeble, totally exhausted.	b	130

Measure/Item Number	Domain	ICF code
QL questionnaire	nd	
General health symptoms of gastrointestinal, respiratory, neurological and muscular origin, together with some general items (e.g. appetite, subjective body temperature, 'feeling healthy')	b	280
Thoracic pain the presence of thoracic pain during various situations	b	140
Feeling of arrhythmia arrhythmia at rest and during exertion	b	440
Breathlessness breathlessness at rest and during exertion	b	152
Anxiety based on the STAI	b	152
Depression based on the CPRS	d	770
Experience of sex life enjoyment and changes in interest secondary to disease	nd	
Self-esteem based on the McMaster Questionnaire		

Abbreviations: QL = Quality of Life Questionnaire; b = body structures and functions; d = activities and participation; e = environmental factors; nd = not definable

Table D: Summary of Study Characteristics

Lead Author	Country	Sample Size		Age (SD)		QOL measure	Recruitment	
		CHD	Control	CHD	Control		CHD	Control
Altintas (2015)	Turkey	31	87	60 (N/A)	51 (N/A)	SF-36	N/A	N/A
Alonso (2004)	Mixed European countries	1047	11196	N/A	N/A	SF-36	N/A	N/A
Claesson (2003)	Sweden	198	100	61	N/A	NIH	Outpatient services	Community data
*De Graaff (2002)	Netherlands	89	89	60 (11)	72 (13)	SF-36	Hospital inpatient	Outpatient services
*Ferrucci (2000)	Italy	54	54	73.9 (7.35)	74.7 (4.41)	SIP	Outpatient services	Outpatient services
**Lalonde (2001)	Canada	320	307 GP 251 OHC	62 (9)	48 (12) N/A	SF-36	Outpatient services	Hospital outpatients
Lee (2010)	Hong Kong	33	35	N/A	N/A	SF-36	Hospital inpatients	Elderly centre
Lee (2015)	Korea	708	28901	63.5 (15.96)	44.5 (32.2)	EQ-5D	Outpatient services	Community data
Noelle (2009)	US	265	3350	69.9 (10.2)	58.9 (N/A)	SF-36, QWB-SA, HUI, EQ-5D	Outpatient services	Community data
Seo (2015)	Korea	85	63	52.6 (10.2)	63 (48.7)	SF-36	Hospital inpatients	Community data
**Srivastava (2017)	India	40	57 GP 40 OHC	53.9 (9.4)	50.7 (10.4) GP 47 (14) OHC	WHOQOL-BREF	Outpatient services	Psychiatric outpatients
Tavella (2011)	Australia	828	3168	62 (11)	52 (15)	SF-36	Hospital inpatients	Community data
Unsar (2007)	Turkey	100	100	57.9 (11.1)	57.5 (12.3)	15D	Outpatient services	Outpatient services
Westin (1997)	Sweden	296	88	60.3 (N/A)	N/A	QL	Hospital inpatients	Community data

Note. *Studies that compare CHD with other health conditions, **Studies that compare CHD with both the general population and other health conditions

Abbreviations: *N* participants = number of participants, CHD = coronary heart disease; *GP* = general population; OHC = other health condition; MONICA = Monitoring of Trends and Determinants of Cardiovascular Disease

Measures abbreviations: QL = Quality of Life Questionnaire; HALex = Health and Activities Limitation Index; QWB-SA = Quality of Well-being Scale – Self-Administered; EQ-5D = EuroQol Group – health-related quality of life measure; HUI 2 = Health Utilities Index Mark 2; Health Utilities Index Mark 3; WHOQOL-BREF = World Health Organisation Quality of Life questionnaire – brief version; SF – 36 = 36-item Short Form Health Survey; NIH = National Institute of Health – Post-CABG Study measure

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Please consult the Editorial concerning "Publication Guidelines for Intervention Studies in the Journal of Health Psychology" by David F. Marks J Health Psychol January 2010 vol. 15 no. 1 5-7: http://hpq.sagepub.com/content/15/1/5.full.pdf+html The criteria for publication include the application of the CONSORT, TREND and PRISMA statements.

Brief reports
The Journal also publishes Brief Reports of up to 3,000 words. Brief Reports should include an abstract of 100 words, and may include a table or figure in lieu of 500 words of the 3,000-word maximum.

Article length and house style
Articles should be as short as is consistent with clear presentation of subject matter. There is no absolute limit on length but 6,000 words, including footnotes and reference list, is a useful maximum. Longer articles will be considered at the discretion of the Editor. Tables and figures count as 500 words each which should be attached as separate pages at the end. "INSERT HERE" signs should be noted within the text. The title should indicate exactly, but as briefly as possible, the subject of the article. It is essential that your literature review is completely up to date. Please check recent issues of the **Journal of Health Psychology** and other key journals to ensure that any relevant papers are cited. Papers that fail to do this will

be rejected. An Abstract should be at the start of the manuscript and not exceed **100 words** (in spite of what is stated on the ScholarOne website) accompanied by **five** keywords should be selected from the list provided on the JHP ScholarOne website. References are not numbered but appear in alphabetical order by first author surname.

To enable blind, impartial review, all documentation must be anonymized. A common error is to include the author's name in the Word document title, as in:

Smith (blind copy).doc

Such manuscripts will be rejected for re-submission in fully blinded fashion.

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Before submitting your manuscript, please ensure you carefully read and adhere to all the guidelines and instructions to authors provided below. Manuscripts not conforming to these guidelines may be returned.

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The Journal requires authors to have obtained ethical approval from the appropriate local, regional or national review boards or committees. Of particular importance are the treatment of participants with dignity and respect, and the obtaining of fully informed consent. The methods section of the paper must contain reference to the forum used to obtain ethical approval.

Authors must follow the Guidelines to Reduce Bias in Language of the Publication Manual of the American Psychological Association (6th ed). These guidelines relate to level of specificity, labels, participation, gender, sexual orientation, racial and ethnic identity, disabilities and age. Authors should also be sensitive to issues of social class, religion and culture.

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Any acknowledgements should appear first at the end of your article prior to your Declaration of Conflicting Interests (if applicable), any notes and your References.

All contributors who do not meet the criteria for authorship should be listed in an `Acknowledgements' section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, or a department chair who provided only general support. Authors should disclose whether they had any writing assistance and identify the entity that paid for this assistance.

7.1 Funding Acknowledgement

To comply with the guidance for Research Funders, Authors and Publishers issued by the Research Information Network (RIN), **Journal of Health Psychology** additionally requires all Authors to acknowledge their funding in a consistent fashion under a separate heading. Please visit Funding Acknowledgement on the SAGE Journal Author Gateway for funding acknowledgement guidelines.

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9.1 File types

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The text should be double-spaced throughout and with a minimum of 3cm for left and right hand margins and 5cm at head and foot. Text should be standard 10 or 12 point.

9.4.1 Your Title, Keywords and Abstracts: Helping readers find your article online

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9.4.2 Corresponding Author Contact details

Provide full contact details for the corresponding author including email, mailing address and telephone numbers. Academic affiliations are required for all co-authors. These details should be presented separately to the main text of the article to facilitate anonymous peer review.

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For guidance on the preparation of illustrations, pictures and graphs in electronic format, please visit SAGE's Manuscript Submission Guidelines.
Figures supplied in colour will appear in colour online regardless of whether or not these illustrations are reproduced in colour in the printed version. For specifically requested colour reproduction in print, you will receive information regarding the costs from SAGE after receipt of your accepted article.

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10.1 Proofs

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David Marks PhD: editorjhp@gmail.com

SAGE UK Style Guide

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http://www.uk.sagepub.com/repository/binaries/pdf/SAGE_UK_style_guide_short.pdf
(accessed 18 October 2017).

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2. Article opening material

2.1 Headings

1. Headings should have an initial capital with everything else lowercase, unless proper names.
2. Italics can be included in A heads (H1) if needed, e.g. mathematical symbol or genus name.
3. Headings are unnumbered and formatted as below.
4. Where headings are referred to in the text use section names, as headings are not numbered.

A head (H1) (bold with initial cap, all the rest lowercase)

> **Introduction**
>
> The mucosa of the small and large intestines is the largest reservoir of tissue macrophages (Mϕ) in both humans and mice.[1] Although Mϕ possess various

B head (H2) (italic with initial cap, all the rest lowercase)

> *Human samples*
>
> Human specimens of normal large intestine were obtained from normal tissues of three patients with colon cancer who had their large intestine resected for

C head (H3) (same as B head, but set as first line of paragraph, full out; italic with initial cap, all the rest lowercase, followed by a full stop. Following text runs on)

> *Single nucleotide primer extension.* The PCR product from bisulfite-treated genomic DNA was cleaned with ExoSAP (USB) prior to SNuPE reaction. For calibra-

Headings for Abstract, Keywords, Funding, Acknowledgements, Conflict of interest (in that order), References, Appendices are same as A head but smaller font size

> **Acknowledgements**
>
> We thank Dr van Lookeren Campagne (Genentech) for providing blocking mAb against CRIg (clone 14G8) and isotype control mAb (anti-ragweed).

(CEs: where a template is being used there is no need to format these. Where no template is being used, please format as bold/italic, but there is no need to mark the font sizes, TS will format.)

2.2 Article types

Where a journal displays article types, these should appear on the first page of each article, left aligned above the horizontal rule, and in italics.

General technical or research papers should be classified as *Original Article* (with uppercase initial caps) for STM, and *Article* for HSS. (Check with the PE, as there is some variation between journals.)

Other usual paper types are as follows: *Review Article, Case Study, Technical Note, Case Report*. Individual journals may also have other paper types, as agreed with the Editor. Where no particular convention has been agreed, *Original Article* should be followed for STM, and *Article* for HSS.

2.3 Article title

Please format with an initial capital only and remaining words lower case, unless proper names. Italics can be included where necessary (e.g. genus name). Run on subtitle after colon, with initial capital after colon.

2.4 Author names, affiliations, and corresponding address

Authors

List authors in the order that they appear on the manuscript. Authors' first name should be in full, middle names should be initials *without* full stops (e.g. Simon PS Sharma) and no spaces between multiple initials. No series comma before the 'and' before the final author name.

Affiliations

Affiliations should contain only the following: department *or* faculty, institution, country. Some HSS journals may have institution and country only. Do not include titles, positions, qualifications, street names, or postcodes/zip codes. Affiliations should *not* end in a full stop.

STM: author names should be annotated with superscripted numbers (CE: do not use automated endnotes against names and affiliations). If all authors are at the same affiliation no superscript numerals are required. Affiliations appear separately with the corresponding address at the bottom of the right column (see next page):

Mark A Creager[1], Reena L Pande[1] and William R Hiatt[2,3]

HSS: affiliations should directly follow each author name, as follows:

Mark A Creager

(Department of Engineering,) Southampton University, UK

Reena L Pande

(Department of Engineering,) Southampton University, UK

William R Hiatt

County Hospital, CA, USA; Harvard Medical School, USA

Multiple affiliations are separated by a semi-colon.

Corresponding author

The affiliations and corresponding author information is positioned as follows:
Bottom of the right column on the first page of each paper, separated from the text with a horizontal rule (some exceptions apply for specific journals).

Corresponding author:
John Smith, Department of Social Studies, South Bank University, 4 Sample Road, London SE17 9OP, UK
Email: john.smith@sbu.ac.uk

STM: Affiliations and corresponding author details should appear as follows, bottom of right column.
HSS: corresponding author appears in the same position, minus the affiliations.

[1]Research Center Borstel, Leibniz-Center for Medicine and Biosciences, Borstel, Germany
[2]Microbiology Department, Chemical Faculty, Gdańsk University of Technology, Gdańsk, Poland
[3]Novartis, Basel, Switzerland

Corresponding author:
Sven Müller-Loennies, Research Center Borstel, Leibniz-Center for Medicine and Biosciences, Parkallee 22, D-23845 Borstel, Germany.
Email: sml@fz-borstel.de

Please remove any fax or telephone numbers, titles (e.g. Dr, Professor), positions (e.g. Senior Lecturer).

Please note: 'Email' with cap E and without hyphen. Email should start a new line. There *should* be a full stop after the country in the corresponding address.

Affiliations and corresponding address text should be left aligned, not justified, to avoid irregular spacing between words.

2.5 Abstract and keywords

Abstract should appear in bold without a colon, text should start on the next line, with no indent.

Keywords (all one word) should appear in bold without a colon. The keywords should start on the next line, separated by commas only, not semi-colons. The first keyword should have an initial cap.

Abstract
Anaphylaxis related to drug therapy with 5-HT3 antagonists, in particular, palonosetron has not been reported frequently in the literature. Here a case is presented where the patient possibly had an anaphylactic reaction to palonosetron. In this case report, a 40-year-old female with ovarian cancer developed shortness of breath and hypotension after receiving her palonosetron as part of her premedication for chemotherapy. The patient recovered successfully with fluids and supportive care. This case demonstrates that even after successful treatment in the past with palonosetron a patient may later develop a hypersensitivity to the agent.

Keywords
Palonosetron, anaphylaxis, hypersensitivity, 5-HT3 receptor antagonist

In some journals, Abstracts have sub-headings, e.g. Methods, Conclusion etc. These should be formatted in bold with a colon in bold and each sub-heading should start a new paragraph. The text should run on after each heading with an initial capital.

Submitted/accepted dates

For journals that publish received/revised/accepted dates (applies to specific journals, if unsure please check with the PE), this should appear after the Keywords and be formatted thus:

Date received 29 July 2010; reviewed 30 August 2010; accepted 5 November 2010

Keywords
H5N1, apoptosis, TRAIL, caspase-10

Date received: 30 March 2011; revised: 19 April 2011; accepted: 28 April 2011

2.6 Running heads

Recto: should be author surname(s), e.g. *Smith*, or *Smith and Jones*, or *Smith et al.* (for three or more authors, and et al. is also in italic).
Verso: full journal title in italic, followed by 0(0).
For IMechE journals: e.g. *J. Automobile Engineering 0(0)*, without the Proc. IMechE or journal letter).

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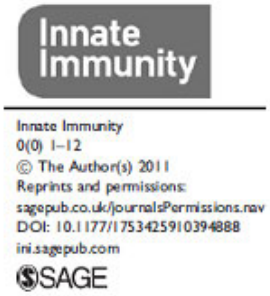
All papers in the standard SAGE design will have a journal logo in the top right with an imprint box underneath (although the logo may be missing on journals that are new to the SAGE design). The imprint box will contain the following information: journal name, vol/issue/page numbers (for papers in production, vol/issue are represented by 0(0), page numbers are the number of pages in the PDF, e.g. 1–9), copyright line, link to permissions web page, DOI, journal URL, SAGE logo:



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5. Any abbreviations needing to be spelled out should be listed after the caption, starting on the next line, in the following format: IC: internal combustion; PID: proportional–integral–derivative).
6. Captions are positioned below the figures and left aligned.
7. Captions should start, for example, **Figure 1.** (with a full point also in bold) and have a full point at the end. Where the text runs onto multiple lines, the captions need not be justified but should be aligned left.
8. Where figures have multiple parts, these should be labelled as (a), (b), (c), etc. (not A, B, C). Captions should contain subheadings for all parts if not present in the figure itself.
9. All figures should be numbered consecutively and cited in the text as Figure 1, Figure 2 etc. (Figure should be spelled out in full, not abbreviated).
10. Text citations: figures should be referenced in the text as follows: Figure 1, or Figures 1 and 2, or Figures 2 to 4, or Figure 1(a) and (b), or Figure 2(a) to (c). Where the figure citation is not part of the sentence it should be placed in parentheses.

Examples: Please see Figure 2 for an illustration of the model used The model used was an X3G standard type, exported from Germany (Figure 2 or see Figure 2).

3.3 Tables

1. Tables do not need to be a full column width or page width, but should be the appropriate width for the content. They will be laid out by the TS so no work is required by CEs on table layout, only on content.
2. Table headings should be left aligned, even when they relate to multiple columns, unless this creates confusion.

3. Tables should only have minimal horizontal rules for clarity, and no vertical rules (done by TS, no need for CE to format).
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7. Any abbreviations needing to be spelled out should be listed under the table (smaller font, TS will format), in the following format: IC: internal combustion; PID: proportional–integral–derivative.
8. General notes to the Table should be positioned below the Table, typeset in a smaller font and should start 'Note:', and end in a full stop. Do *not* add the word 'Note:' unless needed for clarity.
9. Footnotes should be represented in the table by superscript letters [a], [b], [c], etc., and appear below the Table (smaller font, TS will format). Each footnote should start a new line and end with a full stop. These notes should precede the source for the table, if included.
10. Captions are positioned above the table and left aligned.
11. Captions should start, for example, **Table 1.** (with a full point also in bold) and have a full point at the end. Where the text runs onto multiple lines, the captions need not be justified but aligned left.
12. Dates in Tables can be shortened to, for example, 4 Dec 10, if space is lacking. Do not use the form 04/12/10, as this could be confused as 12 April in US.
13. Normal text in columns should always be left aligned. Data in tables should be aligned on units if all the data in that column take the same units. Otherwise, the data should be left aligned. Units in table headings should be enclosed by parentheses, not square brackets (if any brackets are required at all).

3.4 Lists

1. For lists where items are not full sentences, use (a), (b), (c) etc. or bullet points (whichever is more appropriate) and separate items with semi-colons. Start list with a preceding colon and end list with a full stop.
2. For lists where items are full sentences or multiple sentences, use 1. 2. 3. Start list with a preceding full stop or semi-colon (whichever is more appropriate), and end list with a full stop.
3. List numbering/bullets should be full out and left aligned, with text indented and aligned. Lists should be separated from preceding/following text with a line space.
4. Where list items include headings, that heading should be italic, same size as text and end in a full stop. The following text should run on.

3.5 Maths/equations (see section 5, p. 14 for more details)

1. Equations should be left aligned with a 3 mm indent, *not* centred.
2. Equations can be broken at operator symbols (x, -, +, etc.), and continue on the next line, starting with the operator itself.
3. Equations should be separated from text above and below by at least one line space.
4. Any equation numbers should be enclosed in parentheses and right aligned, and aligned horizontally with the bottom line of the equation or equations, where multiple terms are covered by one equation number. (Not all equations need be numbered, see section 5).

General note: text following Figures, Tables, equations does not need to be full out with no indent. If the next block of text after any of these items is a new paragraph, then this may be indented.

3.6 Appendices

Maths notation list

1. Where present, notation should appear as Appendix 1, following the references. The heading *Notation* should be a B-head (not Notations; it is not plural).
2. Abbreviations list should be separated from mathematical notation under a separate B-head *Abbreviations*.

3. Notation should be listed in alphabetical order, English letters first, followed by Greek, followed by numbers, followed by symbols.
4. Subscripts and superscript should come under a separate C-head (italic and smaller font), and symbols should follow the same order as in point 2 above.
5. The Notation section does not need to be cited in the text, like other Appendices.
6. Notation list should be left aligned. Text in the notation section should be left aligned in general, not justified.
7. Please note that a notation list is not compulsory in mathematical papers, as long as all symbols are defined in the text.

Other appendices

1. Numbering of figures/tables/equations in Appendices should follow on from the numbering in the text.
2. All tables/figures should have captions.
3. All appendices should be cited in the text, e.g. (see Appendix 1). If they are not cited, authors need to be queried for a citation position.

3.7 Notes and footnotes

Textual notes

HSS

References: Vancouver style reference citations are represented as textual notes, as a numeral enclosed in a square bracket. Harvard style references are as follows (Smith, 1999).
Any other textual notes: are indicated by a superscript Arabic numeral placed *after* the punctuation. All textual notes should be collected and placed after the text and before the reference section with the heading **Notes**.

STM

References: Vancouver style reference citations are represented as textual notes, as a superscript Arabic numeral. Harvard style references are as follows (Smith, 1999).
Any other textual notes (whether references are Harvard or Vancouver) are indicated by a superscript Arabic letter and the corresponding footnote appears at the bottom of the relevant column.
In STM journals, footnotes should be edited into the text if appropriately and easily incorporated. However, please leave footnotes if this is not possible.

Authors' biographical notes

These should appear at the end of the paper with the heading **Author biography** (or **biographies**), in same font size as References/Funding etc. heading. Follow journal style.

3.8 Book reviews

Please check that the book details are given in this format at the top of each review.

Author, *title*, publisher: place, date of publication; 000 pp.: ISBN, price (hbk), ISBN, price (pbk)
Editor(s) (ed[s].), *title*, publisher: place, date of publication; 000 pp.: ISBN , price (hbk), ISBN, price (pbk)

4. Spelling, punctuation and formatting

4.1 Author style/voice

We will endeavour to keep the author's voice as much as possible:

1. Some authors write in the first person. CEs please note that we will *not* be taking articles out of the first person into the third person.
2. Where American authors have used American spellings, we should also endeavour to keep the author's grammar/punctuation, e.g. closed em-dashes instead of spaced en-dashes, single quotation marks within double, series comma etc.
3. Where UK authors have used –ise spellings throughout their papers in a consistent fashion, please do not change. Where there is inconsistency, use -ize.

4.2 General spelling rules

The general rules are as follows:

- UK spellings should be followed for European articles (-ise is acceptable)
- US spellings should be followed for North American articles
- Rest of the world – follow author style but make it consistent
- Canadian spellings should be standardized to UK or US, depending on author preference
- The following list shows some common exceptions to the '-ize' rule:

Samples							
advertise	arise	devise	enfranchise	expertise	merchandise	promise	surmise
advise	chastise	disenfranchise	enterprise	franchise	misadvise	reprise	surprise
affranchise	circumcise	disguise	exercise	improvise	premise	revise	televise
apprise	comprise	emprise	excise	incise	prise	supervise	treatise

Note also: analyse (for UK), catalyse, dialyse, paralyse.

Do not mix English and US spellings. Some common US variations in spelling:							
analyze	color	favor	fulfill	labor	license (noun)	program	traveler/traveling
behavior	counseling	fetus	gray	mold	pediatrics	practice (verb)	willful

Follow author style regarding use of the possessive's for proper names ending in s. However, 's is not used for classical names, e.g. Socrates' philosophy.

The following books are recommended: *Hart's Rules*; *Fowler's Modern Usage*.

4.3 Punctuation and formatting

Commas

- Follow author style but make consistent
- Oxford or series comma are not generally used; only use an Oxford/series comma if essential for clarity

Parentheses

These can be used throughout. Double sets of parentheses are acceptable, e.g. (see Figure 2(a)). Do not use square brackets in the text, except in the following circumstances.

Square brackets are used only to enclose an author's comment within a quote, e.g. [sic], [emphasis added]. Square brackets are also used for equations and mathematical expressions within the text.

Quotes

Use single quotes, with double quotes within quoted material. (See section 4.1 for exceptions for articles written by US authors.)

Hyphenation

The basic rule is to follow author style but be consistent.

Use of upper and lower case

Check the author's usage first, and make consistent. For specific titles use initial caps, for generic titles use lower case (useful pointers follow):

Institutions, movements, denominations, political parties:

- the Roman Catholic Church
- he has catholic tastes
- They were Bolsheviks
- bolshevism, communism

Titles, ranks:

- the President (referring to a particular one)
- the Spanish Foreign Minister
- a president
- several government ministers

Geographical names:
Capitalize politically defined or geographically named places, use lower case in all other instances.

- the West, the East
- western values, eastern culture
- South Africa
- the south of Scotland

Periods, events:

- Second World War
- rationing during the war

Article and book titles:
Follow the style used in the references.

Roman and italic usage

- Anglicized words should be roman with no accents (common examples follow):

Samples			
ad hoc	coup d'etat	laissez faire	post mortem
a priori	de facto	nouveau riche	raison d'etre
a propos	elite	op. cit.	sine qua non
avant-garde	en masse	per annum	status quo
bona fide	en route	per capita	vice versa
bourgeois/bourgeoisie	et al.	per se	vis-a-vis
cafe	in situ	post hoc	

- Words in other languages – follow author style and make consistent.
- Keep author's own emphasized words or phrases (in italic), unless excessive.
- General: usual italic rules applies, e.g. genus, species, relevant mathematical symbols, *x*-axis, *y*-axis, journal/book/magazine names, etc.

Quoted text
Spellings and punctuation in quoted texts should not be altered. If they are obviously incorrect, query with author or insert [sic].

Undisplayed quotes:
Short quotations should be indicated by single quotation marks, with double quotation marks for quotation material within the quote. A full point (or other punctuation) follows the reference for the quote, e.g. '… is the most decisive and important' (Smith, 2003).

Displayed quotes:
Lengthy quotes (40 words or more) should be displayed and indented, with a line space above and below, separating it from the text – follow journal style. Font size will be smaller (TS to format).

Money

For currency use the common symbol or abbreviation: £, US$, AUD$, etc. – where the quantity is stated, but not when the unit of currency is being referred to in general terms, examples follow:

- The price of oil rose to US$25 per barrel.
- The US dollar was at an all-time low.
- £150m, *not* millions or mlns.

Units in the text

1. Where units are referred to in the text in general terms, they should be written out in full.
2. Where a specific quantity is used, the abbreviated form of the unit must be used; e.g. the nails were several centimetres long; the nails were each 2 cm in length.
3. Always use numerals with the abbreviated unit and use abbreviated units wherever possible – in lists of statistics, in tables and line artwork.
4. Numeral and units should be separated by a thin space, i.e. 100 km, not 100km (this does not need to be indicated by the CE, the TS will format, PR/PE to check). NOTE: exception to the thin space rule applies for percent and degree symbols, i.e. 90% and 35.7°
5. Abbreviations of units are the same for singular and plural (do not add an s); they do not take a full point. E.g. 25 min, 55 s
6. Use SI units wherever possible (see specific Journal webpages for more specific notes).

Numbers

1. Spell out numbers one to nine; for numbers 10 and over use numerals, except at the beginning of a sentence. Re-work the sentence if necessary.
2. Use numerals with percentages (use the % symbol, not per cent or percent), with units, in statistical passages, in tables, etc.
3. Spell out and hyphenate one-half, two-thirds, etc.
4. Do not use a comma in 4-digit numbers (thousands) but do use one in 5-digit numbers (tens of thousands) and above, e.g. 5643; 1298; 14,600; 342,885; 1,000,001. Do *not* use a thin space.
5. Do not contract number ranges, e.g. page ranges and dates; i.e. use pp. 24–29, 13–15 October, 1981–1999 etc.
6. Decimal points are never raised off the line.
7. Do not mix spelled-out numerals and units: 6 cm not six cm.

Dates

1. Write out dates in text and refs as follows: 30 September 2003, except in Tables if space is short, then a shortened version may be used, e.g. 11 Sep 08 (do not use 11/9/08, as this could be confused in the US as 9th November).
2. Do not use an inverted comma in decades, e.g. 1960s, mid-1930s. Avoid 80s, etc.
3. Use numerals for centuries (except in history journals where it is spelled out), e.g. a 21st-century dilemma.

4.4 Abbreviations

General

1. Do not use abbreviations in the title of a paper, in the abstract, or keywords, unless the full version is very long and clumsy or the abbreviation is better known than the full term (e.g. DNA). Abbreviations may be used in headings and subheadings if they has already been defined previously in the paper at first usage. If in doubt, spell out.
2. Define an abbreviation the first time that it is used (except in the Abstract): write the term out in full followed by the abbreviation in parentheses. Use the abbreviation consistently thereafter, including at the start of sentences.
3. For plural terms, use plural abbreviations, e.g. low-density lipoprotein, LDL; low-density lipoproteins, LDLs.
4. If you need to abbreviate months or days of the week (for example, in a crowded table), use the first three letters without a full-stop (Mon, Tue; Jan, Feb).

5. If abbreviations are used in a figure or table, they must all be defined in the caption or in a Table note/footnote even if they are also defined in the text.
6. Do not use abbreviations invented by the author of a paper for that paper – ideally, only conventional, generally accepted abbreviations should be used.
7. Do not abbreviate single words (exceptions apply) or use two-letter abbreviations other than those listed below. (Two-letter engineering abbreviations are available in the IMechE Style Guide supplement).
8. Abbreviations consisting of capital letters, and acronyms and contractions, should not take full points, e.g. USA, UK, MA, UN, WHO, PhD, NATO (or Nato), UNESCO (or Unesco), AD, BC
9. Unfamiliar (but generally accepted) abbreviations should always be written out in full when first mentioned, with the abbreviated form following in parentheses, e.g. "The Confederación Española de Derechas Autónomas (CEDA) was formed". Thereafter use the abbreviation.
10. Contractions do *not* take a full point, e.g. Mr, St, Ltd, edn, Dr, neither do contracting degrees (Dr, DPhil, PhD, MSc). The following abbreviations take full points: no., Co., p., pp., vol., ch. (but use vols and chs), e.g., ed. (but use eds), et al., etc., i.e., cf., (note that this means 'compare' and not 'see'), n.d.
11. No comma after e.g., i.e. or cf. Etc. has a full stop and is usually preceded by a comma in a list. They may be used in lists or figure or table legends, and within parentheses.
12. In reference lists, notes, footnotes, corresponding author address (if required) and authors' biographical notes, please use the standard abbreviated form for American states (and Canadian/Australian territories). Please spell out in full in the text (see section 7.3 for full list of US state abbreviations).

Some journals use abbreviations that do not need to be spelled out, even at first usage. For a full list of abbreviations that do not need to spelled out for each individual journal, please visit the journal webpage.

STM abbreviations: some abbreviations of terms that we do not define in full are listed here (follow style given):

- SD = standard deviation
- SEM = standard error of the mean
- NS = not significant
- a.m. in the morning (but use 24-hour clock if possible)
- p.m. in the afternoon
- N/A = not applicable
- Chemical symbols (H_2O, H_2SO_4) may be used without definition. However, write in full unless this is inappropriate (e.g. 'Water consists of hydrogen and oxygen'; 'Nitric oxide is also found in peripheral nerves'). Refer to *Scientific terminology* notes for further guidance.

See the Appendix (pp. 26 and 27) for a full list of accepted general two-letter STM abbreviations and engineering abbreviations.

5. Technical content: maths, equations, etc.

5.1 Maths notation convention

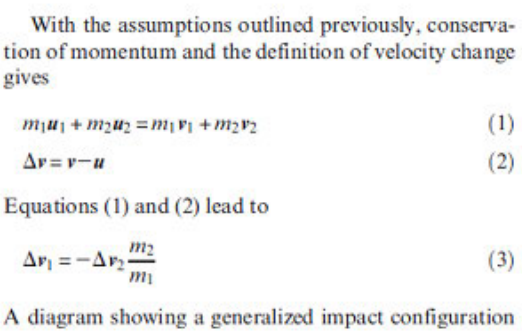
There is no specific convention for mathematical notation in terms of matrices, vectors, variables, operators, functions, subscripts, superscripts and scalars. CE please follow the author's symbols and notation conventions, ensuring that these are consistent throughout the paper.

Please query the author if any symbols are unclear, duplicated with more than one definition, or undefined.

5.2 Equations

Layout of equations

1. Equations should be left aligned on a 3 mm indent, *not* centred.
2. Equations should be numbered in sequence throughout the text, with the numbering continuing through all appendices. However, equations only need to be numbered if cited in the text, and not all equations necessarily need to be numbered.
3. Equation numbers should be set flush right and in sequence. Each numbered equation should have its own line.
4. No punctuation is used before or after an equation (i.e. no commas, colons, hyphens etc.)
5. The equation number should align with the *bottom line of equation*. Where the equation number covers multiple equations, it should align with the bottom line of the last equation.
6. When referred to in text, equations take the form 'equation (1)'. When a range of equation numbers is referred to, use the form: equations (1) and (2); equations (1) to (3); equations, (1), (2), and (5) to (7).



With the assumptions outlined previously, conservation of momentum and the definition of velocity change gives

$$m_1\boldsymbol{u}_1 + m_2\boldsymbol{u}_2 = m_1\boldsymbol{v}_1 + m_2\boldsymbol{v}_2 \quad (1)$$

$$\Delta\boldsymbol{v} = \boldsymbol{v} - \boldsymbol{u} \quad (2)$$

Equations (1) and (2) lead to

$$\Delta\boldsymbol{v}_1 = -\Delta\boldsymbol{v}_2 \frac{m_2}{m_1} \quad (3)$$

A diagram showing a generalized impact configuration

7. If two or more small equations or conditions can fit on one line, then they should be well separated with a 2-em space. Commas and words, set upright not italic, may be used to enhance clarity.
8. Equations in text must be reduced to one line depth. Display equations are built up to two line depth. For instance, the equation $(x - y)/(x^2 + 2y - 3)$ runs on in the text but for display becomes
$$\frac{x - y}{x^2 + 2y - 3}$$
9. CEs: Spaces between + and – and other operators need not be marked. TS will format.
10. Unless separating small equations and conditions, as shown above, odd words between equations such as 'where', 'and', 'thus', 'therefore' should be on a separate line from the equations and flush left. Only use initial capitals for these if they start a new sentence.
11. When a single equation has been presented with a label/header (e.g. 'momentum conservation equation', 'blade element momentum theory', etc.), present the label before the equation, full left, half-line above, and in roman.
12. Where an equation is too long to fit on one line, take over whole terms starting if possible with a + or – or = symbol, and indent.
13. Where a bracketed term has to be split over lines move the second part to the right to show it is still part of the same term (align to the right of the bracket).
14. Pairs of opening and closing brackets should be the same size, even when they are on different lines.
15. Where an equation breaks at an equals sign indent a further em in from the first line.
16. Where equations are split over 2 lines, the break should occur before the operator:

$$m_2(1+e_p)(U_{2p}-U_{1p})$$
$$=(m_1+m_2)\Delta v_1-m_1h_1\Delta\omega_1-m_2h_2\Delta\omega_2 \qquad (9)$$

5.3 Units

SI preferred. Expressions such as rpm, psi, cfm, gpm, mph, kph, tsi, revs should be avoided. Use instead r/min, lbf/in^2, gal/min, mile/h, km/h, ton/in^2, rotational speed, etc.

Notes: Greek μ in μm should always be roman; MPa and GPa should always have a capital P.

5.4 Symbols and operators

A thin non-breaking space should separate symbols and operators from numerals, and be present either side of multiplication dots and all operators, e.g. +, -, =, x, <, >, etc. (this does not need to be indicated by the CE, the TS will format)

Appendices and notation (see section 2.6, p. 7)

6. Appendices

6.1 General STM acceptable 2-letter abbreviations *(should be defined on first mention):*

AH	arterial hypertension	ML	maximum lysis
AP	anteroposterior	MR	magnetic resonance
AR	androgen-receptor	MS	multiple sclerosis
AS	ankylosing spondylitis	ND	no data
AT	anti-thrombin	NF	nuclear factor
BP	blood pressure	NK	natural killer
CE	centre–edge	OD	optical density
CF	cystic fibrosis	OR	odds ratio
CI	cardiac index	OS	overall survival
CI	confidence interval	PC	protein C
CO	cardiac output	PD	potential difference
CP	cerebral palsy	PD	progressive disease
CR	complete response	PE	probable error
CT	clotting time	PP	pulse pressure
CT	computed tomography	PR	partial response
ED	emergency department	PT	prothrombin time
ED50	median effective dose	RA	rheumatoid arthritis
EU	European Union	RA	right atrium
FA	fatty acid	Rh	rhesus
FA	folinic acid	RQ	respiratory quotient
FR	fixed ratio	RR	relative risk
GH	growth hormone	RR	response rates
GM	genetically modified	RT	room temperature
GP	general practitioner	RV	right ventricle
Hb	haemoglobin	SE	standard error
HR	heart rate	SV	stroke volume
IR	infrared	TB	tuberculosis
LD50	median lethal dose	TC	total cholesterol
LH	luteinising hormone	TF	tissue factor
LV	left ventricle	TS	thymidylate synthase
mAb	monoclonal antibody	TT	thrombin time
ME	medial epicondyle	UV	ultraviolet
ME	myalgic encephalomyelitis	VD	venereal disease
MI	myocardial infarction		

6.2 Engineering acceptable 2-letter abbreviations *(should be defined on first mention):*

AC/DC	alternating current/direct current	HC	hydrocarbon
A/C	air conditioning	KF	Kalman filter
AI	artificial intelligence	MR	magnetorheological
AI	auto-ignition	MR	magnetic resonance
CA	crank angle (also used as a unit of measurement)	MS	mass spectrometry
CC	combustion chamber	MW	molecular weight
CG	centre of gravity	NN	neural network
CI	compression ignition	NS	Navier–Stokes
CM	centre of mass	PI	proportional–integral
CV	cyclic variability	PM	particulate matter
DI	direct injection	*Re*	Reynold's number
EA	evolutionary algorithm	RF	radio frequency
EM	electromagnetic	RI	rollover index
EV	electric vehicle	SD	standard deviation
FE	finite element	SI	spark ignition
GA	genetic algorithm	TC	traction control
GT	gas turbine	UV	ultraviolet

SAGE Harvard Reference Style

6.1 SAGE Harvard

1. General

1. Initials should be used without spaces or full points.
2. Up to three authors may be listed. If more are provided, then list the first three authors and represent the rest by et al. Fewer authors followed by et al. is also acceptable.

2. Text citations

1. All references in the text and notes must be specified by the authors' last names and date of publication together with page numbers if given.
2. Do not use Ibid., op. cit., Infra., supra. Instead, show the subsequent citation of the same source in the same way as the first.
3. Where et al. is used in textual citations, this should always be upright, not italic.

Note the following for the style of text citations:

1. If the author's name is in the text, follow with year in parentheses:

... Author Last Name (year) has argued ...

2. If author's name is not in the text, insert last name, comma and year:

... several works (Author Last Name, year) have described ...

3. Where appropriate, the page number follows the year, separated by a colon:

... It has been noted (Author Last Name, year: page nos) that ...

4. Where there are two authors, give both names, joined by "and"; if three or more authors, use et al.:

... It has been stated (Author Last Name and Author Last Name, year) ...

... some investigators (Author Last Name et al., year) ...

5. If there is more than one reference to the same author and year, insert a, b, etc. in both the text and the list:

... It was described (Author Last Name, yeara, yearb) ...

6. Enclose within a single pair of parentheses a series of references, separated by semicolons:

... and it has been noted (Author Last Name and Author Last Name, year; Author Last Name and Author Last Name, year; Author Last Name, year) ...

Please order alphabetically by author names.

7. If two or more references by the same author are cited together, separate the dates with a comma:

... the author has stated this in several studies (Author Last Name, year, year, year, year) ...

Please start with the oldest publication.

8. Enclose within the parentheses any brief phrase associated with the reference:

... several investigators have claimed this (but see Author Last Name, year: page nos–page nos)

9. For an institutional authorship, supply the minimum citation from the beginning of the complete reference:

... a recent statement (Name of Institution, year: page nos) ...

... occupational data (Name of Bureau or Institution, year: page nos) reveal ...

10. For authorless articles or studies, use the name of the magazine, journal, newspaper or sponsoring organization, and not the title of the article:

... It was stated (*Name of Journal*, year) that ...

11. Citations from personal communications are not included in the reference list:

... has been hypothesized (Name of Person Cited, year, personal communication).

SAGE UK Style Guide

3. Reference list

1. Check that the list is in alphabetical order (treat Mc as Mac).
2. Names should be in upper and lower case.
3. Where several references have the same author(s), do not use ditto marks or em dashes; the name must be repeated each time.
4. Last Names containing de, van, von, De, Van, Von, de la, etc. should be listed under D and V respectively. List them as: De Roux DP and not Roux DP, de. When cited in the main text without the first name, use capitals for De, Van, Von, De la, etc. (Van Dijk, year)
5. Names containing Jr or II should be listed as follows:
   - Author Last Name Initial Jr (year)
   - Author Last Name Initial II (year)
6. References where the first-named author is the same should be listed as follows:
   - Single-author references in date order;
   - Two-author references in alphabetical order according to the second author's name;
   - Et al. references in alphabetical order; in the event of more than one entry having the same date, they should be placed in alphabetical order of second (or third) author, and a, b, etc. must be inserted.

   Brown J (2003)
   Brown TR and Yates P (2003)
   Brown W (2002)
   Brown W (2003a)
   Brown W (2003b)
   Brown W and Jones M (2003)
   Brown W and Peters P (2003)
   Brown W, Hughes J and Kent T (2003a)
   Brown W, Kent T and Lewis S (2003b)
7. Check that all periodical data are included – volume, issue and page numbers, publisher, place of publication, etc.
8. Journal titles should not be abbreviated in SAGE Harvard journal references
9. Where et al. is used in reference lists, it should always be upright, not italic.

4. Reference styles

Book

Clark JM and Hockey L (1979) *Research for Nursing*. Leeds: Dobson Publishers.

Book chapter

Gumley V (1988) Skin cancers. In: Tschudin V and Brown EB (eds) *Nursing the Patient with Cancer*. London: Hall House, pp.26–52.

Journal article

Huth EJ, King K and Lock S (1988) Uniform requirements for manuscripts submitted to biomedical journals. *British Medical Journal* 296(4): 401–405.

Journal article published ahead of print

Huth EJ, King K and Lock S (1988) Uniform requirements for manuscripts submitted to biomedical journals. *British Medical Journal*. Epub ahead of print 12 June 2011. DOI: 10.1177/09544327167940.

Website

National Center for Professional Certification (2002) Factors affecting organizational climate and retention. Available at: www.cwla.org./programmes/trtechmann/2002fbwfiles (accessed 10 July 2010).

Thesis/dissertation

Clark JM (2001) *Referencing style for journals*. PhD Thesis, University of Leicester, UK.

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Newspaper/magazine

Clark JM (2006) Referencing style for journals. *The Independent*, 21 May, 10.

Conference article (published or unpublished)

Clark JM and Smith P (2002) Latest research on car exhaust manifolds. In: *17th International conference on strain analysis* (ed L Macadam), London, UK, 23–25 September 2010, pp.12–14. London: Professional Engineering Publishing.

Blog

Clark JM (2006) Article title. In: Blog title. Available at: www.blogit.com/johnmatthewclark (accessed 20 August 2011).

Report

1. MacDonald S (2008) The state of social welfare in the UK. Report, University of Durham, UK, June.

2. Citigroup Ltd. (2011) *How to make your money work for you*. Report for the Department of Finance. Report no. 123345, 13 June. Oxford: OUP.

Package Insert (medical etc.)

1. Elsai Inc. (2008) Aloxi (package insert). New York: Esai Inc.

Standard

1. ISO 27799:2008 (2008) Information security management in health.