OVERVIEW OF HEALTH IN THE PALESTINIAN POPULATION:

A PILOT STUDY

Moath Abuejheisheh

Tesis doctoral

Programa de Doctorado en Medicina Clínica y Salud Pública (B12.56.1)
Universidad de Granada
Facultad de Ciencias de la Salud

Granada, 2020

Editor: Universidad de Granada. Tesis Doctorales
Autor: Moath Ibrahim Yousef Abuejheisheh
ISBN: 978-84-1306-708-7
URI: http://hdl.handle.net/10481/65426

ESTADO GENERAL DE LA SALUD EN LA POBLACIÓN PALESTINA:

UN ESTUDIO PILOTO

Esta tesis ha sido desarrollada bajo la dirección de:

Dra. Jacqueline Schmidt Rio-Valle

Dra. María Correa Rodríguez

ACKNOWLEDGMENTS

I want to express my sincere thanks to all those people who have made this work possible.

Especially to my directors Jacqueline and María, for having given me their unconditional support, for having guided me, and for giving me strength at the most testing times.

Thank you, Jacqueline, for being the star that guides this path.

To my Spanish colleagues, for letting me join their team and discover another way to do research.

To Ángel and Ahmad for trusting me at all times, for walking with me on this journey.

To Tamer and Mahmud who have not stopped being present for a single day.

To my friends in Jordan and Palestine for listening to me, for giving me strength, and for the fighting lesson.

Indeed, thanks to all the people who have contributed to making this dream come true.

Finally, I am ever grateful to my parents and my brothers for never letting me give up and for teaching me to fight for my dreams.

INDEX

INDEX OF TABLES AND FIGURES

ABBREVIATIONS

BDI: Beck Depression Inventory.
BMI: Body Mass Index.
CABG: Coronary Artery Bypass Graft.
CAD: Coronary Artery Diseases.
CDC: Centers for Disease Control and Prevention.
CES-D: Centre for Epidemiological Studies Depression Scale.
CVD: Cardiovascular Diseases.
DALYs: Disability – Adjusted Life Years.
DBP: Diastolic Blood Pressure.
HADS: Hospital Anxiety and Depression Scale.
HC: Waist Circumference.
HRQoL: Health-Related Quality Of Life.
MAP: Mean Arterial Pressure.
MENA: Middle East and North Africa.
MOH: Ministry of Health.
NCDs: Non-Communicable Diseases.
NHANES: National Health and Nutrition Examination Survey.
NHP: Nottingham Health Profile Questionnaire.
PCBS: Palestinian Central Bureau of Statistics.
PCI: Percutaneous Coronary Interventions.
PHQ-9: Patient Health Questionnaire.
PRISMA: Preferred Reporting Items for Systematic Review and Meta-Analysis.
PTCA: Percutaneous Transluminal Coronary Angioplasty.
SBP: Systolic Blood Pressure.
SF-HQ: Short-Form Health Questionnaire.
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology.
UNRWA: United Nations Relief and Works Agency.
WC: Waist Circumference.
WHO: World Health Organisation.
WHR: Waist-to-Hip Ratio.
WHtR: Waist-to-Height Ratio.

SUMMARY

This doctoral thesis provides a health overview for the Palestinian population in regard to factors relating to quality of life and the prevalence of depression in patients undergoing a coronary artery bypass graft (CABG), in addition to the prevalence of overweight/obesity and high blood pressure/hypertension in children and adults. The findings of this work are contained in five main sections (two systematic reviews and meta-analyses and three original research papers).

The first systematic review and meta-analysis study demonstrates that the prevalence of depression pre-CABG ranges from 19–37%, while post-CABG this is 15–33%. Although this study reports an overall improvement in depressive symptoms after a CABG, depression persists postoperatively in the majority of patients. The depression levels present prior to the operation may affect a patient's postoperative recovery. Thus, given the prevalence of depression and its impact, early detection is crucial, since this enables the identification of at-risk patients, through a clinical interview employing validated measurement tools. Health professionals can then implement preventive strategies and monitor the development of the depression.

In the second systematic-review and meta-analysis study, we observed that CABG surgery improves people's quality of life both physically and mentally, although this improvement is more extensive in physical terms. This favours the normalisation of the day-to-day life of these people in both their personal and work environments, and a decrease in impact prevalence was observed in different

aspects of their lives that varied between 18% and 6%. This surgery therefore seems to be a good choice for improving the quality of life of people with coronary disease, once the possible existing risks have been assessed.

In the original research investigating the associations between health-related quality of life (HRQoL) and sociodemographic and clinical characteristics in 119 Palestinian patients who underwent CABG surgery, our findings indicate that HRQoL decreases as age increases, whereas HRQoL increases with a higher educational level, greater job security, and a higher salary. Additionally, patients who had undergone a prior percutaneous coronary intervention (PCI) reported worse HRQoL, with all domains having a significantly lower score. The results of this study are relevant for health professionals, particularly nursing professionals, since they reveal that comprehensive assessments of individuals undergoing a CABG are necessary to prepare high-quality patient care that allows them a greater HRQoL and better post-operative rehabilitation. This study also shows that other factors, such as emotional components and certain sociodemographic variables, have an important influence on patients undergoing CABG surgery and these should be considered by the nursing staff when developing nursing care plans.

In the original study of a 971 cohort of children, we found that the prevalence of overweight/obesity was 25.3% in girls and 23.1% in boys. Additionally, 26.3% of Palestinian children have elevated systolic blood pressure/hypertension, whereas 23.4% have elevated diastolic blood pressure/hypertension. Palestinian children with elevated blood pressure or hypertension have a significantly higher weight, body mass index, waist circumference, hip circumference, fat mass, and fat-free mass than the participants with normotension, supporting a direct association between high values of obesity-related parameters and high blood pressure. Similar results were found in the research conducted on a cohort of 1337 Palestinian adults. In that case, the prevalence of hypertension in adults was 61.7% in males and 38.3% in females.

Our results therefore highlight the need for a serious focus on obesity and hypertension in the Palestinian population as well as community-based programmes to manage this health problem. Weight reduction interventions are essential for reducing the prevalence of related disorders, including hypertension in both childhood and adulthood; as well as halting the development of cardiovascular diseases that involve surgery, increased health costs, and decreased HRQoL. For this reason, obesity prevention should be a national public health priority in Palestine.

RESUMEN

En esta Tesis Doctoral se muestra una visión general de la salud en la población palestina respecto a la calidad de vida y la prevalencia de depresión en pacientes sometidos a cirugía de revascularización coronaria o bypass (CABG, por sus siglas en inglés). Asimismo se valora la prevalencia de sobrepeso/obesidad y de presión arterial alta/hipertensión en población infantil y adulta. Los resultados de esta tesis se han organizado en cinco trabajos (dos revisiones sistemáticas con metaanálisis y tres investigaciones originales).

En la primera revisión sistemática y metaanálisis, encontramos que la prevalencia de depresión antes del CABG varía entre 19-37% y después del CABG entre 15-33%. Este estudio muestra una mejora general en los síntomas depresivos después de la CABG, si bien constatamos que la depresión persiste después de la cirugía en la mayoría de los pacientes. Dado que los niveles de depresión presentes antes de la operación pueden afectar la recuperación posoperatoria y dada la elevada prevalencia de la misma, se hace necesario identificar a los pacientes en riesgo a través de entrevistas clínicas que empleen herramientas validadas. De esto modo será posible implementar estrategias preventivas y hacer un seguimiento exhaustivo de la depresión y de la evolución general del paciente en el postoperatorio.

En la segunda revisión sistemática y metaanálisis, observamos que la cirugía de CABG mejora la calidad de vida de las personas tanto física como mentalmente, aunque esta mejoría es más evidente en los aspectos físicos. Esto favorece la normalización del día a día de estas personas en su entorno personal y laboral, ob-

servándose una disminución en la prevalencia de afectación a diferentes aspectos de la vida de entre un 18% y un 6%. Por tanto, esta cirugía parece ser una buena opción para mejorar la calidad de vida de las personas con enfermedad coronaria, una vez evaluados los posibles riesgos existentes.

En la investigación original que analiza las asociaciones entre la calidad de vida relacionada con la salud (HRQoL, por sus siglas en inglés) y las características sociodemográficas y clínicas en 119 pacientes palestinos que se sometieron a cirugía CABG, encontramos que la HRQoL disminuye a medida que aumenta la edad, mientras que la HRQoL aumenta con un mayor nivel educativo, mayor seguridad laboral y un salario más alto. Destacar que los pacientes sometidos a una intervención coronaria percutánea previa (PCI, por sus siglas en inglés) mostraron una peor HRQoL global, con todos los dominios con una puntuación significativamente más baja. Los resultados de este estudio son relevantes para los profesionales de la salud, especialmente los profesionales de enfermería, ya que ponen de manifiesto la necesidad de realizar valoraciones integrales a los pacientes que van a ser sometidos a un CABG con el fin de preparar una atención de calidad que les permita tener una mayor HRQoL y una mejor rehabilitación postoperatoria. Además, este estudio también muestra que factores como los componentes emocionales, ciertas variables sociodemográficas y la existencia previa de procedimientos invasivos como PCI, influyen de manera importante en los pacientes sometidos a cirugía de CABG; y estos deben ser considerados por el personal de enfermería a la hora de desarrollar planes de cuidados.

Por otro lado, en el estudio realizado en una cohorte de 971 participantes con una edad de 9 a 12 años encontramos que 25,3% de las niñas y el 23,1% de los niños presentaban sobrepeso/obesidad; asimismo 26,3% de los niños palestinos presenta presión arterial sistólica elevada y el 23,4 % tiene presión arterial diastólica elevada. Los niños palestinos con presión arterial elevada/hipertensión tienen valores significativamente más altos de peso, índice de masa corporal, circunferencia de la cintura, circunferencia de la cadera, masa grasa y masa libre de grasa que los participantes con normotensión, lo que respalda una asociación directa entre valores altos de parámetros relacionados con la obesidad y valores de presión arterial alta en edades tempranas. Se obtuvieron resultados similares en una cohorte de 1337 palestinos adultos; de modo que el 61,7% de los varones y el 38,3% de las mujeres son hipertensos.

Nuestros resultados apuntan a la necesidad de un abordaje institucional centrado en la obesidad de la población palestina y revelan la importancia de establecer programas comunitarios para afrontar este problema de salud. Las intervenciones de reducción de peso son esenciales para reducir la prevalencia de trastornos relacionados como la hipertensión en la niñez y la edad adulta; así como, paliar el desarrollo de enfermedades cardiovasculares que requerirán intervenciones quirúrgicas, aumento del gasto sanitario y disminución de la HRQoL. Por esta razón, la prevención de la obesidad debe ser una prioridad nacional de salud pública en Palestina.

I

INTRODUCTION

INTRODUCTION

1. General information on Palestine

Palestine is a sovereign country in Western Asia that includes the West Bank and Gaza Strip, with East Jerusalem as the designated capital, although its administrative centre is currently located in Ramallah. Palestine is a region in the eastern Mediterranean region between the Jordan River and the Mediterranean Sea in Asia; it is located at 31.8833° N, 35.2000° E, and its total area is 6217 square metres (United Nations [UN], 2020). Palestine has a Mediterranean climate, which is characterised by a lack of extremes, with hot dry summers and mild wet winters. Average temperatures range between 10 and 18 °C in the winter and 27 to 35 °C in the summer, but precipitation varies from region to region and from year to year (Fanack, *Geography of Palestine*, 2020).

The Palestinian economy is almost entirely dependent on international aid for its survival (Chalabi, 2013). As a result, when aid falls short of expectations, the results are felt deeply. Reduced or decreased international aid is one of the main reasons the West Bank's GDP shrank in early 2013 (Chalabi, 2013). The Palestinian economy was devastated and became unbalanced due to a resource gap, an unbalanced labour market, and an unhealthy dependence on external sources of income, predominantly as a result of the political instability (UN, *Conference on Trade and Development*, 2015; UN, 2019). Thus, the outlook for the Palestinian economy is increasingly bleak, and it has proven incapable of functioning in the way necessary to maintain basic life standards (World Bank, *West Bank and*

Gaza – Coping and conflict: poverty and inclusion, 2011; World Bank, *Economic monitoring report to the ad hoc liaison committee,* 2017).

According to the Palestinian Central Bureau of Statistics, in 2018, the country's unemployment rate was 52% in Gaza Strip compared with 19% in West Bank, 25.0% among males compared to 51% among females (Palestinian Central Bureau of Statistics [PCBS], *Palestinians at the End of 2018,* 2018). The highest unemployment rate in the first quarter 2018 was concentrated among young people aged 20-24 years; 49.6% for both sexes (PCBS, 2018).

About 93% of the total population of the State of Palestine is from the Sunni Muslim community (Sawe, 2019). Christianity represents 6% of all Palestinians worldwide, although in Palestine it accounts for only 0.6% of the population. Palestine is also home to people practicing other religions, including Jews, Druze, and Samaritans, and in the areas that are considered Palestinian there are approximately 400,000 Jewish settlers, who are identified as Palestinian Jews even though they are considered Israeli citizens. The basic laws assume that Islam is the state religion and guarantees freedom of religion (Sawe, 2019). Lastly, although many languages are spoken in Palestine, the official language is Arabic.

2. Sociodemographic characteristics

In 2018, it was estimated that there were about 13.050 million Palestinians, of which about 4.915 million were in the State of Palestine, 1.568 million in the Territories, 5.850 million in Arabic countries, and 717 thousand in foreign countries, as shown in Table1 (PCBS, 2018).

Table 1. Estimated Palestinian population in the world by country of residence.

Country	No. Palestinians	Percentage of total Palestinians
State of Palestine	4,915,349	37.7%
1948 Territory	1,568,067	12.0%
Arab Countries	5,850,148	44.8%
Foreign Countries	716,704	5.5%
Total	13,050,268	100%

**Palestinian Central Bureau of Statistics, 2018*

Data for 2018 indicated that 42.2% of the population in Palestine were refugees. As shown in Table 2, the percentage of refugees in the West Bank was 26.3% of the area's total population, while in the Gaza Strip this figure was 66.1% (PCBS, 2018).

Table 2. Population in the state of Palestine by refugee status and region.

Region	Total		Not Stated		Non-refugee		Refugee	
	%	No.	%	No.	%	No.	%	No.
State of Palestine	100	4,697,286	0.7	33,166	57.1	2,683,560	42.2	1,980,560
West Bank	100	2,823,633	1.1	32,403	72.6	2,049,782	26.3	741,448
Gaza Strip	100	1,873,653	0.0	763	33.8	633,778	66.1	1,239,112

**Palestinian Central Bureau of Statistics, 2018*

The Palestinian population is divided into 2.954 million people in the West Bank (60.1%) and 1.961 million in the Gaza Strip (39.9%). The estimated population at the end of 2018, according to Palestinian governorates and cities, is shown in Table 3.

Table 3. Estimated population in the state of Palestine by governorate.

Governorate	Percent %	Population Number
State of Palestine	100.0	4,915,348
West Bank	60.1	2,953,343
Jenin	6.6	321,950
Tubas &Northern Valleys	1.3	62,430
Tulkarm	3.9	190,169
Nablus	8.1	395,210
Qalqillya	2.3	115,184
Salfit	1.6	77,473
Ramallah & Al-Bireh	6.8	336,835
Jericho &Al A ghwar	1.0	50,946
Jerusalem	9.1	446,585
Bethlehem	4.5	222,624
Hebron	14.9	733,537
Gaza Strip	39.9	1,961,406
North Gaza	7.8	383,762
Gaza	13.6	670,138
Dier Al balah	5.7	282,017
Khan Yunis	7.8	383,712
Rafah	5.0	241,777

**Palestinian Central Bureau of Statistics, 2018*

Palestinian society in the State of Palestine is young, with around 38.5% of individuals being under the age of 15 at the end of 2018, although there is a clear difference between the West Bank (36.6%) and Gaza Strip (41.6%). The percentage of individuals aged 65 and over in the State of Palestine was estimated at 3.3%, with 3.6% in the West Bank and 2.7% in the Gaza Strip (Palestinian Central Bureau of Statistics, 2018). The estimated population in Palestine by region, age and sex at the end of 2018 is shown in Table 4.

Table 4. Estimated Population in Palestine by region, age, and sex.

	Gaza Strip			West Bank			State of Palestine		
Age	**Females**	**Males**	**Both sexes**	**Females**	**Males**	**Both sexes**	**Females**	**Males**	**Both sexes**
0-4	142,418	148,924	281,130	188,510	198,733	387,243	330,928	347,657	678,585
5-9	137,273	143,857	281,130	174,980	184,491	359,471	312,253	328,348	640,601
10-14	118,559	124,263	242,822	162,733	170,081	332,814	281,292	294,344	575,636
15-19	96,185	100,930	197,115	150,178	156,652	306,830	246,363	257,582	503,945
20-24	94,893	97,975	192,868	140,878	149,476	290,354	235,771	247,451	483,222
25-29	88,368	90,274	178,642	126,220	134,416	260,636	214,588	224,690	439,27
30-34	67,217	67,368	134,585	100,857	103,712	204,569	168,074	171,080	339,154
35-39	51,591	50,838	102,429	82,922	83,492	166,414	134,513	134,330	268,843
40-44	42,716	42,857	85,573	74,053	76,342	150,395	116,769	119,199	235,968
45-49	32,562	33,149	65,711	64,249	67,364	131,613	96,811	100,513	197,324
50-54	28,234	30,141	58,375	53,256	56,742	109,998	81,490	86,883	168,373
55-59	21,766	23,146	44,912	42,486	45,367	87,853	64,252	68,513	132,765
60-64	15,667	15,427	31,094	29,397	30,607	60,004	45,064	46,034	91,098
65-69	12,058	11,443	23,501	20,280	19,968	40,248	32,338	31,411	63,749
70-74	7,704	7,046	14,750	14,477	12,851	27,328	22,181	19,897	42,078
75-79	4,547	3,439	7,986	10,529	7,730	18,259	15,076	11,169	26,245
+80	5,437	3,134	8,571	12,085	7,829	19,914	17,522	10,963	28,485
Total	967,195	994,211	1,961,406	1,448,090	1,505,853	2,953,943	2,415,285	2,500,064	4,915,349

**Palestinian Central Bureau of Statistics, 2018*

The population pyramid shows that the Palestinian society is young, and the base of the pyramid is widened by this high percentage of individuals under the age of fifteen compared to other age groups. Table 5 shows numbers and percentage

distribution of the population by age groups and sex (Ministry of Health- Palestinian Health Information Center [MH-PHIC], *Annual Health Report – Palestine*, 2017).

Table 5. Number and percentage distribuation of population by age and sex.

Age	Males		Female		Total	
	No.	%	No.	%	No.	%
0 -14	963,47	020.0	923,26	619.2	1,886,73	639.2
15 – 64	1,423,13	129.5	1,366,49	428.4	2,789,62	557.9
+65	61,01	51.3	79,12	91.6	140,14	22.9
Total	2,447,61	650.8	2,368,88	749.2	4,816,503	100

** (Ministry of Health - Palestinian Health Information Center, 2017)*

3. Health care services in Palestine

The World Health Organisation (WHO) office for the West Bank and Gaza supports the Palestinian Ministry of Health and partners in improving the health and well-being of Palestinians, driving towards universal health coverage and ensuring no-one is left behind. The WHO strives to provide the Ministry of Health with advice to help them provide the best possible health service that meets the needs of the people, with a focus on strong primary healthcare, and the development and implementation of the national health policy agenda, based on the principles of equity and sustainability, improving preparedness for cases and health emergencies, and advocating for the right to health (WHO, *Occupied Palestinian territory,* 2020). Through its work in Palestine, the WHO is reaching out to the most vulnerable people in the West Bank and Gaza: newborns, pregnant and breast feeding women, trauma patients, and those suffering from chronic diseases, including people in need of mental health and psychosocial support (WHO, *Preventing non communicable diseases,* 2020).

There are four main healthcare service providers in the West Bank and Gaza Strip: the Ministry of Health, the United Nations Relief and Works Agency (UNRWA), non-governmental organisations, and the Palestinian Military Medical Services, each with its own respective network of primary healthcare centres and hospitals (MH-PHIC, 2019). According to the MH-PHIC (2018), there are 730 primary care centres in Palestine, of which 587 are in the West Bank, the vast majority of these centres being affiliated to the Palestinian Ministry of Health (MH-PHIC, 2018). In

fact, there are 471 government primary healthcare centres, representing 62% of the total health service provision, while there are 62 UNRWA centres providing services to Palestinian refugees. There are 80 hospitals in Palestine; 50 Hospitals in the West Bank, and 30 Hospitals in the Gaza Strip, with capacity of 6,006 beds (MH-PHIC, 2016).

A World Bank report (2017) indicates that 29% of Palestinians are living in poverty and therefore, 2.5 million people need humanitarian assistance. Moreover, a high percentage of Palestinians suffer food insecurity according to the World Food Program. In this context, a previous study indicated that Israeli checkpoints, roadblocks, and the separation wall in Palestine limit access to medical equipment and medicines, restrict the education of health professionals, and prevent access to preventive and curative health services (Sousa & Hagopian, 2011).

4. Chronic diseases

Chronic diseases are on the rise globally and are expected to become the leading cause of death and disability by 2030 (Lauvergeon et al., 2012). In the annual report submitted by the Palestinian Ministry of Health, it was found that chronic or non-communicable diseases impact Palestinian society. These diseases can be greatly influenced by lifestyle, including food habits and physical activity (Palestine Economic Policy Research Institute (MAS), 2017). Patterns of food consumption, sedentary lifestyles, unemployment, and poverty contribute to the increased prevalence of these behavioural risk factors, all linked to the development of non-communicable diseases, particularly cardiovascular diseases (CVD), obesity, and diabetes (MH-PHIC, 2016). A previous study of the Palestinian healthcare sector that used disability–adjusted life years to quantify the burden of chronic diseases, found that the Palestinian Territories face an increasing burden of chronic diseases, particularly heart disease, cancer, and hypertension in terms of mortality and disability-corrected life years (Mosleh, 2018). The Ministry of Health spends around 80% of its budget on initiatives to combat non-communicable diseases, the main burden on its resources (Ministry of Health, State of Palestine, 2016).

4.1. Cardiovascular diseases

Cardiovascular diseases (CVD) are chronic diseases present across the globe, and are the most common cause of death in Palestine (MH-PHIC, 2019), and it has

been predicted that these will continue to be the leading cause of death worldwide (Lehtonen et al., 2009).The Arab world is considered to have a large percentage of young people with an average life expectancy of 70 years (WHO, *Global status report on non communicable diseases,* 2011). Obesity (13% in men and 24.5% in women), diabetes (11.3%), and smoking (30% among men and 5% among women) are very common in the region (WHO, 2012). Consequently, CVD have become one of the leading causes of death in this population; indeed, 30.3% of deaths reported in 2017 were attributable to CVD (MH-PHIC, 2018).

The prevalence of both male and female CVD patients is continually increasing, which is attributed to genetics and lifestyle changes. A cross-sectional study conducted in Gaza-Palestine to determine the prevalence of cardiovascular disease among 2,240 participants evidenced that close to 10% of the population over the age of 25 was suffering CVD (JameeShahwan et al., 2019). Interestingly, it has been proposed that the key factors in the development of CVD, surpassing even the classic factors such as dyslipidaemia, hypertension, tobacco use, and even obesity could be a sedentary lifestyle and an inadequate diet (McAuley et al., 2012). Monitoring nutrition, physical activity, smoking habits, and stress levels is of special interest for preventing coronary artery diseases (CAD) (Zarani et al., 2011). Currently, there are many methods for treating CAD, including therapeutic medication, percutaneous transluminal coronary angioplasty (PTCA), and coronary artery bypass graft (CABG) surgery (Staniūtė & Brožaitienė, 2010).

In the Palestinian territories, poor dietary habits, sedentary lifestyles, and obesity, are highly prevalent (Abdeen et al., 2012). Many Palestinians have unhealthy behaviour that increases the risk of CVD, including diets low in fruits and vegetables, a high consumption of soft drinks, decreased fibre and vegetable consumption, frequent consumption of fast foods, and physical inactivity (Ghrayeb et al., 2013; Ghrayeb et al., 2014). Additionally, in the occupied Palestinian territory, health is powerfully influenced by political, economic and social determinants (Bhaiwala, 2015).

4.2. Hypertension

The prevalence of hypertension globally is high and continues to increase (Forouzanfar et al., 2017). Annually, about 7.5 million deaths worldwide are caused by high blood pressure (WHO, 2011). Furthermore, a previous study showed that

the prevalence of hypertension is expected to increase by 7.2% from the 2013 estimate to 2030 (Mozaffarian et al., 2015). In Arab countries it is estimated that about 30% of adults have high blood pressure (Tailakh et al., 2013). In Palestine, the overall prevalence of hypertension has been reported as being 27.6% of the adult population aged 25 and over, with a higher percentage among men than women (Khdour et al., 2013).

Hypertension can lead to serious health complications and increase the risk of heart disease, stroke, and death (Felman, 2019). Primary hypertension is more common in the adult population and secondary causes of high blood pressure are found predominantly in children (Kliegman et al., 2011). Kidney and vascular disease rank first among the specific causes of high blood pressure in children (Baracco et al., 2012). Several factors such as obesity, diet, sex, and academic stress are claimed to be responsible for the increased prevalence of essential hypertension in early stages of life (Rao, 2016; Ewald & Haldeman, 2016). Interestingly, a recent study found that obesity-related hypertension in children was related to increased cardiovascular morbidity and mortality (Wühl, 2018). Consequently, high blood pressure is one of the most pressing public health challenges.

Hypertension in children can easily become hypertension in adults, and this is an important risk of CVD (Urbina et al., 2019). Hypertension in children is defined as a systolic or diastolic blood pressure (BP) value$\geq 95^{th}$ percentile. Blood pressure between the 90^{th} and 95^{th} percentile in childhood is designated "elevated blood pressure" (Flynn et al., 2017). While readings of SBP $\geq$130 mmHg and DBP$\geq$80 mmHg in adults are taken as being hypertensive; readings of SBP <120 mmHg and DBP<80 mmHg are normotensive (Whelton et al., 2018). Due to the global obesity epidemic, hypertension has now been established as one of the most common health conditions in young people (Flynn, 2013).

4.3. Overweight and obesity

Obesity is the excessive accumulation of fat in the body and is currently a major problem, now reaching severe epidemic proportions (WHO, *Obesity: preventing and managing the global epidemic,* 2000). In 2016, 39.0% of adults were overweight and 13.0% were obese (WHO, *Obesity and overweight*, 2020). In Saudi Arabia, obesity is a major public health concern, as the speed its prevalence is increasing is one of the fastest in the world (Azzeh et al., 2017). Increasing body weight is an important risk factor for the development of many serious

diseases such as diabetes and hypertension. Previous work has revealed that being overweight or obese can significantly increase the risk of chronic diseases and adverse health outcomes, including high blood pressure, insensitivity to insulin, diabetes, and CVD (Palestine Economic Policy Research Institute (MAS), 2017; Hruby et al., 2016).

The prevalence of overweight and obesity among children and adolescents aged 5-19 has increased dramatically from only 4% in 1975 to just over 18% in 2016 (WHO, *Obesity and overweight*, 2020). Overweight and obesity are increasing at an alarming rate in developed and developing countries like Palestine. Findings from marginalised Palestinian schools in the West Bank showed that 34% of adolescents were overweight or obese, $\geq 85^{th}$ percentile (Amer et al., 2019). In 2016, a cross-sectional study of students at An-Najah National University in the Nablus area (northern Palestine) showed that the prevalence of overweight and obesity was 26.2%, being significantly higher in males (36.4%) than females (19.1%) (Damiri et al., 2018). Another cross-sectional study conducted on 1,320 school-age Palestinian children found that the prevalence of overweight and obesity was 14.5 and 15.7%, respectively (Al-Lahham et al., 2019). This is similar to the figures seen in some neighbouring countries in the Middle East, e.g., Jordan (Zayed et al., 2016), whereas in 2009, the rate was around 13% and 6%, respectively (Massad et al., 2016; Isbaih, 2009). The most recent results show that there has been a rapid rise in the prevalence of obesity in Palestinian children, which is alarming.

Children who are considered obese or overweight are expected to be overweight in adulthood and are therefore more likely to develop non-communicable diseases, such as diabetes and cardiovascular disease, at a younger age (Mikki et al., 2009). For this reason, obesity in Palestine requires attention due to its high prevalence among adults and the scarcity of studies on children, who constitute about half the Palestinian population.

4.4. Depression

Depression is a common condition worldwide that is predicted to have become the largest global disease burden by 2030 (Malhi & Mann, 2018). Depression is characterised by many symptoms, including sadness, loss of interest, feelings of guilt, sleep disturbance, fatigue, and decreased focus (Lim et al., 2018). The risk of depression may be related to a combination of genetic, physical, psychological and environmental factors including a family history of mental illness, chronic

physical or mental disorders, major life changes and tension, little or no social support, psychological factors, low socioeconomic status, age, sleep disturbance, and medication (Martin, B, 2020). In addition, a cross-sectional study found that ageing, low education level, low income, unemployment, poor self-awareness of health, obesity, and the struggle for mental health were associated with poor quality of life in people with depression (Cho et al., 2019).

Depressive disorders are considered a major cause of disease burden in both women and men (Meyer, 2004; Üstün et al., 2004). Palestinians are even more vulnerable to stress and depression due to the psychological stress they suffer– their lives are put at risk every day– and their quality of life is low (Husseini et al., 2009). The history of Palestine, even today, is characterised by conflict. The 1948 war (United Nations, 2012), and the 1967 war (Sarraj & Qouta, 2005) between Palestine and Israel impacted the psychological well-being and lifestyles of Palestinians. Thus, due to these historical events, about a third of the Palestinian people need interventions in the field of mental and psychological health (Afana et al., 2004). A systematic review was conducted on the mental health of children and adolescents in areas of armed conflict in the Middle East, including Palestine (Dimitry, 2011), and a survey of Palestinian adolescents was conducted in schools to investigate exposure to violence and its negative impact on mental health (Giacaman et al., 2007). Palestinians residing in the occupied territories often live in unbearable conditions due to the failure to meet their basic humanitarian needs (United Nations, 2019). Indeed, the WHO have reported that efforts should be made to improve the capacities of mental health teams, and increase their care and quality (WHO, *Health conditions in the occupied Palestinian territory*, 2014).

5. Nutrition and lifestyle in Palestine

Eating habits vary according to socioeconomic level, education, sex, and age (Rasmussen et al., 2006). Currently, major features of young people's eating habits include skipping breakfast, snacking, and a reduced intake of fruits and vegetables (WHO, *Inequalities in young people's health,* 2008), and evidence suggests that adolescent eating behaviour carries over into adulthood (Lien et al., 2001). A study assessing healthy nutrition and physical activity in students in Egypt, Libya, and Palestine observed that there is a very low rate of healthy eating (El Ansari & Berg-Beckhoff, 2017).

Food consumption patterns among Palestinians have shifted through a decrease in the intake of traditional foods to an increase in the consumption of modern refined foods, such as commercial white bread, soft drinks, and sweets (Stene et al., 1999). A study in Palestine describing dietary habits and associated sociodemographic factors found that eating sweets and salty snacks on a daily basis was common among girls, and boys typically consumed soft drinks every day (Mikki et al., 2010). In this study, they also showed that parental education was negatively correlated with the degree of western food, as well as sweet and savoury snacks. A higher parental education level is therefore associated with healthy eating (Patrick & Nicklas, 2005). Along the same lines, a previous study examined dietary habits and physical activity patterns in Palestinian young people, finding that in the West Bank subjects consumed more fruit, meat, chicken, sweets, and soft drinks, while in Gaza young people consumed fewer vegetables, and reported less physical activity (Al Sabbah et al., 2007).

Moreover, physical inactivity is the fourth major risk factor for death worldwide, and is responsible for 6% of deaths globally (WHO, *Global recommendations on physical activity for health,* 2010). Also, insufficient physical activity is one of the main factors contributing to health risks globally (WHO, *Health conditions in the occupied Palestinian territory*, 2014). The latest guidelines on recommended levels of physical activity for children and young adults (5-18 years) state that they should engage in moderate to vigorous levels of physical activity for at least 60 minutes and up to several hours each day, and the amount of sedentary time should be reduced (British Nutrition Foundation, 2011). Thus, healthy lifestyles that include tobacco use, alcohol intake, an unhealthy diet, and physical inactivity have been postulated as the leading risk factors for non-communicable diseases worldwide (WHO, *Preventing non communicable disease*, 2020).

In Palestine, food insufficiency has remained alarmingly high, with many Palestinian households reporting deterioration in living standards, particularly in the Gaza Strip. This may be due to the blockade of Gaza, while the West Bank's economic and social inequalities can be observed daily both between and within the territories (PCBS, 2016). Malnutrition in the Gaza Strip is more prevalent than in the West Bank. The lack of dietary quality can be associated with a lack of access to or the unavailability of various food items due to the Palestinian-Israeli conflict (PCBS, 2016). In the occupied Palestinian territory poor dietary habits, a sedentary lifestyle, and obesity are highly prevalent and this is expected to increase over the coming decade (Abdeen et al., 2012). A study to determine the prevalence

of physical inactivity and determinant factors among urban Palestinians showed that Palestinian women in urban areas, especially middle-aged or older and with a low educational level are at greater risk from physical inactivity (Merom et al., 2012).

6. Main causes of death

The estimated crude mortality rate in Palestine decreased from 4.5 deaths per 1000 population in 2000 to 2.6 deaths per 1000 population in 2018 (MH-PHIC, 2019). In Palestine, non-communicable diseases are the leading cause of death, accounting for more than two-thirds of deaths in 2017 (MH-PHIC, 2018). Causes of reported deaths according to the MH-PHIC (2016) are shown in Table 6. CVD remains the leading cause of death among Palestinians, accounting for30.3% of deaths; cancer is the second ranked (14.7%); strokes are third (11.7%); and perinatal mortality is the fourth most common cause of death (9.3%) (MH-PHIC, 2018).

Table 6. Causes of reported death in Palestine.

Rank	Cause of reported death	% of all reported deaths
1	Cardiovascular disease	27.5
2	Cancer	13.8
3	Cerebrovascular disease	9.9
4	Perinatal conditions	6.9
5	Diabetes mellitus	6.8
6	Respiratory disease	6.6
7	Accident	5.1
8	Congenital malformation	3.9
9	Infectious disease	2.4
10	Senility	2.3

**Health Annual Report, 2016. Ramallah. Ministry of Health, 2018*

II

JUSTIFICATION, OBJECTIVES, AND DESIGN

JUSTIFICATION, OBJECTIVES, AND DESIGN

1. Justification

Coronary artery disease (CAD) is one of the leading causes of death in developed countries, including Palestine, and is associated with a deteriorated quality of life, disability, and premature death. The usual surgical treatment involves a CABG. Even though the effects of a CABG have been studied in terms of morbidity, mortality, and organ function, the effect or influence this has on mood disorders, like depression, and quality of life remain unclear. It seems that depression predicts how much a patient's health will deteriorate. It is therefore extremely important to assess how the disease affects a patient, as this can influence the therapeutic benefit and, consequently, which interventions and care are prioritised, and which self-care strategies are implemented both before and after surgery.

Moreover, the growing incidence of percutaneous coronary interventions (PCI) prior to CABG represents an increased risk of post-operative morbidity and, consequently, decreased HRQoL. Investigating the factors associated with HRQoL in order to optimise quality of life in patients undergoing a CABG and, consequently, their health, is therefore of special interest. To our knowledge, no previous research has examined the potential factors influencing HRQoL in patients, either with or without a previous history of PCI, who undergo a CABG for the first time.

On the other hand, due to the global obesity epidemic, hypertension has now been established as one of the most common health conditions in children and adults. Previous studies have shown that an elevated body mass index (BMI) is associated with increase diastolic and systolic blood pressure among obese children and adults in the western region of Saudi Arabia. Nevertheless, the evidence available on the relationship between obesity and hypertension in the Palestinian population is limited. Most studies have focused on the impact of BMI or anthropometric measurements on blood pressure, but these studies provide no data on body composition. This means that the potential relationships between body composition parameters and blood pressure values in specific cohorts of Palestinian children and adults have not previously been analysed. Measurements of body composition, including fat mass and fat-free mass, in addition to anthropometric markers, would provide data to further the understanding of the potential associations between obesity and hypertension.

2. Objectives

2.1. Main objective

To examine the impact of CABG surgery on the prevalence of depression and the quality of life in patients, and to provide an overview of health in the Palestinian Population regarding factors related to quality of life in patients undergoing CABG, as well as to analyse the associations between obesity-related parameters and blood pressure levels in Palestinian children and adults.

2.2. Specific objectives

1. To analyse the prevalence of depression in patients both before and after CABG surgery and to examine depression levels over time (Study 1).
2. To examine the impact of CABG surgery on both physical and mental quality of life (Study 2).
3. To investigate the associations between health-related quality of life and sociodemographic and clinical characteristics, and examine the impact of prior percutaneous coronary interventions on HRQoL in Palestinian patients undergoing a CABG (Study 3).
4. To analyse the prevalence of overweight/obesity and elevated blood pressure/hypertension and investigate the associations between obesity-related parameters, including anthropometric and body composition markers and blood pressure levels in a population of Palestinian school children (Study 4).
5. To examine the associations between anthropometric and body composition variables and blood pressure in a large population of Palestinian adults and determine which anthropometric indices correlate with high blood pressure (Study 5).

2.3. Design

Publication 1. "Prevalence of Depression in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis"

This meta-analysis has been published in the *Journal of Clinical Medicine* (Impact Factor in *JCR* 3.303; Medicine, General & Internal category (36/165; Q1/T1)). Table 7 shows the method developed.

Table 7. Summary Method Publication 1.

Title	Prevalence of Depression in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis.
Design	Systematic review and meta-analysis.
Participants	Total sample n=16501 patients. Total items n=65, n=29 included in the meta-analysis.
Search strategy	Past 10 years Databases: CINAHL, LILACS, MEDLINE, PsycINFO, SciELO, Scopus, Web of Science. MeSH: (depression OR depressive disorder) AND (coronary artery bypass grafting)".
Data extraction	1. Data on the study. 2. Type of CABG. 3. Study characteristics. 4.Measurement tool. 5. Mean, standard deviation, prevalence of depression.
Assessment of quality and measurements of bias	Observational studies, Strengthening the Reporting of Observational. Studies in Epidemiology (STROBE). Clinical trials, standards in the Cochrane Collaboration Risk of Bias.

Publication 2. "Quality of Life in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis"

This meta-analysis is under review in the *International Journal of Environmental Research and Public Health* (Impact Factor in *JCR* 2.849; Public, Environmental& Occupational Sciences category (58/193; Q2/T1)). Table 8 shows the method developed.

Table 8. Summary Method Publication 2.

Title	Quality of Life in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis.
Design	Systematic review and meta-analysis.
Participants	Total sample n=7537 patients. Total items n=16, n=3 included in the meta-analysis.
Search strategy	Past 10 years Databases: CINAHL, Pubmed, Scopus y Cuiden. MeSH: ("Quality of Life" OR "Health-Related Quality Of Life" OR "Life Quality") AND ("Aortocoronary Bypass" OR "Bypass Surgery, Coronary Artery" OR "Bypass, Coronary Artery" OR "Coronary Artery Bypass Grafting" OR "Coronary Artery Bypass Surgery") AND "Postoperative Period".
Data extraction	1. Authors. 2. Year and country of publication. 3. Type of surgery. 4. Characteristics of the sample. 5. Instrument for measuring quality of life. 6. Scores on the quality of life scale.
Assessment of quality and measurements of bias	Levels of Evidence Working Group of the Oxford Centre for Evidence-Based Medicine (OCEBM). The studies included in the research were critically read using the STROBE checklist.

Publication 3. "Prior Percutaneous coronary intervention is associated with low health-related quality of life after coronary artery bypass graft"

This observational study has been published in the scientific journal *Nursing & Health Sciences* (Impact Factor in *JCR*1.269; Nursing category (72/123; Q3/T2)). Table 9 shows the method developed.

Table 9. Summary Method Publication 3.

Title	Prior percutaneous coronary intervention is associated with low health-related quality of life after coronary artery bypass graft.
Design	Cross-sectional study.
Participants	Females (n=28). Males (n=91).
Procedure	Clinical records of patients from hospitals, then Selection Coronary bypass surgery for the first time 12 months prior, then face-to-face interview.
Variables	Sociodemographic characteristics, clinical characteristics, lifestyle factors, prior coronary intervention such as angioplasty and stent placement, SF-36 variables.
Instruments	The Short Form-36 Health Survey (SF-36).

*Ethics Committees of the An-Najah National University Hospital (approval no. 0419494), Nablus Specialty Hospital (approval no. 2949855), and the Specialised Arab Hospital in Nablus (approval no. 749752).

Publication 4. "Obesity-Related Parameters are Associated With Blood Pressure in Palestinian Children"

This observational study has been published in the scientific journal *Biological Research for Nursing* (Impact Factor in *JCR*1.789; Nursing category (35/123 Q2/ T1). Table 10 shows the method developed.

Table 10. Summary Method Publication 4.

Title	Obesity-Related Parameters are Associated With Blood Pressure in Palestinian Children.
Design	Cross-sectional study.
Participants	Girls (n=486). Boys (n=485).
Procedure	An informative meeting was held to inform participants of the study objective. Data collection meeting scheduled. Measurements and body composition taken in the morning.
Variables	Blood Pressure, Body composition and Anthropometric measurements.
Instruments	Harpenden stadiometer. Seca automatic roll-upmetal measuring tape. A body composition analyser (TANITABC-418MA). Dinamap vital signs monitor.

*Ethical committee of the Arab American University-Palestine involved in the study (approval no. 1139247). Permission was obtained from the Ministry of Education in Palestine.

Publication 5. "Correlation between Anthropometric Measurements and Blood Pressure in a population of Palestinian Adults."

This observational study is under review in *African Health Sciences* (Impact Factor in *JCR* 0.840 position 137/165 Q4/T3). Table 11 shows the method developed.

Table 11. Summary Method Publication 5.

Title	Correlation between Anthropometric Measurements and Blood Pressure in a population of Palestinian Adults.
Design	Cross-sectional study.
Participants	Females (n=598). Males (n=739).
Procedure	Recruitment days were held to inform participants about the study. A further day was scheduled for taking measurements; body composition and anthropometric indices taken in the morning.
Variables	Blood Pressure, body composition and anthropometric indices.
Instruments	Portable stadiometer. Automatic roll-up metal measuring tape. A body composition analyser (TANITABC-418MA) Dinamap vital signs monitor.

*Ethical committee of the Arab American University-Palestine involved in the study (approval no. 1626952020). Permission was obtained from the Ministry of Health in Palestine.

PUBLICATIONS

PUBLICATION

I. Prevalence of Depression in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis.

[Correa-Rodríguez M, Abu Ejheisheh M, Suleiman-Martos N, Membrive-Jiménez MJ, Velando-Soriano A, Schmidt-RioValle J, Gómez-Urquiza JL.(2020). Journal of Clinical Medicine, 9(4):909. doi: 10.3390/jcm9040909].

Impact Factor in JCR 3.303; Medicine, General & Internal category (36/165; Q1/T1).

Journal of
Clinical Medicine

MDPI

Review

Prevalence of Depression in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis

María Correa-Rodríguez [1,2], Moath Abu Ejheisheh [1], Nora Suleiman-Martos [3,*], María José Membrive-Jiménez [4], Almudena Velando-Soriano [5], Jacqueline Schmidt-RioValle [1,†] and José Luis Gómez-Urquiza [1,†]

1 Faculty of Health Sciences, University of Granada, Avenida de la Ilustración N. 60, 18016 Granada, Spain; macoro@ugr.es (M.C.-R.); moad.ibrahem@hotmail.com (M.A.E.); jschmidt@ugr.es (J.S.-R.); jlgurquiza@ugr.es (J.L.G.-U.)
2 Instituto de Investigación Biosanitaria, IBS, 18012 Granada, Spain
3 Faculty of Health Sciences, University of Granada, Campus Universitario de Ceuta, C/Cortadura del Valle s/n, 51001 Ceuta, Spain
4 University Hospital of Ceuta. Institute of Health Management. C/Colmenar s/n, 51003 Ceuta, Spain; mariajose.membrive@gmail.com
5 University Hospital Virgen de las Nieves. Andalusian Health Service. Av. de las Fuerzas Armadas 2, 18014 Granada, Spain; srtavelando@correo.ugr.es
* Correspondence: norasm@ugr.es
† These authors contributed equally to this work.

Received: 4 February 2020; Accepted: 25 March 2020; Published: 26 March 2020

Abstract: Coronary artery bypass graft surgery (CABG) might adversely affect the health status of the patients, producing cognitive deterioration, with depression being the most common symptom. The aim of this study is to analyse the prevalence of depression in patients before and after coronary artery bypass surgery. A systematic review and meta-analysis was carried out, involving a study of the past 10 years of the following databases: CINAHL, LILACS, MEDLINE, PsycINFO, SciELO, Scopus, and Web of Science. The total sample comprised n = 16,501 patients. The total number of items was n = 65, with n = 29 included in the meta-analysis. Based on the different measurement tools used, the prevalence of depression pre-CABG ranges from 19–37%, and post-CABG from 15–33%. There is a considerable presence of depression in this type of patient, but this varies according to the measurement tool used and the quality of the study. Systematically detecting depression prior to cardiac surgery could identify patients at potential risk.

Keywords: coronary artery bypass graft; depression; mental health; meta-analysis; prevalence; surgery; systematic review

1. Introduction

Coronary artery disease (CAD) is one of the leading causes of death in developed countries, and it is associated with deteriorated quality of life, disability, and premature death [1]. The usual surgical treatment involves coronary artery bypass graft surgery (CABG). This technique is based on revascularisation by diverting blood flow to other arteries to increase the blood supply to the heart muscle [2].

Although CABG surgery increases life expectancy [3], it is associated with multiple physical complications, including myocardial infarction, stroke, and even kidney failure [4]; in addition to psychological consequences, such as mood disorders, fatigue, weakness, stress, anxiety, and depression [5].

Short-term recovery factors include a longer hospital stay, pain, and infection, which may predispose towards cognitive disorders, like anxiety and depression [6]. In the long term, it is estimated that at least 25% of patients will experience deteriorated quality of life after a CABG; and, it even doubles the post-surgery risk of future cardiac events and mortality related to high levels of anxiety and depression [7].

In particular, depression is considered to be one of the main reasons for reduced well-being, having a negative impact on a patient's quality of life, as well as their social and family life. It is a strong risk factor for mortality, being related to the occurrence of new cardiac events and reduced functionality up to six months post-CABG surgery, increasing the risk of hospital readmission in up to 20% of patients, due to complications including infection, arrhythmia, and volume overload [8].

Diagnosis is sometimes difficult, since symptoms, such as loss of appetite, sleep cycle disturbance, and constant fatigue, may be superimposed over the same symptoms that were derived from surgery. For this reason, determining the degree to which a CABG can affect a patient's mental, psychological, and social skills, and, specifically, analysing the level of depression, requires the use of multiple tools validated during a clinical interview [9,10].

A number of factors seem to influence the relationship between depression and CABG, including biological alterations (cardiac rhythm alterations, tone of cardiac muscle, hormone levels, and reduced brain perfusion) [11]. However, in many cases, the high prevalence of mood disorders cannot be explained by the severity of the illness, but is instead related to psychosocial factors, such as socioeconomic status, lifestyle (adherence to the recommended diet or prescribed treatment), or the level of social support [12].

Even though the effects of CABG have been studied in terms of morbidity, mortality, and organ function, the effect or influence it has on mood disorders, like depression, remains unclear. It seems that depression predicts how much a patient's health will deteriorate. Therefore, it is extremely important to assess how the disease affects a patient, as this can influence the therapeutic benefit and, consequently, which interventions and care are prioritised, and which self-care strategies are implemented both before and after surgery [13,14].

Although depression is considered to have a negative impact on patient recovery, few studies have examined the association between CABG and depression. Some systematic reviews have analysed the risk factors [15], and there are also reports regarding the effect of certain interventions [16,17]. However, to our knowledge, no meta-analysis studies that include a prevalence analysis have been exclusively undertaken on CABG patients.

Describing the levels of depression in CABG patients is essential for analysing the importance of this surgery with regard to depression levels. The purpose of this work is, therefore: (1) to analyse the prevalence of depression in patients both before and after CABG surgery; and, (2) to analyse the depression levels over time.

2. Materials and Methods

The data were extracted and analysed based on the recommendations of preferred reporting items for systematic review and meta-analysis (PRISMA) 2015 [18].

2.1. Search Strategy

A search was conducted of CINAHL, LILACS, MEDLINE, PsychINFO, SciELO, Scopus, and Web of Science in January 2020. MeSH descriptors were used, with the search strategy being: "(depression OR depressive disorder) AND (coronary artery bypass grafting)".

2.2. Inclusion and Exclusion Criteria

The inclusion criteria were the following: (1) full text of quantitative primary studies; (2) men and women aged over 18; (3) no psychiatric pathology or illness; (4) CABG surgery; (5) study of depression

levels prior to or after CABG; (6) the use of a validated scale; (7) written in English, Portuguese, Spanish, or French; and, (8) published in the last 10 years.

The exclusion criteria were the following: (1) paediatric population; (2) a different type of cardiac surgery that was not exclusively CABG (CABG with valve replacement); (3) measurement of depression in relatives; (4) patients with an active treatment deriving from a psychiatric disorder; (5) data from duplicate articles in previous studies; and, (6) no depression data extracted using a validated scale.

2.3. Selection of Articles and Information Analysis

Firstly, two authors checked the title and abstract, and, secondly, the full text of the article. A third author was consulted in the case of discrepancy.

For the meta-analysis, we selected the data from those studies that used the same measurement tool, since the inclusion of several measurement tools would not permit the results to be integrated, due to different scores.

2.4. Data Extraction

The following variables were recorded: (1) data on the study (author, year, country); (2) type of CABG (first time, elective or emergency); (3) study characteristics (sample, type of study, sex, and follow-up time); (4) measurement tool; and, (5) mean, standard deviation, prevalence of depression. For clinical trials or quasi-experimental studies, we selected only the levels of depression prior to the programme intervention (baseline) or those relating to the control group.

We used the intraclass correlation coefficient to analyse coding reliability, obtaining an average value of 0.97 (minimum = 0.93; maximum = 1), and the Cohen's kappa coefficient with a mean value of 0.94 (minimum = 0.92; maximum = 1).

2.5. Assessment of Quality and Measurement of Bias

Two independently authors assessed the quality of the studies, consulting with a third party in the event of a disagreement.

For observational studies (cohort and cross-sectional), we followed the guidelines in "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) [19]. We followed the standards in the Cochrane Collaboration Risk of Bias tool for clinical trials [20].

We used a second quality assessment tool to analyse the level of evidence in accordance with the recommendations of the Oxford Centre for Evidence-Based Medicine [21] (Table 1).

2.6. Data Synthesis and Statistical Analysis

The meta-analysis included those studies that used the same tool for measuring depression. We performed six meta-analyses using a random-effects model and two meta-analyses using a fixed-effect model, for prevalence levels and confidence intervals, through the statistical package StatsDirect (version 3, StatsDirect Ltd., Cambridge, UK).

We used I^2 to analyse the heterogeneity, grouping values into low (25%), moderate (50%), or high (75%) heterogeneity [22]. The publication bias was assessed using Egger's test.

3. Results

The search yielded a total of n = 1874 articles. After reading the title and abstract, 662 were excluded. Figure 1 shows the study selection process.

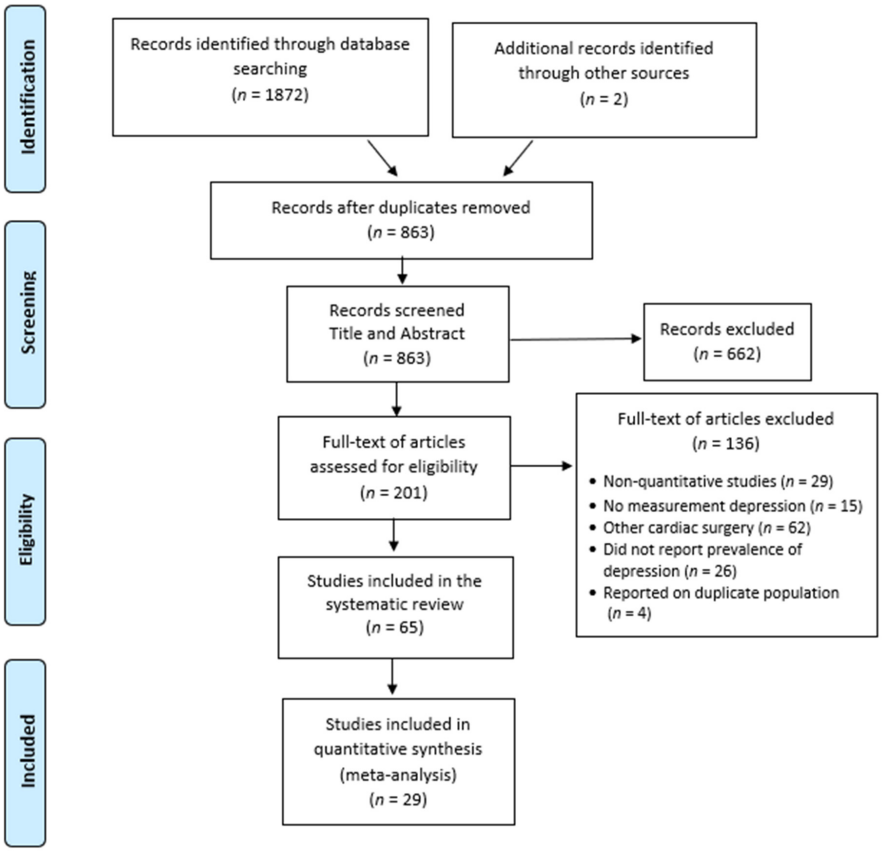


Figure 1. Preferred reporting items for systematic review and meta-analysis (PRISMA) flow-chart of included studies.

3.1. Characteristics of Included Studies

The total sample comprised 16,501 patients, predominantly male (n = 54). Most of the studies were cohort studies (n = 34), followed by cross-sectional studies (n = 12). Thirteen studies evaluated the levels prior to surgery, 23 after surgery, and 29 both before and after. Most of the studies were carried out in the USA (n = 17), followed by Germany (n = 7), Iran (n = 7), and Australia (n = 6) (Table 1). The depression follow-up ranged from a month prior to surgery (since the pre-assessment clinic appointment) [23] up to six years after surgery [24,25].

Table 1. Studies reporting prevalence and levels of coronary artery bypass graft surgery (CABG) depression.

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Abbott et al., [26] USA Elective CABG	RCT *n* = 226 83% male	HADS	After CABG	–	Cluster 1: 5.9 (4.3) Cluster 2: 8.2 (4.8) Cluster 3: 11.8 (6.9)	Elderly patients with more symptoms and chronic illnesses are more prone to depression	1a/A
Aburuz, [27] Jordan Elective CABG	Cohort *n* = 227 78% male	HADS	2-weeks before, 1-month after	12.76 (6.80) Normal: 57.26% Mild: 11.90% Moderate-severe: 30.84%	11.11 (6.78) Normal: 59.47% Mild: 13.66% Moderate-severe: 26.87%	Pre-operative depressive symptoms increased postoperative hospital length of stay	2c/B
Açıkel, [28] Turkey Elective CABG	Cohort *n* = 65 76.9% male	BDI	1-day before 3–7 days, 1-month after	8.12 (5.44) Normal: 61.5% Mild: 30.8% Moderate: 7.7% Severe: 0%	**3rd day:** 12.43 (6.36) Normal: 35.4% Mild: 40.0% Moderate: 23.1% Severe: 1.5% **7th day:** 11.66 (6.95) Normal: 40.0% Mild: 30.8% Moderate: 27.7% Severe: 1.5% **1 month:** 12.29 (9.08) Normal: 47.7% Mild: 26.2% Moderate: 23.1% Severe: 3.1%	Depression levels increase during postoperative CABG period	2c/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Afridi et al., [29] Pakistan First-time CABG	Cohort *n* = 134 84.3% male	HAM-D	2 days before, at discharge, 6-months follow-up	98.5% Mild: 71.6% Moderate: 23.9% Severe: 1.5% Very severe: 1.5%	**At discharge:** 80.6% Mild: 73.9% Moderate: 2.23% Severe: 2.23% Very severe: 2.23% **6-months:** 16.4%	Depression is commonly reported before and after CABG and influences the quality of life of the patients	2c/B
Ajtahed et al., [30] Iran First-time CABG	RCT *n* = 75 67% male	DASS	After CABG	–	**Control group:** **Group 1:** Normal: 60% Mild: 40% Moderate: 24% Severe: 12% Extremely severe: 0% **Group 2:** Normal: 52% Mild: 8% Moderate: 32% Severe: 0% Extremely severe: 8% **Group 3:** Normal: 45% Mild: 9.1% Moderate: 13.6% Severe: 13.6% Extremely severe: 18.2%	Training cognitive rehabilitation can improve cognitive functions and quality of life in patients after CABG surgery	1a/A
Ammouri et al., [31] Jordan First-time CABG	Cross-sectional *n* = 100 80% male	CSS	2-weeks after discharge	–	3%	Pain, leg swelling, poor appetite and trouble sleeping are the most frequent symptoms after CABG	2c/B
Amouzeshi et al., [32] Iran Elective CABG	Cross-sectional *n* = 54 68% male	BDI	1 day before and after ICU	11.7 (7) Minimal: 55.4% Mild: 28.6% Moderate: 16.1% Severe: 0%	**Male:** 31.5 (10.60) **Female:** 29.3 (10.55) Minimal: 0% Mild: 17.9% Moderate: 32.1% Severe: 46.4%	No relationship between age, sex, marital status, and education level with post-operative depression	2c/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Azzopardi & Lee, [33] Australia Elective CABG	Cohort *n* = 48 85.4% male	BDI	Before, 6-weeks after, 1–2 years follow-up	7.31 (4.1)	**2 years:** 7.90 (7.1)	Depression levels 2 years after CABG were not severe	2b/B
Bay et al., [34] USA Elective CABG	RCT *n* = 170 75% male	HADS	Baseline,1–6 months after	**Control group:** 7.3 (3.7)	**Control group:** **1-month:** 3.0 (3.1) **6-months:** 3.0 (3.1)	A coping religious intervention can reduce depression levels up to 6 months after surgery	1a/A
Beresnevaite et al., [35] Lithuania Elective CABG	Cross-sectional *n* = 109 100% male	SCL-90R	1-day before after	63.13 (8.22) High level: 23%	–	Preoperative depression score is related with a length stay hospital ($p < 0.001$) and perioperative complications ($p < 0.05$)	2b/B
Cebeci & Çelik, [36] Turkey First-time CABG	Quasi-experimental *n* = 52 80.8% male	HADS	1-day before, 1-day,1-week, 1-month after	8.3 (3.6)	**At discharge:** 7.9 (4.2) **1-week:** 8.2 (4.5) **1-month:** 7.7 (4.3)	At the time of admission, patients had a higher level of depression than at the time of discharge	1b/A
Chocron et al., [37] France First-time CABG	RCT *n* = 361	BDI	Before CABG	39%	–	Antidepressant treatment did not affect the morbidity and mortality events after CABG surgery	1a/A
Colella et al., [38] Canada First-time CABG	RCT *n* = 124 100% male	BDI	At discharge, 6–12 weeks after	–	**Control group:** **After:** 8.87 (4.74) **6-weeks:** 5.84 (5.30) **12-weeks:** 4.43 (5.26)	Physiological and psychological challenges after CABG increases the depression risk	1a/A
Dal Boni et al., [39] Brazil Elective CABG	Cross-sectional *n* = 78 67% male	BDI	Before, 2-months after	8.49 (6.87)	5.01 (6.61)	CABG had a positive impact on the patient's quality of life	2b/B
Doering et al., [40] USA First-time CABG	Cohort *n* = 67 100% female	HAM-D	At discharge, 1 month after	–	41.79%	Six months after CABG, women with major depression have at increased risk for infections	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Donohue et al., [41] USA Elective CABG	RCT *n* = 2485	PHQ-2	At discharge	–	56%	A nurse-guided intervention in the mental health area reduces the level of depression and health costs post-CABG	1a/A
Dunkel et al., [42] Germany Elective CABG	Cross-sectional *n* = 1238 72% male	PHQ-9	Before CABG	21.6%	–	Lower age, female gender, less than 10 years of education and living alone are related to depression symptoms	2b/B
Dunkel et al., [43] Germany Elective CABG	Cross-sectional *n* = 971 80.1% male	PHQ-9	1–3 days before, 1 year after	5.61 (4.31)	–	Female gender is related to depression symptoms Attributions to stress, personality and destiny are associated with higher depression scores	2b/B
El-Baz et al., [44] Netherlands and Slovakia Elective CABG	Observational multicentre *n* total = 226 *n*1 = 114 Slovakia *n*2 = 112 Netherlands 80% male	HADS	Before CABG	*n*1 = 5.01 (3.73) *n*2 = 4.96 (3.16)	–	Female gender, smoking, lower education, and lower social support are risks factors of depression	2b/B
Elliott et al., [45] Australia Elective CABG	Cohort *n* = 174 80% male	POMS-D	Before, 2–6 months after	10.50 (11.76)	**2-months:** 7.38 (9.41) **6-months:** 8.32 (10.52)	The young, male and smoking are the main risk factors of depression	2b/B
Feuchtinger et al., [46] Germany First-time CABG	Cross-sectional *n* = 24 37.5% male	HADS	1-day before	6.7 (5.1) Low: 54.17% Moderate: 20.83% Severe: 25%	–	Interventions such as information, spiritual support or cognitive behavioral therapy are the key to reduce the feeling of fear before CABG surgery	2b/B
Freedland et al., [47] USA Elective CABG	RCT *n* = 123 50% male	BDI HAM-D	1 year after	–	BDI = 22.26 (1.3) HAM-D = 19.53 (1)	Improvement in perceived cognitive impairment correlated with improvement in depression	1a/A
Gallagher & McKinley, [48] Australia Elective CABG	Cohort *n* = 155 74% male	HADS	Before, after surgery, 2-weeks after	4.10 (3.22) 16%	**After:** 18.2% 4.67 (3.49) **2-weeks:** 45% 6.58 (4.03)	26.5% of patients reported low perceptions of control before CABG, 22% after surgery and 10.3% at discharge	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Gelogahi et al., [49] Iran Elective CABG	RCT *n* = 40 37.5% male	DASS	Before, after	6.67 (4.7)	12.1 (8.1)	Nurses interventions can reduce depression levels after surgery	1a/A
Hazavei et al., [50] Iran First-time CABG	Quasi-experimental *n* = 27 77.8% male	CDS	Before, 4-8 weeks after	104.5 (30.4)	**2-months after:** 89.2 (27.8)	Most patients lacked the skills in health education and lifestyle-related with coronary artery disease	1b/A
Horne et al., [51] Canada Elective CABG	Cohort *n* = 104	PHQ-9	Before	60.6%	–	Length of stay (more than 7 days) is associated with a higher risk of depression	2b/B
Hweidi et al., [52] Jordan Elective CABG	Cross-sectional *n* = 143 53.1% male	SDS	2 days after	–	Mild: 32.2% Moderate: 60.1% Severe: 5.6%	Depression is related to female, unmarried and unemployed patients	2b/B
Kendel et al., [53] Germany Elective CABG	Cohort *n* = 351 77% male	PHQ-9	2 months, 2 years after	–	Male: 5.38 (4.2) Female: 6.84 (4.8)	Females have a higher level of depressive symptoms	2b/B
Kendel et al., [54] Germany Elective CABG	Cohort *n* = 883 80.2% male	PHQ-9	1–3 days before	5.38 (4.09) 8.5%	–	Depression is related to a deterioration of physical condition in patients undergoing CABG surgery	2b/B
Khoueiry et al., [55] USA Elective CABG	Cohort *n* = 50 56% male	BDI	Before, 1–3–6–9 months follow-up	8%	**After:** 60% **3-months:** 44% **6-months:** 40% **9-months:** 44%	Age and gender are not correlated with depression levels	2b/B
King et al., [56] Canada First-time CABG	Cohort *n* = 120 100% male	BDI CDS	At discharge, 6–12–36 weeks follow-up	–	**BDI** **At discharge:** 8.08 (4.76) 4.3% **6-weeks:** 5.82 (5.36) 1.9% **12-weeks:** 4.81 (4.73) 1.9% **36-weeks:** 4.31 (5.81) 2.1% **CDS** **At discharge:** 74.46 (24.29) 17.2% **6-weeks:** 59.58 (25.19) 7.6% **12-weeks:** 54.56 (23.06) 6.7% **36 weeks:** 51.22 (23.17) 4.3%	Family reduces the risk of depression	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Korbmacher et al., [57] Germany Elective CABG	Cohort *n* = 135 77% male	HADS	1–2 days before,1-week, 6-months after	4.3 (3.1) 20.7%	**1-week:** 5 (3.9) 24% **6-months:** 4.7 (4.3) 28%	Hight levels of depression are not associated with mortality. A 24.2% of patients with normal scores before surgery suffers depression 6-months latter	2b/B
Kozora et al., [58] USA Elective CABG	Cohort *n* = 1156 99.2% male	BDI	After, 1-year follow-up	9.9 (7.65)	8.9 (7.85)	Older age and lower education are related to depression levels	2b/B
Macken et al., [59] USA Elective CABG	Quasi-experimental *n* = 34 76.5% male	PHQ-9	After CABG	–	Control group: 18%	An intervention cardiac program can reduce depressive symptoms	1b/A
McGrady et al., [60] USA Elective CABG	Quasi-experimental *n* = 91	BDI	After CABG	–	9.2 (7.5)	The symptoms can affect adherence to prescribed treatment and may also affect morbidity and mortality	1b/A
McKenzie et al., [61] UK Elective or emergency CABG	Cross-sectional *n* = 111 82.9% male	HADS	After CABG	–	3.16 (3.61)13.5%	Post-operative depression predicts activities of daily living functioning	2b/B
McKhann et al., [24] USA Elective CABG	Cohort *n* = 220 73.6% male	CES-D	After, 3 months, 1–3–6 years after	–	**Baseline:** 13.2 (9.8) 32.4% **3-months:** 10.2 (9.9) 24.1% **1 year:** 9.1 (9.8) 17.3% **3 year:** 8.9 (9.5) 11.8% **6 year:** 10.1 (9.4) 16.8%	Depressed patients tended to have more memory complaints	2b/B
Modica et al., [62] Italy Elective CABG	Cross-sectional *n* = 1179 80% male	HADS	After CABG	–	Moderate-severe: 10.4% Male: 9.2% Female: 15.4%	Female gender is related to a higher depression score	2b/B
Moser et al., [63] USA Elective CABG	Observational multicentre *n* = 131 94% male	MAACL	After CABG	–	13.0 (5.5) 53%	Factors such as being a woman and have lower educational attainment are related to depression	2b/B
Murphy et al., [64] Australia Elective CABG	Cohort *n* = 184 79% male	HADS	Before, 2–6 months follow-up	5.35 (4.01)	**2-months:** 4.16 (3.71) **6-months:** 3.87 (3.51)	Over 6-months follow-up patients show a minor score of depression	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Nair et al., [65] India Elective CABG	Quasi-experimental *n* = 500 20.2% male	HADS	6 months after	–	20.2%	11.6% of patients after CABG adhered to healthy lifestyle practices	1b/A
Nemati & Astaneh, [66] Iran Elective CABG	Cohort *n* = 71 73% male	HADS	Before, 4-weeks after	Male: 13.58 (8.54) Female: 17.88 (7.54)	Male: 9.51 (6.00) Female: 15.05 (8.63)	CABG surgery can decrease the level of depression in a short-term follow-up	2b/B
Nunes et al., [67] Brazil Elective CABG	Cohort *n* = 57 68.42% male	BDI	Before, 6-months after	Minimal: 56.14% Mild: 26.32% Moderate: 12.28% Severe: 5.26%	Minimal: 49.12% Mild: 29.82% Moderate: 17.54% Severe: 3.51%	Improvement the quality of life with CABG surgery reducing depressive symptoms	2b/B
Okamoto et al., [68] Japan Elective or emergency CABG	Cross-sectional *n* = 79 75.9% male	HADS	1–5 years after	–	Mild: 10.1% Moderate-severe: 10.1%	Depression in CABG patients is related to a decrease in functional status or activities of daily living	2b/B
Oldham et al., [69] USA First-time CABG	Cohort *n* = 131 73% male	HAM-D PHQ-9 GDS	Before	HAM-D: 9.9% 16.3 (5.4) PHQ-9: 56.2% 13.4 (3.9) GDS: 6.9 (3.6)	–	Preoperative depression predicts post-CABG cognitive health	2b/B
Perrotti et al., [70] France Elective CABG	RCT *n* = 359 85% male	BDI	Before,1 year after	39.6%	–	In the first year after CABG, depressed patients have a lower improvement and quality of life	1a/A
Perrotti et al., [71] France Elective CABG	Cohort *n* = 272 78% male	HADS	2-weeks before	6%	–	CABG surgery improve the functional mobility, quality of life and maintenance of an independent status	2b/B
Phillips-Bute et al., [72] USA Elective CABG	Cohort *n* = 427 70% male	CES-D	Before, 6 months, 1 year after	Mild-Severe Male: 28% Female: 57%	Mild-severe: **Male:** 6-months: 17% 1-year: 17% **Female:** 6-months: 33% 1-year: 32%	Depressed patients are more prone than nondepressed patients to have a new cardiac event within 2 years of CABG	2b/B
Poole et al., [23] UK First-time CABG	Cohort *n* = 310 86% male	BDI	29 days before, after surgery	8.68 (6.61) 30.3% Minimal: 69.7% Mild: 25.5% Moderate-severe: 4.8%	8.33	Pre-operative depression is associated with longer postoperative hospital stays. The young, female gender, overweight, smoking and hypertension variables are related to depression symptoms	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Pourafkari et al., [73] Iran Elective CABG	Quasi-experimental *n* = 40 82% male	BDI	After CABG	–	25% Minimal: 75% Mild: 12% Moderate: 8% Severe: 5%	The emergence of new-onset depression after CABG is associated with a poor outcome	1b/A
Rezaei et al., [74] Iran Elective CABG	Cohort *n* = 135 75% male	SCL-90R	6 months after	–	1.17 (0.75) 44.22%	The prevalent mental disorder after CABG is depression followed by sensitivity, paranoia, hostility, anxiety, obsession, somatization, phobia, and psychosis	2b/B
Sandau et al., [75] USA Elective CABG	Cohort *n* = 54 78% male	CES-D	Before, 3-months after	14.2 (8.6) 20%	10.4 (7.5)	Depressive symptoms remain constant from pre- to postoperatively at 3 months	2b/B
Schwarz et al., [76] Germany Elective CABG	Cohort *n* = 47 89% male	HADS	Before, 3-months after	5.0 (3.4)	3.8 (3.1)	Depression and health-related quality of life are not associated with cognitive dysfunction after CABG	2b/B
Selnes et al., [25] USA Elective or emergency CABG	Cohort *n* = 152 76% male	CES-D	Before, 12–72 months follow-up	13.2 (9.6) 33%	9.5 (9.2) 13%	CABG patients had a decline of score 72-months after	2b/B
Sorensen & Wang, [77] USA First-time CABG	Cohort *n* = 70 66% male	GDS	Before, 6-weeks after	3.1 (2.5) 24.2%	2.4 (2.3) 15.9%	Women had greater depression pre-operative and post-operative. Length of stay and age are not related to depression	2b/B
Spezzaferri et al., [78] Italy Elective CABG	Cohort *n* = 118 100% male	CBA 2.0-D	At discharge, 1 year after	–	**At discharge:** 12.7% **1 year:** 5.9%	1 year after CABG depression level decreased	2b/B
Stenman & Sartipy, [79] Sweden Elective and emergency CABG	Cohort *n* = 302	PHQ-9	Before	29%	–	Depressive symptoms are twice as frequent in women as in men	2b/B
Thomas et al., [80] India First-time CABG	Quasi-experimental *n* = 100 85% male	HADS	Before, 1-week, 1 month after	4.10 (3.30)	**1-week:** 2.03 (2.60) **1-month:** 1.26 (1.82)	Medical adherence behavior is related to depression six weeks after surgery	1b/A
Tsai et al., [81] Taiwan First-time CABG	Cohort *n* = 198 81% male	CSS	Before, 1–6 weeks, 3 months follow-up	2.42 (2.64)	**1-week:** 1.41 (2.00) **6-weeks:** 1.24 (1.86) **3-months:** 0.96 (1.70)	Age, a longer stay in ICU, smoking, and lack of exercise are related to worse symptoms. 88% of patients have a trajectory of depression levels that decrease over time	2b/B

Table 1. *Cont.*

Study CABG (First, Elective, Emergency)	Design and Sample	Depression Screening Instrument	Timing of Assessment	M (SD)/Prevalence		Main Results	EL/RG
				Pre	Post		
Tully et al., [82] Australia First-time CABG	Cohort n = 226 83% male	DASS	Before, 4 days after	20.1%	23.5%	Readmission is related to a higher depression score. Depression symptoms are associated with morbidity	2b/B
Tully et al., [83] Australia First-time CABG	Cohort n = 226 83% male	BDI	Before, after surgery	8.62 (6.23)	9.05 (6.40)	Pessimism, past failure, self-criticalness and, worthlessness are associated with cardiac morbidity and mortality	2b/B
Yang et al., [84] China First-time CABG	Cohort n = 232 81% male	PHQ-9	3-days before, 6-months after	4.8 (5.0) 18.1%	4.2 (5.0) 18.1%	Preoperative depression is associated with women gender	2b/B
Yang et al., [85] Taiwan Elective and emergency CABG	Cross-sectional n = 87 74.7% male	HADS	1 week, 1 month after	–	**1 week:** Mild: 17.2% Moderate-severe: 60.9% **1 month:** 8.75 (4.63) Mild: 24.1% Moderate-severe: 35.6%	Depression is related to sleep quality after CABG surgery	2b/B
Yüksel et al., [86] Turkey Elective and first-CABG	Cohort n = 63 G1: diagnosed after experiencing an ACS G2: diagnosed without an ACS	BDI	Before	G1:14.9 (9.5) G2: 12.1 (7.4) 66.6% Mild: 22.2% Moderate-severe: 44.4%	–	Patients in both groups were found to be depressed and hopeless about the future	2b/B
Zimmerman et al., [87] USA Elective CABG	RCT n = 226 83% male	CSS	At discharge	–	19%	Health care providers must assist the patients before hospital discharge to identify the risks and difficulties in patients after CABG up to 6 months after surgery	1a/A

ACS = Acute Coronary Syndrome; BDI = Beck Depression Inventory; CABG = Coronary Artery Bypass Graft; CBA 2.0-D = Depression scales of the Cognitive Behavioural Assessment; CDS = Cardiac Depression Scale; CES-D = Center for Epidemiological Studies Depression Scale; CSS = Cardiac Symptom Survey; DASS = Depression, Anxiety, Stress scale; GDS = Geriatric Depression Scale; HADS = Hospital Anxiety and Depression Scale; HAM-D = Hamilton Rating Scale for Depression; ICU = Intensive care unit; MAACL = Multiple Affect Adjective Checklist; PHQ-2 = Patient Health Questionnaire 2-item; PHQ-9 = Patient Health Questionnaire 9-item; POMS-D = Profile of Mood State Depression Scale; RCT = Randomized Clinical Trial; SDS = Self-rating Depression Scale; SCL-90R = Symptom Checklist-90 Revised.

J. Clin. Med. **2020**, *9*, 909

3.2. Measurement of Depression

We used a total of 15 measurement tools. The Hospital Anxiety and Depression Scale (HADS) (n = 18), Beck Depression Inventory (BDI) (n = 17), nine-item Patient Health Questionnaire (PHQ-9) (n = 9), and Centre for Epidemiological Studies Depression Scale (CES-D) (n = 4) were the measurement tools used (Table 1 and Supplementary Table S1).

3.3. Meta-Analysis

A total of 1217 patients were included in the meta-analysis prior to CABG surgery, and 596 patients after the operation. Egger's test showed no publication bias in any case.

For the HADS tool, the prevalence of depression prior to surgery (n = 144) was 19% (95% CI = 9–31) with a high degree of heterogeneity (I^2 = 93.4%), while the prevalence after surgery (n = 394) was 19% (95% CI = 13–26) with I^2 = 92.2%, according to the random effects model (Figures 2 and 3).

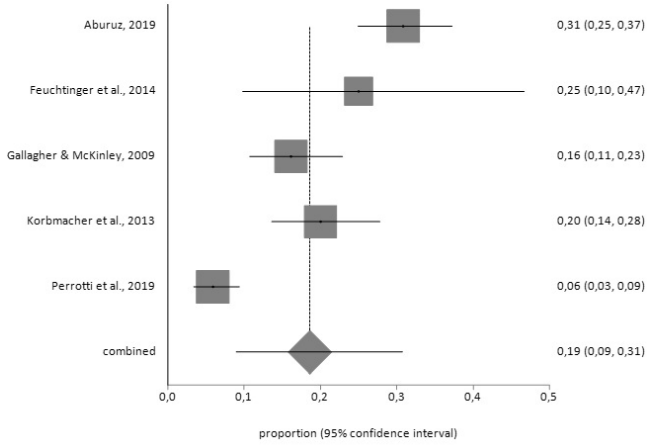


Figure 2. Forest plot for pre-CABG depression using Hospital Anxiety and Depression Scale (HADS).

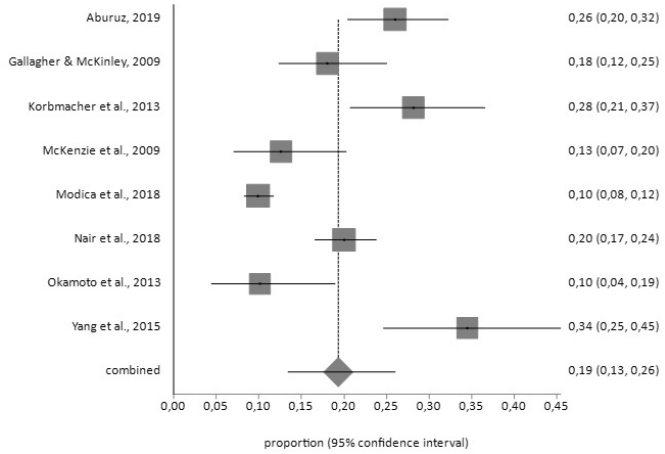


Figure 3. Forest plot for post-CABG depression using HADS.

For the BDI tool, the prevalence of depression prior to surgery (n = 469) was 37% (95% CI = 28–46) with a high degree of heterogeneity (I^2 = 89.4%), while the prevalence afterwards (n = 97) was 33% (95% CI = 12–59) with a high degree of heterogeneity (I^2 = 96.6%), according to the random effects model (Figures 4 and 5).

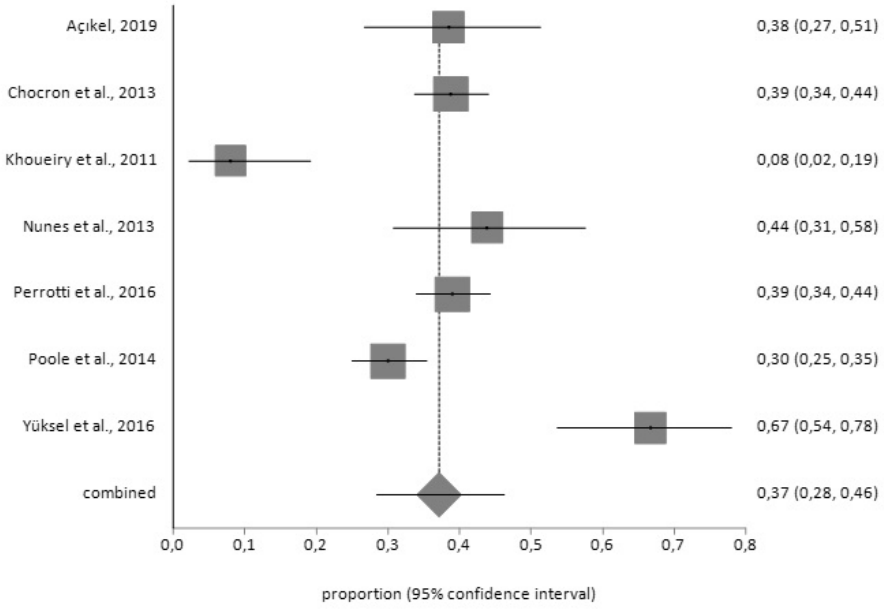


Figure 4. Forest plot for pre-CABG depression using Beck Depression Inventory (BDI).

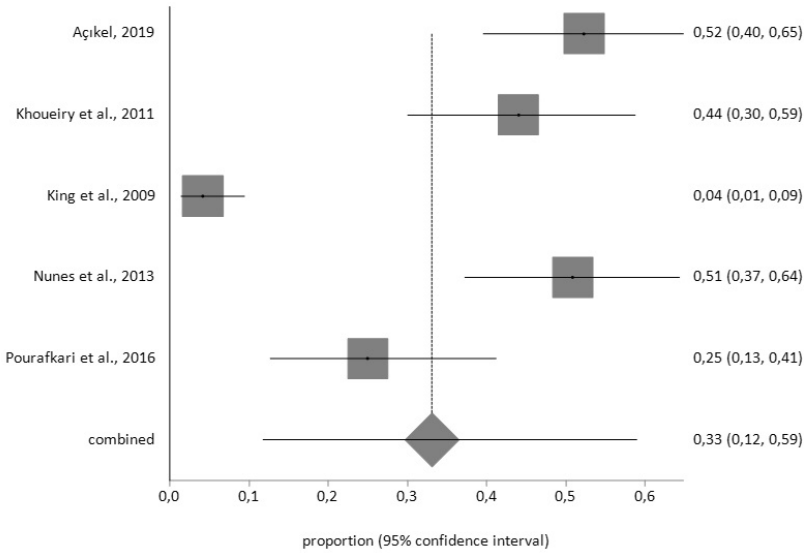


Figure 5. Forest plot for post-CABG depression using BDI.

J. Clin. Med. **2020**, *9*, 909

According to the PHQ-9 tool, the prevalence prior to surgery (n = 543) was 22% (95% CI = 12–33) with a high degree of heterogeneity (I^2 = 97.5%) according to the random effects model; and, the prevalence of depression after surgery (n = 48), using the fixed effects model, was 18% (95% CI = 14–23) (Figures 6 and 7), with a low degree of heterogeneity (I^2 = 2%).

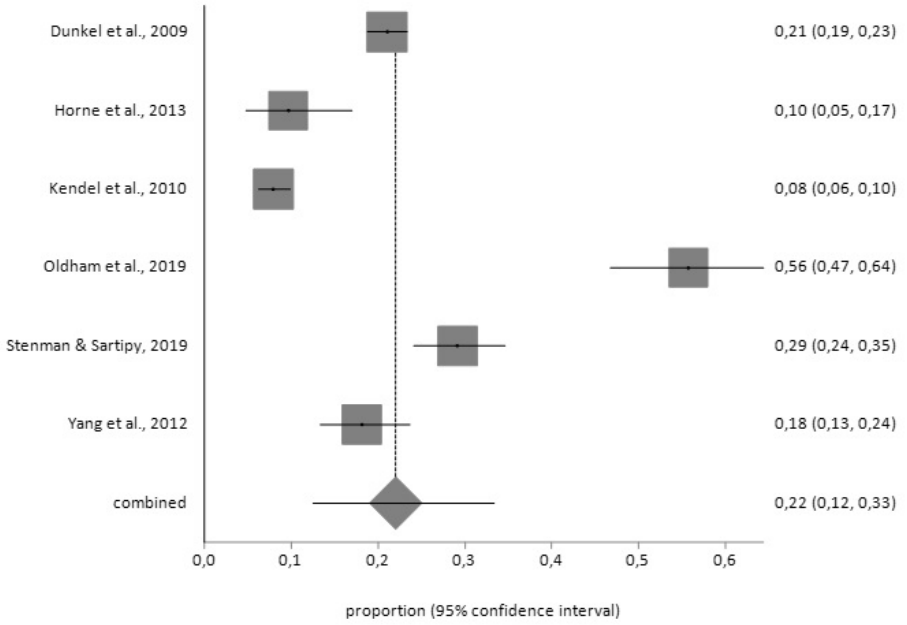


Figure 6. Forest plot for pre-CABG depression using Patient Health Questionnaire (PHQ-9).

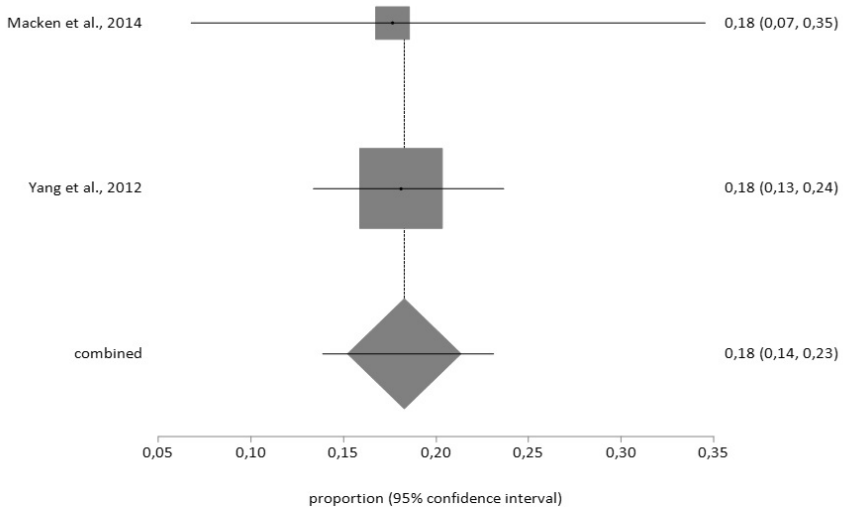


Figure 7. Forest plot for post-CABG depression using PHQ-9.

Finally, for CES-D, the prevalence of pre-CABG depression ($n = 61$) using the random effects model was 28% (95% CI = 17–40) with a moderate degree of heterogeneity ($I^2 = 66.9\%$); while the prevalence after surgery ($n = 57$) was 15% (95% CI = 12–19) with a low degree of heterogeneity ($I^2 = 2\%$), according to the fixed effects model (Figures 8 and 9)

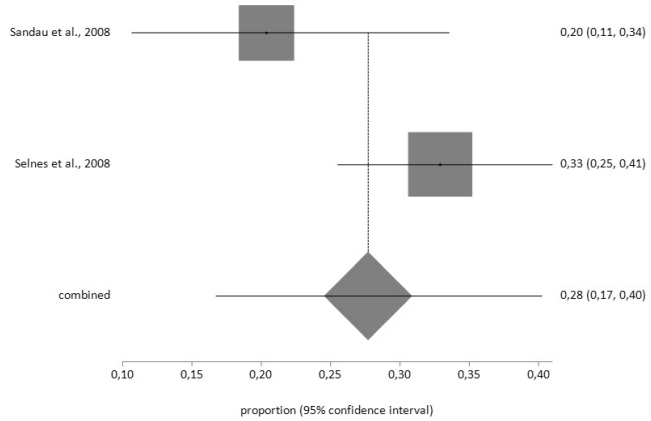


Figure 8. Forest plot for pre-CABG depression using Centre for Epidemiological Studies Depression Scale (CES-D).

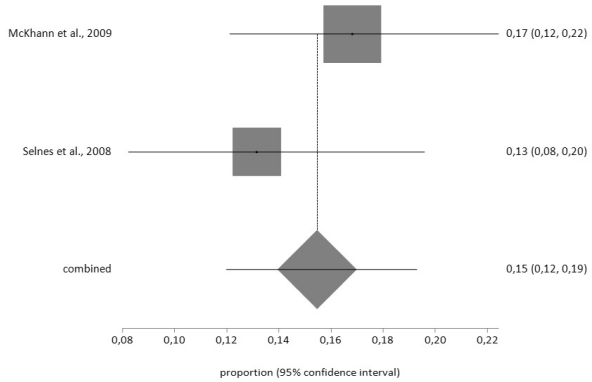


Figure 9. Forest plot for post-CABG depression using CES-D.

3.4. Levels of Depression Before and After CABG Surgery and Follow Up

Prior to CABG surgery, most of the authors report depression levels within the normal range, although others found mild [36,55,58,83,86] and moderate levels [27,35,66,69] (Table 1).

Post-surgery, most authors report normal levels, while others found mild [28,36,49,53,58,60,66,83,85,88], moderate [27,47,69], and severe [32] levels.

The majority of authors observed a positive impact on depression prevalence and levels after surgery, as well as in the short and medium term, although others found that these levels increased after surgery [28,32,33,48,49,55,57,89].

4. Discussion

The prevalence of depression obtained in this study varied between 19% and 37% prior to surgery, and between 15% and 33% after surgery, depending on the type of measurement tool

used. Other studies that combine CABG with valve replacement have reported similar percentages, with depression prevalence ranging from 15% pre-CABG [90] to 37.7% post-CABG [51,91], associated with the development of the disease, worse quality of life, longer hospital stays, and high rates of hospital readmissions [8].

Normal levels of pre-CABG depression are observed, although other studies have indicated higher levels, from moderate to severe [92]. However, more than 25% of patients with normal levels are at risk of worsening, for which reason continuous reassessment can identify patients with transient symptoms of depression [93].

High levels of depression prior to the operation predict a worse quality of life [94,95], worse survival after a CABG [12,96], and more symptoms up to six months after surgery [97].

We have observed that depression levels did not go to remission, but they tend to improve in depressive symptoms, which is probably due to an improvement in the patient's quality of life [98], and even due to greater optimism that facilitates commitment to adaptation [99]. Some authors have found a positive impact on patients from eight weeks [100], while others report a slight improvement from the first month post-CABG surgery [101]. For the majority of patients, depression persists after the surgery. Recent meta-analyses demonstrated that patients undergoing heart valve surgery are at risk of cognitive dysfunction up to six months after surgery [102,103].

Although there is a relationship between depression and CABG, its temporal onset is not clear. Depression can be a pre-existing condition, which increases the risk of cardiovascular disease that is related to behavioural alterations in diet, physical activity level, toxic habits, or poor adherence to treatment and recommendations [45]; or, can appear as a consequence of multiple postoperative complications, such as longer hospital stays [23], readmissions [104,105], general pain [104], or even when facing a series of lifestyle changes [12].

Without evaluation, it is unlikely that depression is being treated correctly. Some authors report that more than 50% of patients were receiving medical treatment for depression, even though they had no symptoms of depression [106]. For this reason, the use of measurement tools to confirm the presence and levels of depression makes it possible to identify the at-risk patients, and therefore carry out a more in-depth post-CABG follow-up, of at least nine months [93].

The current study highlights the importance of depression measures before and after CABG in assessing clinically meaningful mood disturbance, in order to provide early intervention. Systematic screening for depression in the period both before and after this procedure is crucial. Planned coaching combined with counselling can reduce these levels [36]. Cardiac rehabilitation programmes [107,108] and cognitive-behavioural therapies are also available, which reduce the levels of depression and even decrease the length of hospital stays [109]. However, further studies are needed to understand the potential prognostic implication of depression and investigate the best ways to approach the treatment of depression in this patient group.

Depression counselling prior to surgery can influence the post-surgical depression levels by positively improving a patient's perception of illness control and management [13]. Planning is therefore an essential part of the healthcare process as it has the potential to promote self-care [36].

From a clinical perspective, these results suggest that strategies that are aimed to improve depression as a disorder, such as the application of policies and depression assessment protocols prior to CABG by health care providers, are essential, because the depression level might help risk stratification in patients undergoing CABG identifying the high-risk groups and the trajectory of recovery experienced [11].

This study has several limitations. Firstly, the heterogeneity in terms of prevalence is due to different estimation methods over time, differences in the timing of assessment and demographic differences between samples, different uses of cut-offs on questionnaire measures, as well as the use of various tools for assessing the symptoms of depression. Secondly, the measuring tools assess the severity of depression symptoms, but they do not replace a formal clinical diagnosis of depression.

5. Conclusions

There is a high presence of depression both before and after CABG surgery. While this study found an overall improvement in depressive symptoms after CABG, depression persists after the surgery for the majority of patients. The depression levels present prior to the operation may affect postoperative recovery.

Given the prevalence of depression and its impact, early detection is crucial, since it enables the identification of at-risk patients, through a clinical interview that uses validated measurement tools. This enables the medical team to implement preventive strategies as well as monitor the development of the depression.

Supplementary Materials: The following are available online at http://www.mdpi.com/2077-0383/9/4/909/s1, Table S1: Depression Assessment Instruments Used by the 65 Studies Included in the Systematic Review [110–122].

Author Contributions: J.S.-R., J.L.G.-U. and M.C.-R. conceived and designed the review and meta-analysis; M.A.E., N.S.-M. and M.J.M.-J. contributed to the selection process and analysis of the risk of bias; N.S.-M. and J.L.G.-U. contributed to the meta-analysis; J.S.-R., M.C.-R. and A.V.-S. contributed to the data extraction; N.S.-M. and M.C.-R. wrote the paper; J.S.-R. and J.L.G.-U. drafted the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: The results reported in the study are from the doctoral thesis of Moath Abu Ejheisheh and belong to the Clinical Medicine and Health Public Programme (B 12.56.1) of the University of Granada, Spain.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Le, J.; Dorstyn, D.S.; Mpfou, E.; Prior, E.; Tully, P.J. Health-related quality of life in coronary heart disease: A systematic review and meta-analysis mapped against the International Classification of Functioning, Disability and Health. *Qual. Life Res.* **2018**, *27*, 2491–2503. [CrossRef] [PubMed]
2. Alexander, J.H.; Smith, P.K. Coronary-Artery Bypass Grafting. *N. Engl. J. Med.* **2016**, *374*, 1954–1964. [CrossRef] [PubMed]
3. Noyez, L.; de Jager, M.J.; Markou, A.L.P. Quality of life after cardiac surgery: Underresearched research. *Interact. Cardiovasc. Thorac. Surg.* **2011**, *13*, 511–515. [CrossRef] [PubMed]
4. Karim, M.N.; Reid, C.M.; Huq, M.; Brilleman, S.L.; Cochrane, A.; Tran, L.; Billah, B. Predicting long-term survival after coronary artery bypass graft surgery. *Interact. Cardiovasc. Thorac. Surg.* **2018**, *26*, 257–263. [CrossRef] [PubMed]
5. AbuRuz, M.E.; Al-Dweik, G.; Al-Akash, H.Y. Checking the moderating effect of perceived control on the relationship between anxiety and postoperative hospital length of stay among coronary artery bypass graft patients. *Int. J. Gen. Med.* **2019**, *12*, 79–85. [CrossRef] [PubMed]
6. Kidd, T.; Poole, L.; Ronaldson, A.; Leigh, E.; Jahangiri, M.; Steptoe, A. Attachment anxiety predicts depression and anxiety symptoms following coronary artery bypass graft surgery. *Br. J. Health Psychol.* **2016**, *21*, 796–811. [CrossRef]
7. Celano, C.M.; Huffman, J.C. Depression and cardiac disease: A review. *Cardiol. Rev.* **2011**, *19*, 130–142. [CrossRef]
8. Iribarne, A.; Chang, H.; Alexander, J.H.; Gillinov, A.M.; Moquete, E.; Puskas, J.D.; Bagiella, E.; Acker, M.A.; Mayer, M.L.; Ferguson, T.B.; et al. Readmissions after cardiac surgery: Experience of the national institutes of health/canadian institutes of health research cardiothoracic surgical trials network. *Ann. Thorac. Surg.* **2014**, *98*, 1274–1280. [CrossRef]
9. Beck, A.; Steer, R. *Manual for the Beck Depression Inventory*, 1993 ed.; Psychological Corporation: San Antonio, TX, USA, 1987.
10. Zigmond, A.S.; Snaith, R.P. The hospital anxiety and depression scale. *Acta Psychiatr. Scand.* **1983**, *67*, 361–370. [CrossRef]
11. Ravven, S.; Bader, C.; Azar, A.; Rudolph, J.L. Depressive symptoms after CABG surgery: A meta-analysis. *Harv. Rev. Psychiatry* **2013**, *21*, 59–69. [CrossRef]

12. Stenman, M.; Holzmann, M.J.; Sartipy, U. Association between preoperative depression and long-term survival following coronary artery bypass surgery—A systematic review and meta-analysis. *Int. J. Cardiol.* **2016**, *222*, 462–466. [CrossRef] [PubMed]
13. Rushton, M.; Howarth, M.; Grant, M.J.; Astin, F. Person-centred discharge education following coronary artery bypass graft: A critical review. *J. Clin. Nurs.* **2017**, *26*, 5206–5215. [CrossRef] [PubMed]
14. Abdulrahman, M.; Alsabbagh, A.; Kuntze, T.; Lauer, B.; Ohlow, M.A. Impact of hierarchy on multidisciplinary heart-team recommendations in patients with isolated multivessel coronary artery disease. *J. Clin. Med.* **2019**, *8*, 1490. [CrossRef]
15. McKenzie, L.; Simpson, J.; Stewart, M. A systematic review of pre-operative predictors of post-operative depression and anxiety in individuals who have undergone coronary artery bypass graft surgery. *Psychol. Health Med.* **2010**, *15*, 74–93. [CrossRef]
16. Protogerou, C.; Fleeman, N.; Dwan, K.; Richardson, M.; Dundar, Y.; Hagger, M.S. Moderators of the effect of psychological interventions on depression and anxiety in cardiac surgery patients: A systematic review and meta-analysis. *Behav. Res. Ther.* **2015**, *73*, 151–164. [CrossRef] [PubMed]
17. Keeping-Burke, L.; Purden, M.; Frasure-Smith, N.; Cossette, S.; McCarthy, F.; Amsel, R. Bridging the transition from hospital to home: Effects of the VITAL telehealth program on recovery for CABG surgery patients and their caregivers. *Res. Nurs. Health* **2013**, *36*, 540–553. [CrossRef]
18. Moher, D.; Shamseer, L.; Clarke, M.; Ghersi, D.; Liberati, A.; Petticrew, M.; Shekelle, P.; Stewart, L. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst. Rev.* **2015**, *4*, 1. [CrossRef] [PubMed]
19. Sanderson, S.; Tatt, I.D.; Higgins, J.P.T. Tools for assessing quality and susceptibility to bias in observational studies in epidemiology: A systematic review and annotated bibliography. *Int. J. Epidemiol.* **2007**, *36*, 666–676. [CrossRef]
20. Higgins, J.P.T.; Green, S. Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0. The Cochrane Collaboration. Available online: www.cochrane-handbook.org (accessed on 10 September 2019).
21. Howick, J.; Chalmers, I.; Glasziou, P.; Greenhalg, T.; Heneghan, C.; Liberati, A.; Moschetti, I.; Phillips, B.; Thornton, H. The Oxford 2011 Levels of Evidence. Available online: https://www.cebm.net/2016/05/ocebm-levels-of-evidence (accessed on 10 September 2019).
22. Higgins, J.P.T.; Thompson, S.G.; Deeks, J.J.; Altman, D.G. Measuring inconsistency in meta-analyses. *Br. Med. J.* **2003**, *327*, 557–560. [CrossRef]
23. Poole, L.; Leigh, E.; Kidd, T.; Ronaldson, A.; Jahangiri, M.; Steptoe, A. The combined association of depression and socioeconomic status with length of post-operative hospital stay following coronary artery bypass graft surgery: Data from a prospective cohort study. *J. Psychosom. Res.* **2014**, *76*, 34–40. [CrossRef]
24. McKhann, G.M.; Selnes, O.A.; Grega, M.A.; Bailey, M.M.; Pham, L.D.; Baumgartner, W.A.; Zeger, S.L. Subjective memory symptoms in surgical and nonsurgical coronary artery patients: 6-year follow-up. *Ann. Thorac. Surg.* **2009**, *87*, 27–34. [CrossRef] [PubMed]
25. Selnes, O.A.; Grega, M.A.; Bailey, M.M.; Pham, L.D.; Zeger, S.L.; Baumgartner, W.A.; McKhann, G.M. Cognition 6 years after surgical or medical therapy for coronary artery disease. *Ann. Neurol.* **2008**, *63*, 581–590. [CrossRef] [PubMed]
26. Abbott, A.; Barnason, S.; Zimmerman, L. Symptom burden clusters and their impact on psychosocial functioning following coronary artery bypass surgery. *J. Cardiovasc. Nurs.* **2010**, *25*, 301–310. [CrossRef] [PubMed]
27. Aburuz, M.E. Pre-operative depression predicted longer hospital length of stay among patients undergoing coronary artery bypass graft surgery. *Risk Manag. Healthc. Policy* **2019**, *12*, 75–83. [CrossRef] [PubMed]
28. Açıkel, M.E.T. Evaluation of depression and anxiety in coronary artery bypass surgery patients: A prospective clinical study. *Braz. J. Cardiovasc. Surg.* **2019**, *34*, 389–395. [CrossRef] [PubMed]
29. Afridi, M.I.; Habib, S.; Lal, C.; Khan, A.U.R.; Afaq, S.M.; Tariq, Q.D. Frequency of depression in patients undergoing coronary artery bypass grafting surgery (CABGS), before the surgery, at discharge and at six months follow up. *J. Liaquat Univ. Med. Heal. Sci.* **2016**, *15*, 110–115.
30. Ajtahed, S.S.; Rezapour, T.; Etemadi, S.; Moradi, H.; Habibi Asgarabad, M.; Ekhtiari, H. Efficacy of neurocognitive rehabilitation after coronary artery bypass graft surgery in improving quality of life: An interventional trial. *Front. Psychol.* **2019**, *10*, 1759. [CrossRef]

31. Ammouri, A.A.; Al-Daakak, Z.M.; Gharaibeh, H.; Al-Zaru, I. Symptoms experienced by jordanian men and women after coronary artery bypass graft surgery. *Dimens. Crit. Care Nurs.* **2016**, *35*, 125–132. [CrossRef]
32. Amouzeshi, A.; Hosseini, S.M.; Javadi, A.; Norozian, F.; Zamanian, N.; Yahya, M.; Jomefourjan, S.; Amouzeshi, Z.; Kohan, M. Depression and associated factors in patients undergoing coronary artery bypass grafting in Imam Reza Hospital of Mashhad in 2013. *J. Surg. Trauma* **2015**, *3*, 51–56.
33. Azzopardi, S.; Lee, G. Health-related quality of life 2 years after coronary artery bypass graft surgery. *J. Cardiovasc. Nurs.* **2009**, *24*, 232–240. [CrossRef]
34. Bay, P.S.; Beckman, D.; Trippi, J.; Gunderman, R.; Terry, C. The effect of pastoral care services on anxiety, depression, hope, religious coping, and religious problem solving styles: A randomized controlled study. *J. Relig. Health* **2008**, *47*, 57–69. [CrossRef] [PubMed]
35. Beresnevaite, M.; Benetis, R.; Taylor, G.J.; Jurnien, K.; Kinduris, Š.; Barauskien, V. Depression predicts perioperative outcomes following coronary artery bypass graft surgery. *Scand. Cardiovasc. J.* **2010**, *44*, 289–294. [CrossRef] [PubMed]
36. Cebeci, F.; Çelik, S.Ş. Effects of discharge teaching and counselling on anxiety and depression level of CABG patients. *Turk. J. Thorac. Cardiovasc. Surg.* **2011**, *19*, 170–176. [CrossRef]
37. Chocron, S.; Vandel, P.; Durst, C.; Laluc, F.; Kaili, D.; Chocron, M.; Etievent, J.-P. Antidepressant therapy in patients undergoing coronary artery bypass grafting: The MOTIV-CABG trial. *Ann. Thorac. Surg.* **2013**, *95*, 1609–1618. [CrossRef]
38. Colella, T.J.; King-Shier, K. The effect of a peer support intervention on early recovery outcomes in men recovering from coronary bypass surgery: A randomized controlled trial. *Eur. J. Cardiovasc. Nurs.* **2018**, *17*, 408–417. [CrossRef] [PubMed]
39. Dal Boni, A.L.M.; Martinez, J.E.; Da Silva Saccomann, I.C.R. Quality of Life of patients undergoing coronary artery bypass grafting. *Acta Paul. Enferm.* **2013**, *26*, 575–580. [CrossRef]
40. Doering, L.V.; Martínez-Maza, O.; Vredevoe, D.L.; Cowan, M.J. Relation of depression, natural killer cell function, and infections after coronary artery bypass in women. *Eur. J. Cardiovasc. Nurs.* **2008**, *7*, 52–58. [CrossRef]
41. Donohue, J.M.; Belnap, B.H.; Men, A.; He, F.; Roberts, M.S.; Schulberg, H.C.; Reynolds, C.F.; Rollman, B.L. Twelve-month cost-effectiveness of telephone-delivered collaborative care for treating depression following CABG surgery: A randomized controlled trial. *Gen. Hosp. Psychiatry* **2014**, *36*, 453–459. [CrossRef]
42. Dunkel, A.; Kendel, F.; Lehmkuhl, E.; Babitsch, B.; Oertelt-Prigione, S.; Hetzer, R.; Regitz-Zagrosek, V. Predictors of preoperative depressive risk in patients undergoing coronary artery bypass graft surgery. *Clin. Res. Cardiol.* **2009**, *98*, 643–650. [CrossRef]
43. Dunkel, A.; Kendel, F.; Lehmkuhl, E.; Hetzer, R.; Regitz-Zagrosek, V. Causal attributions among patients undergoing coronary artery bypass surgery: Gender aspects and relation to depressive symptomatology. *J. Behav. Med.* **2011**, *34*, 351–359. [CrossRef]
44. El-Baz, N.; Ondusova, D.; Studencan, M.; Rosenberger, J.; Reijneveld, S.A.; van Dijk, J.P.; Middel, B. Differences between Slovak and Dutch patients scheduled for coronary artery bypass graft surgery regarding clinical and psychosocial predictors of physical and mental health-related quality of life. *Eur. J. Cardiovasc. Nurs.* **2018**, *17*, 324–335. [CrossRef] [PubMed]
45. Elliott, P.C.; Murphy, B.M.; Oster, K.A.; Le Grande, M.R.; Higgins, R.O.; Worcester, M.U.C. Changes in mood states after coronary artery bypass graft surgery. *Eur. J. Cardiovasc. Nurs.* **2010**, *9*, 188–194. [CrossRef] [PubMed]
46. Feuchtinger, J.; Burbaum, C.; Heilmann, C.; Imbery, C.; Siepe, M.; Stotz, U.; Fritzsche, K.; Beyersdorf, F. Anxiety and fear in patients with short waiting times before coronary artery bypass surgery—A qualitative study. *J. Clin. Nurs.* **2014**, *23*, 1900–1907. [CrossRef] [PubMed]
47. Freedland, K.; Skala, J.; Carney, R.; Rubin, E.; Lustman, P.; Dávila-Román, V.; Steinmeyer, B.; Hogue, C. Treatment of depression after coronary artery bypass surgery: A randomized controlled trial. *Arch. Gen. Psychiatry* **2009**, *66*, 387–396. [CrossRef] [PubMed]
48. Gallagher, R.; McKinley, S. Anxiety, depression and perceived control in patients having coronary artery bypass grafts. *J. Adv. Nurs.* **2009**, *65*, 2386–2396. [CrossRef] [PubMed]
49. Gelogahi, Z.K.; Aghebati, N.; Mazloum, S.R.; Mohajer, S. Effectiveness of nurse's intentional presence as a holistic modality on depression, anxiety, and stress of cardiac surgery patients. *Holist. Nurs. Pract.* **2018**, *32*, 296–306. [CrossRef]

50. Hazavei, S.M.M.; Sabzmakan, L.; Hasanzadeh, A.; Rabiei, K.; Roohafza, H. The effects of an educational program based on PRECEDE model on depression levels in patients with coronary artery bypass grafting. *ARYA Atheroscler.* **2012**, *8*, 36–42.
51. Horne, D.; Kehler, S.; Kaoukis, G.; Hiebert, B.; Garcia, E.; Duhamel, T.A.; Arora, R.C. Depression before and after cardiac surgery: Do all patients respond the same? *J. Thorac. Cardiovasc. Surg.* **2013**, *145*, 1400–1406. [CrossRef]
52. Hweidi, I.M.; Gharaibeh, B.A.; Al-Obeisat, S.M.; Al-Smadi, A.M. Prevalence of depression and its associated factors in patients post-coronary artery bypass graft surgery. *J. Res. Nurs.* **2018**, *23*, 76–88. [CrossRef]
53. Kendel, F.; Dunkel, A.; Lehmkuhl, E.; Hetzer, R.; Regitz-Zagrosek, V. Does time spent on household activities or housework stress complicate recovery following coronary artery bypass surgery? *Women Health* **2008**, *48*, 325–338.
54. Kendel, F.; Gelbrich, G.; Wirtz, M.; Lehmkuhl, E.; Knoll, N.; Hetzer, R.; Regitz-Zagrosek, V. Predictive relationship between depression and physical functioning after coronary surgery. *Arch. Intern. Med.* **2010**, *170*, 1717–1721. [CrossRef] [PubMed]
55. Khoueiry, G.; Flory, M.; Abi Rafeh, N.; Zgheib, M.H.; Goldman, M.; Abdallah, T.; Wettimuny, S.; Telesford, B.; Costantino, T.; McGinn, J.T. Depression, disability, and quality of life after off-pump coronary artery bypass grafting: A prospective 9-month follow-up study. *Hear. Lung J. Acute Crit. Care* **2011**, *40*, 217–225. [CrossRef] [PubMed]
56. King, K.M.; Colella, T.J.; Faris, P.; Thompson, D.R. Using the cardiac depression scale in men recovering from coronary artery bypass surgery. *J. Clin. Nurs.* **2009**, *18*, 1617–1624. [CrossRef]
57. Korbmacher, B.; Ulbrich, S.; Dalyanoglu, H.; Lichtenberg, A.; Schipke, J.D.; Franz, M.; Schäfer, R. Perioperative and long-term development of anxiety and depression in CABG patients. *Thorac. Cardiovasc. Surg.* **2013**, *61*, 676–681. [CrossRef]
58. Kozora, E.; Kongs, S.; Collins, J.; Hattler, B.; Baltz, J.; Hampton, M.; Grover, F.; Novitzky, D.; Shroyer, L. Cognitive outcomes after on- versus off-pump coronary artery bypass surgery. *Ann. Thorac. Surg.* **2010**, *90*, 1134–1141. [CrossRef] [PubMed]
59. Macken, L.C.; Yates, B.C.; Meza, J.; Norman, J.; Barnason, S.; Pozehl, B. Health-related quality-of-life outcomes in coronary artery bypass surgery patients and partners. *J. Cardiopulm. Rehabil. Prev.* **2014**, *34*, 130–137. [CrossRef]
60. McGrady, A.; McGinnis, R.; Badenhop, D.; Bentle, M.; Rajput, M. Effects of depression and anxiety on adherence to cardiac rehabilitation. *J. Cardiopulm. Rehabil. Prev.* **2009**, *29*, 358–364. [CrossRef]
61. McKenzie, L.; Simpson, J.; Stewart, M. The impact of depression on activities of daily living skills in individuals who have undergone coronary artery bypass graft surgery. *Psychol. Health Med.* **2009**, *14*, 641–653. [CrossRef]
62. Modica, M.; Castiglioni, P.; Minotti, A.; Faini, A.; Racca, V.; Ferratini, M. Psychological profile in coronary artery by-pass graft patients vs. valve replacement patients entering cardiac rehabilitation after surgery. *Sci. Rep.* **2018**, *8*, 14381. [CrossRef]
63. Moser, D.K.; Dracup, K.; Evangelista, L.S.; Zambroski, C.H.; Lennie, T.A.; Chung, M.L.; Doering, L.V.; Westlake, C.; Heo, S. Comparison of prevalence of symptoms of depression, anxiety, and hostility in elderly patients with heart failure, myocardial infarction, and a coronary artery bypass graft. *Hear. Lung J. Acute Crit. Care* **2010**, *39*, 378–385. [CrossRef]
64. Murphy, B.; Elliott, P.; Higgins, R.; Le Grande, M.; Worcester, M.; Goble, A.; Tatoulis, J. Anxiety and depression after coronary artery bypass graft surgery: Most get better, some get worse. *Eur. J. Cardiovasc. Prev. Rehabil.* **2008**, *15*, 434–440. [CrossRef] [PubMed]
65. Nair, V.V.; Nair, J.T.K.; Das, S.; Singh, K.K.; Kathayanat, J.T.; Radhakrishnan, R.; Chooriyil, N.; Babu, A. Lifestyle practices, health problems, and quality of life after coronary artery bypass grafting. *Indian J. Thorac. Cardiovasc. Surg.* **2018**, *34*, 476–482. [CrossRef]
66. Nemati, M.H.; Astaneh, B. The impact of coronary artery bypass graft surgery on depression and anxiety. *J. Cardiovasc. Med. (Hagerstown)* **2011**, *12*, 401–404. [CrossRef] [PubMed]
67. Nunes, J.K.V.R.S.; de Figueiredo Neto, J.A.; de Sousa, R.M.L.; Costa, V.L.X.D.C.; Silva, F.M.A.M.; da Hora, A.F.L.T.; da Silva, E.L.C.; Reis, L.M.C.B. Depression after CABG: A prospective study. *Braz. J. Cardiovasc. Surg.* **2013**, *28*, 491–497.

68. Okamoto, Y.; Motomura, N.; Murashima, S.; Takamoto, S. Anxiety and depression after thoracic aortic surgery or coronary artery bypass. *Asian Cardiovasc. Thorac. Ann.* **2013**, *21*, 22–30. [CrossRef]
69. Oldham, M.A.; Hawkins, K.A.; Lin, I.H.; Deng, Y.; Hao, Q.; Scoutt, L.M.; Yuh, D.D.; Lee, H.B. Depression predicts delirium after coronary artery bypass graft surgery independent of cognitive impairment and cerebrovascular disease: An analysis of the neuropsychiatric outcomes after heart surgery study. *Am. J. Geriatr. Psychiatry* **2019**, *27*, 476–486. [CrossRef]
70. Perrotti, A.; Mariet, A.S.; Durst, C.; Monaco, F.; Vandel, P.; Monnet, E.; Chocron, S. Relationship between depression and health-related quality of life in patients undergoing coronary artery bypass grafting: A MOTIV-CABG substudy. *Qual. Life Res.* **2016**, *25*, 1433–1440. [CrossRef]
71. Perrotti, A.; Ecarnot, F.; Monaco, F.; Dorigo, E.; Monteleone, P.; Besch, G.; Chocron, S. Quality of life 10 years after cardiac surgery in adults: A long-term follow-up study. *Health Qual. Life Outcomes* **2019**, *17*, 88. [CrossRef]
72. Phillips-Bute, B.; Mathew, J.P.; Blumenthal, J.A.; Morris, R.W.; Podgoreanu, M.V.; Smith, M.; Stafford-Smith, M.; Grocott, H.P.; Schwinn, D.A.; Newman, M.F.; et al. Relationship of genetic variability and depressive symptoms to adverse events after coronary artery bypass graft surgery. *Psychosom. Med.* **2008**, *70*, 953–959. [CrossRef]
73. Pourafkari, L.; Ghaffari, S.; Tajlil, A.; Shahamfar, J.; Hedayati, S.; Nader, N.D. The impact of cardiac rehabilitation program on anxiety and depression levels after coronary artery bypass graft surgery. *Cor Vasa* **2016**, *58*, e384–e390. [CrossRef]
74. Rezaei, O.; Komeilian, R.; Fattah, L.; Mandegar, M.H.; Dolatshahi, B. Quality of life and mental disorders in patients after coronary artery bypass grafting. *World Appl. Sci. J.* **2013**, *26*, 34–38. [CrossRef]
75. Sandau, K.E.; Lindquist, R.A.; Treat-Jacobson, D.; Savik, K. Health-related quality of life and subjective neurocognitive function three months after coronary artery bypass graft surgery. *Hear. Lung J. Acute Crit. Care* **2008**, *37*, 161–172. [CrossRef] [PubMed]
76. Schwarz, N.; Schoenburg, M.; Möllmann, H.; Kastaun, S.; Kaps, M.; Bachmann, G.; Sammer, G.; Hamm, C.; Walther, T.; Gerriets, T. Cognitive decline and ischemic microlesions after coronary catheterization. A comparison to coronary artery bypass grafting. *Am. Heart J.* **2011**, *162*, 756–763. [CrossRef] [PubMed]
77. Sorensen, E.A.; Wang, F. Social support, depression, functional status, and gender differences in older adults undergoing first-time coronary artery bypass graft surgery. *Hear. Lung J. Acute Crit. Care* **2009**, *38*, 306–317. [CrossRef] [PubMed]
78. Spezzaferri, R.; Modica, M.; Racca, V.; Ripamonti, V.; Tavanelli, M.; Brambilla, G.; Ferratini, M. Psychological disorders after coronary artery by-pass surgery: A one-year prospective study. *Monaldi Arch. Chest Dis. Arch. Monaldi Mal. Torace* **2009**, *72*, 200–205. [CrossRef] [PubMed]
79. Stenman, M.; Sartipy, U. Depression screening in cardiac surgery patients. *Hear. Lung Circ.* **2019**, *28*, 953–958. [CrossRef]
80. Thomas, M.; Hariharan, M.; Rana, S. Psychological distress as predictor of adherence and prognosis among patients undergoing coronary artery bypass grafting. *J. Indian Acad. Appl. Psychol.* **2016**, *42*, 161–171.
81. Tsai, M.F.; Tsay, S.F.; Moser, D.; Huang, T.Y.; Tsai, F.C. Examining symptom trajectories that predict worse outcomes in post-CABG patients. *Eur. J. Cardiovasc. Nurs.* **2019**, *18*, 204–214. [CrossRef]
82. Tully, P.J.; Baker, R.A.; Turnbull, D.; Winefield, H. The role of depression and anxiety symptoms in hospital readmissions after cardiac surgery. *J. Behav. Med.* **2008**, *31*, 281–290. [CrossRef]
83. Tully, P.J.; Winefield, H.R.; Baker, R.A.; Turnbull, D.A.; De Jonge, P. Confirmatory factor analysis of the Beck Depression Inventory-II and the association with cardiac morbidity and mortality after coronary revascularization. *J. Health Psychol.* **2011**, *16*, 584–595. [CrossRef]
84. Yang, L.; Wang, J.; Zhang, L.Z.; Hou, J.H.; Yuan, X.; Hu, S.; Zheng, Z. Preoperative high-sensitivity C-reactive protein predicts depression in patients undergoing coronary artery bypass surgery: A single-center prospective observational study. *J. Thorac. Cardiovasc. Surg.* **2012**, *144*, 500–505. [CrossRef] [PubMed]
85. Yang, P.; Huang, G.; Tsai, C.; Lou, M. Sleep quality and emotional correlates in taiwanese coronary artery bypass graft patients 1 week and 1 month after hospital discharge: A repeated descriptive correlational study. *PLoS ONE* **2015**, *10*, e0136431. [CrossRef] [PubMed]
86. Yüksel, V.; Gorgulu, Y.; Cinar, R.K.; Huseyin, S.; Sonmez, M.B.; Canbaz, S. Impact of experiencing acute coronary syndrome prior to open heart surgery on psychiatric status. *Braz. J. Cardiovasc. Surg.* **2016**, *31*, 281–286. [CrossRef] [PubMed]

87. Zimmerman, L.; Barnason, S.; Young, L.; Tu, C.; Schulz, P.; Abbott, A. Symptom profiles of coronary artery bypass surgery patients at risk for poor functioning outcomes. *J. Cardiovasc. Nurs.* **2010**, *25*, 292–300. [CrossRef]
88. Gong, Y.; Han, T.; Yin, X.; Yang, G.; Zhuang, R.; Chen, Y.; Lu, Z. Prevalence of depressive symptoms and work-related risk factors among nurses in public hospitals in southern China: A cross-sectional study. *Sci. Rep.* **2015**, *4*, 1–5. [CrossRef]
89. Tully, P.J.; Bennetts, J.S.; Baker, R.A.; McGavigan, A.D.; Turnbull, D.A.; Winefield, H.R. Anxiety, depression, and stress as risk factors for atrial fibrillation after cardiac surgery. *Hear. Lung J. Acute Crit. Care* **2011**, *40*, 4–11. [CrossRef]
90. Botzet, K.; Dalyanoglu, H.; Schäfer, R.; Lichtenberg, A.; Schipke, J.D.; Korbmacher, B. Anxiety and depression in patients undergoing mitral valve surgery: A prospective clinical study. *Thorac. Cardiovasc. Surg.* **2018**, *66*, 530–536. [CrossRef]
91. Boyer, B.A.; Matour, S.J.; Crittenden, K.B.; Larson, K.A.; Cox, J.M.; Link, D.D. Appraisals of fear, helplessness, and perceived life-threat during emergent cardiac surgery: Relationship to pre-surgical depression, trauma history, and posttraumatic stress. *J. Clin. Psychol. Med. Settings* **2013**, *20*, 173–185. [CrossRef]
92. Poole, L.; Ronaldson, A.; Kidd, T.; Leigh, E.; Jahangiri, M.; Steptoe, A. Pre-surgical depression and anxiety and recovery following coronary artery bypass graft surgery. *J. Behav. Med.* **2017**, *40*, 249–258. [CrossRef]
93. Murphy, B.; Rogerson, M.; Worcester, M.; Elliott, P.; Higgins, R.; Le Grande, M.; Turner, A.; Goble, A. Predicting mortality 12 years after an acute cardiac event: Comparison between inhospital and 2-month assessment of depressive symptoms in women. *J. Cardiopulm. Rehabil. Prev.* **2013**, *33*, 160–167. [CrossRef]
94. Kendel, F.; Dunkel, A.; Müller-Tasch, T.; Steinberg, K.; Lehmkuhl, E.; Hetzer, R.; Regitz-Zagrosek, V. Gender differences in health-related quality of life after coronary bypass surgery: Results from a 1-year follow-up in propensity-matched men and women. *Psychosom. Med.* **2011**, *73*, 280–285. [CrossRef] [PubMed]
95. Bjørnnes, A.K.; Parry, M.; Lie, I.; Falk, R.; Leegaard, M.; Rustøen, T. The association between hope, marital status, depression and persistent pain in men and women following cardiac surgery. *BMC Womens. Health* **2018**, *18*, 2. [CrossRef] [PubMed]
96. Geulayov, G.; Novikov, I.; Dankner, D.; Dankner, R. Symptoms of depression and anxiety and 11-year all-cause mortality in men and women undergoing coronary artery bypass graft (CABG) surgery. *J. Psychosom. Res.* **2018**, *105*, 106–114. [CrossRef] [PubMed]
97. Lie, I.; Arnesen, H.; Sandvik, L.; Hamilton, G.; Bunch, E.H. Predictors for physical and mental health 6months after coronary artery bypass grafting. A cohort study. *Eur. J. Cardiovasc. Nurs.* **2010**, *9*, 238–243. [CrossRef]
98. Patron, E.; Messerotti Benvenuti, S.; Palomba, D. Preoperative and perioperative predictors of reactive and persistent depression after cardiac surgery: A three-month follow-up study. *Psychosomatics* **2014**, *55*, 261–271. [CrossRef]
99. Tindle, H.; Belnap, B.H.; Houck, P.R.; Mazumdar, S.; Scheier, M.F.; Matthews, K.A.; He, F.; Rollman, B.L. Optimism, response to treatment of depression, and rehospitalization after coronary artery bypass graft surgery. *Psychosom. Med.* **2012**, *74*, 200–207. [CrossRef]
100. Bruce, K.M.; Yelland, G.W.; Smith, J.A.; Robinson, S.R. Recovery of cognitive function after coronary artery bypass graft operations. *Ann. Thorac. Surg.* **2013**, *95*, 1306–1313. [CrossRef]
101. Roohafza, H.; Sadeghi, M.; Khani, A.; Andalib, E.; Alikhasi, H.; Rafiei, M. Psychological state in patients undergoing coronary artery bypass grafting surgery or percutaneous coronary intervention and their spouses. *Int. J. Nurs. Pract.* **2015**, *21*, 214–220. [CrossRef]
102. Oldham, M.A.; Vachon, J.; Yuh, D.; Lee, H.B. Cognitive outcomes after heart valve surgery: A systematic review and meta-analysis. *J. Am. Geriatr. Soc.* **2018**, *66*, 2327–2334. [CrossRef]
103. Haschke, A.; Hutter, N.; Baumeister, H. Indirect costs in patients with coronary artery disease and mental disorders: A systematic review and meta-analysis. *Int. J. Occup. Med. Environ. Health* **2012**, *25*, 319–329. [CrossRef]
104. Morone, N.E.; Weiner, D.K.; Belnap, B.H.; Karp, J.F.; Mazumdar, S.; Houck, P.R.; He, F.; Rollman, B.L. The impact of pain and depression on recovery after coronary artery bypass grafting. *Psychosom. Med.* **2010**, *72*, 620–625. [CrossRef] [PubMed]
105. Khoury, H.; Sanaiha, Y.; Rudasill, S.E.; Mardock, A.L.; Sareh, S.; Benharash, P. Readmissions following isolated coronary artery bypass graft surgery in the United States (from the Nationwide Readmissions Database 2010 to 2014). *Am. J. Cardiol.* **2019**, *124*, 205–210. [CrossRef] [PubMed]

106. Koivula, M.; Halme, N.; Åstedt-Kurki, P. Predictors of depressive symptoms among coronary heart disease patients: A cross-sectional study nine years after coronary artery bypass grafting. *Hear. Lung J. Acute Crit. Care* **2010**, *39*, 421–431. [CrossRef]
107. Sharif, F.; Shoul, A.; Janati, M.; Kojuri, J.; Zare, N. The effect of cardiac rehabilitation on anxiety and depression in patients undergoing cardiac bypass graft surgery in Iran. *BMC Cardiovasc. Disord.* **2012**, *12*, 40. [CrossRef]
108. Kabboul, N.; Tomlinson, G.; Francis, T.; Grace, S.; Chaves, G.; Rac, V.; Daou-Kabboul, T.; Bielecki, J.; Alter, D.; Krahn, M. Comparative effectiveness of the core components of cardiac rehabilitation on mortality and morbidity: A systematic review and network meta-analysis. *J. Clin. Med.* **2018**, *7*, 514. [CrossRef] [PubMed]
109. Dao, T.K.; Youssef, N.A.; Armsworth, M.; Wear, E.; Papathopoulos, K.N.; Gopaldas, R. Randomized controlled trial of brief cognitive behavioral intervention for depression and anxiety symptoms preoperatively in patients undergoing coronary artery bypass graft surgery. *J. Thorac. Cardiovasc. Surg.* **2011**, *142*, e109–e115. [CrossRef] [PubMed]
110. Hare, D.L.; Davis, C.R. Cardiac depression scale: Validation of a new depression scale for cardiac patients. *J. Psychosom. Res.* **1996**, *40*, 379–386. [CrossRef]
111. Radloff, L.S. The CES-D Scale a self-report depression scale for research in the general population. *Appl. Psychol. Meas.* **1977**, *1*, 385–401. [CrossRef]
112. Nieveen, J.L.; Zimmerman, L.M.; Barnason, S.A.; Yates, B.C. Development and content validity testing of the Cardiac Symptom Survey in patients after coronary artery bypass grafting. *Hear. Lung J. Acute Crit. Care* **2008**, *37*, 17–27. [CrossRef]
113. Brown, T.A.; Chorpita, B.F.; Korotitsch, W.; Barlow, D.H. Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. *Behav. Res. Ther.* **1997**, *35*, 79–89. [CrossRef]
114. Sanavio, S.; Bertolotti, G.; Michielin, P.; Vidotto, G.; Zotti, A. *Cognitive Behavioural Assessment 2.0, Scale Primarie*; Organizzazioni Speciali: Firenze, Italy, 1987.
115. Sheikh, J.I.; Yesavage, J.A. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clin. Gerontol. J. Aging Ment. Heal.* **1986**, *5*, 165–173.
116. Hamilton, M. A rating scale for depression. *J. Neurol. Neurosurg. Psychiatry* **1960**, *23*, 56–62. [CrossRef] [PubMed]
117. Zuckerman, M.; Lubin, B. *Manual for the Multiple Affect Adjective Checklist*; Educational and Industrial Testing Service: San Diego, CA, USA, 1965.
118. Kroenke, K.; Spitzer, R.L.; Williams, J.B.W. The patient health questionnaire-2: Validity of a two-item depression screener. *Med. Care* **2003**, *41*, 1284–1292. [CrossRef] [PubMed]
119. Kroenke, K.; Spitzer, R.L.; Williams, J.B.W. The PHQ-9: Validity of a brief depression severity measure. *J. Gen. Intern. Med.* **2001**, *16*, 606–613. [CrossRef] [PubMed]
120. McNair, D.; Lor, M.; Droppeman, L. *Profile of Mood States Manual*; Educational and Industrial Testing Service: San Diego, CA, USA, 1992.
121. Zung, W.W.K. A Self-Rating depression scale. *Arch. Gen. Psychiatry* **1965**, *12*, 63–70. [CrossRef] [PubMed]
122. Derogatis, L.R. *SCL-90-R, Administration, Scoring & Procedures Manual-II for the Revised Version and Other Instruments of the Psychopathology Rating Scale Series*; Clinical Psychometric Research: Townson, MD, USA, 1992.

PUBLICATION

II. Quality of Life in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis.

[Schmidt-RioValle J, Abu Ejheisheh M, Membrive-Jiménez MJ, Albendín-García L, Suleiman-Martos N, Velando-Soriano A, Correa-Rodríguez M, Gómez-Urquiza JL. (2020). International Journal of Environmental and Public Health, under review].

Impact Factor in JCR 2.849; Public, Environmental& Occupational Sciences category (58/193; Q2/T1).

Article

QUALITY OF LIFE AFTER CORONARY ARTERY BYPASS SURGERY: A SYSTEMATIC REVIEW AND META-ANALYSIS

Jacqueline Schmidt-RioValle[1], Moath Abu Ejheisheh[1], María José Membrive-Jiménez[2], Luis Albendín-García[1], María Correa-Rodríguez[1]† , and José Luis Gómez-Urquiza[1]†

[1] Faculty of Health Sciences, University of Granada, Avenida de la Ilustración N. 60, 18016 Granada, Spain;

jschmidt@ugr.es (J.S.-R.); moad.ibrahem@hotmail.com (M.A.E.); lualbgar1979@ugr.es (L.A.-G.); macoro@ugr.es (M.C.-R.); jlgurquiza@ugr.es (J.L.G.-U.)

[2] University Hospital of Ceuta. Institute of Health Management. C/Colmenar s/n, 51003 Ceuta, Spain; mariajose.membrive@gmail.com

* Correspondence: mariajose.membrive@gmail.com

† These authors contributed equally to this work.

Received: date; Accepted: date; Published: date

Abstract: Coronary heart disease is a public health problem and is one of the leading causes of loss of quality of life, disability, and death worldwide. The main procedure these patients undergo is cardiac catheterisation, which helps improve their quality of life, the symptoms of myocardial ischemia, and ventricular function, thus helping to increase the survival rate of sufferers. The objective of this study was to analyse how coronary artery bypass grafting (CABG) influences quality of life. A systematic review and meta-analysis was conducted, using the CINAHL, Pubmed, Scopus and Cuiden databases. A total of 7537 subjects were included, 16 in the systematic review and 3 in the meta-analysis. The studies analysing quality of life using the SF questionnaire showed improvements in the quality of physical and mental appearance, and those using the NHP questionnaire showed score improvements and, in some cases, differences in quality of life between women and men. This operation seems to be a good choice for improving the quality of life of people with coronary pathologies once the possible existing risks have been assessed.

Keywords: coronary artery bypass graft; meta-analysis; prevalence; surgery; systematic review; quality of life.

1. Introduction

Coronary heart disease is a public health problem and is one of the leading causes of loss of quality of life, disability and death worldwide. The main procedure these patients undergo is cardiac catheterisation, both for diagnostic and therapeutic purposes[1]. Cardiac catheterisation helps improve quality of life, the symptoms of myocardial ischaemia and ventricular function, thus helping to increase the survival rate of sufferers, but it can also lead to physical consequences, including kidney failure, acute myocardial infarction, and stroke[2]. It also has psychological consequences, such as stress responses, anxiety, fear, and depression[3]. Another of the most widely used therapeutic options for the treatment of coronary disease worldwide is coronary artery bypass grafting (CABG). The development of this technique in recent decades has led to an improvement in both post-operative and long-term outcomes[4].

People with coronary heart disease are more likely to suffer heart problems and other pathologies[5] as, in addition to being one of the main causes of death worldwide, it also favours the development of comorbidities. The treatments described above are designed to improve myocardial perfusion to improve the symptoms and reduce the incidence of heart attacks and death[5].

This improvement in cardiac activity is also reflected in the daily life of an individual with heart disease. In fact, one of the most important aspects sought is improved quality of life. Evaluating quality of life allows us to ascertain a subjective assessment of an individual's health, as well as the impact that the disease and its treatment have on that person's daily life[6].

Quality of life is a concept that encompasses the physical, emotional and social dimensions, and it varies with time and the individual's perception[7,8]. There are currently a multitude of questionnaires available to measure patient quality of life. The generic validated Short Form 36 (SF36) questionnaire has been used on patients undergoing heart surgery. It consists of 35 items, distributed across eight domains and divided into two main groups: physical and psychological components[9].

Another questionnaire reported in the literature for measuring quality of life in patients with chronic diseases and disabling symptoms is the two-part Nottingham Health Profile (NHP)[10]. The first part contains 38 items, divided into six dimensions: physical mobility, pain, sleep, energy, social isolation, and emotional reactions. Patients answer yes or no to the questions according to whether they have suffered the problems. The second part comprises seven aspects affected by the patients' health status: capacity to work, ability to do housework, social life, family relationships, sex life, hobbies, and holidays. The score for each section ranges from 10 to 100, the higher the score the greater the problem presented by the patient and the lower their quality of life.

A CABG involves risk, so this study was designed to elucidate the benefits this operation provides people who undergo the surgery, for example, related to their quality of life. Thus. the objective of this study was to analyse how coronary artery bypass graft (CABG) influences quality of life.

2. Materials and Methods

A systematic review including a meta-analysis was conducted, following the recommendations of the PRISMA statement[11].

2.1. Search strategy

The search was carried out using the CINAHL, Pubmed, Scopus and Cuiden databases, between March and June 2020. The search equation, based on MeSH terms, was: ("Quality of Life" OR "Health-Related Quality Of Life" OR "Life Quality") AND ("Aortocoronary Bypass" OR "Bypass Surgery, Coronary Artery" OR "Bypass, Coronary Artery" OR "Coronary Artery Bypass Grafting" OR "Coronary Artery Bypass Surgery") AND "Postoperative Period". No restrictions were placed on the publication date, sample size, or type of surgery, whether elective or emergency, thus minimising publication bias.

2.2. Inclusion and Exclusion Criteria

The inclusion criteria were: quantitative studies, with subjects undergoing both elective and emergency coronary artery bypass graft surgery; and studies using validated scales, written in English, Spanish, or Portuguese that included post-surgery follow-up. The exclusion criteria used were: studies that included subjects undergoing other types of cardiological operations, such as valve replacement; studies that did not use a validated questionnaire to measure quality of life or which exclusively measured psychological variables, such as anxiety or depression; studies that

included paediatric, psychiatrically challenged, and intubated/sedated patients or those with language difficulties.

2.3. Selection process and result codification

Two members of the team independently conducted the search, selection and analysis of the studies found. In the event of a disagreement, a third researcher from the group intervened. The selection was based on a reading of the title and abstract, then the full text, and finally a reverse search in the selected studies. For the meta-analysis, we selected studies that used the same measuring instrument, and which provided the data necessary for its execution. More specifically, these studies used the second part of the NHP questionnaire, as this provides viable data for meta-analytical estimation. The variables studied were: (a) authors; (b) year and country of publication; (c) type of surgery (emergency or elective); (d) characteristics of the sample, such as: number of subjects included, sex, and follow-up over time; (e) instrument for measuring quality of life; (f) scores on the quality of life scale.

2.4. Critical reading and level of evidence

The studies included in the research were reviewed critically, using the STROBE[12] checklist. The selected studies were assigned a methodological quality grade according to the levels of evidence and degrees of recommendation proposed by the Working Group on Levels of Evidence of the Oxford Centre for Evidence-Based Medicine (OCEBM)[13].

2.5. Statistical analysis

Random effects meta-analyses were performed using the StatsDirect software package. A sensitivity analysis was carried out, and the publication bias was assessed using the Egger linear regression. The I2 index was used as a measure of heterogeneity.

3. Results

The search returned a total of 398 articles, which after eliminating duplicates yielded 278 articles. After applying the inclusion and exclusion criteria, a total of 36 studies were obtained for full-text reading, and n=16 studies were finally selected, of which 3 contributed data for the meta-analysis. The data from the study selection process is shown in Figure 1.

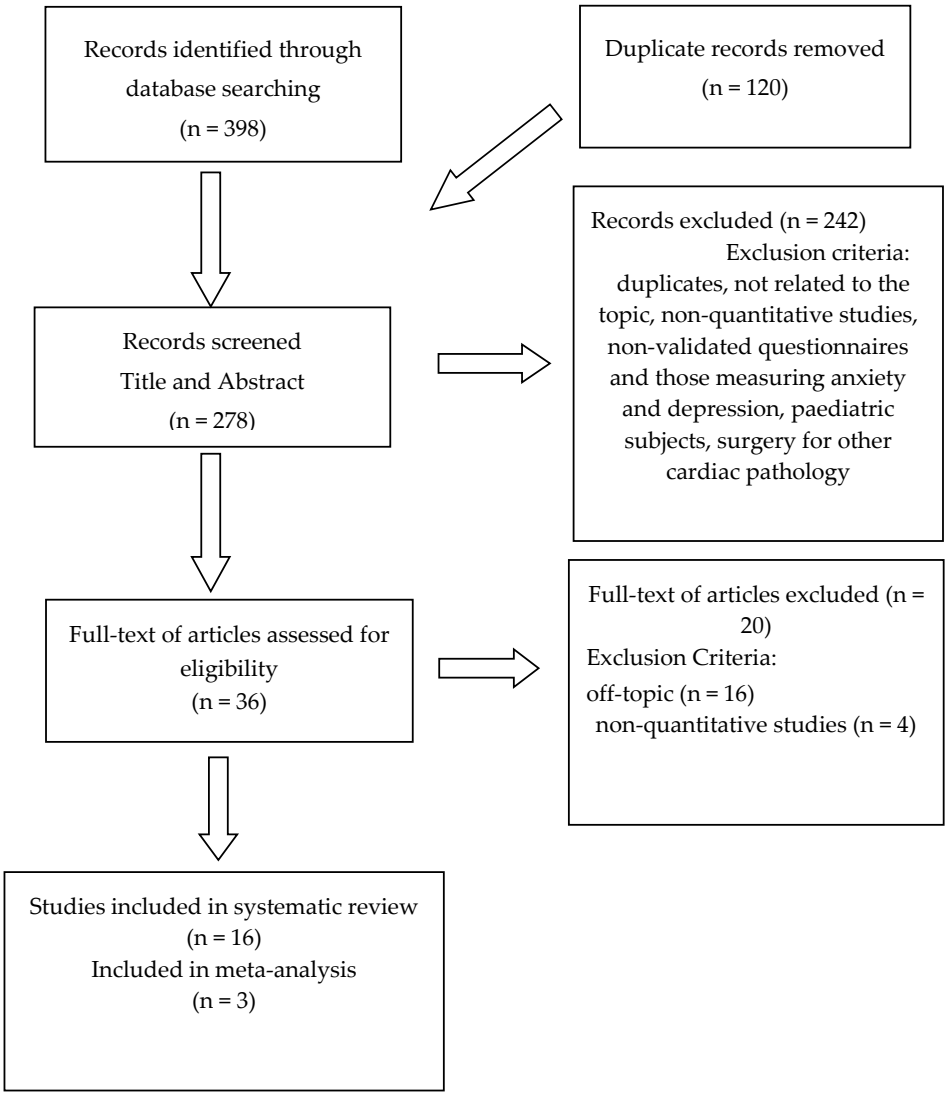


Figure 1. Study-selection diagram.

3.1. Characteristics of the studies included

A total of 7537 subjects were included in the sample, most of which were men. The majority of the studies included cohorts (n=15) and were conducted in the USA (n=3)[14,15,16] or Sweden (n=5)[17,18,19,20,21]. Of the studies chosen, 11 involved elective surgery[22,23,24,25]. The 16 studies evaluated quality of life prior to surgery, coinciding with the preoperative angiography performed at the surgical hospitalisation appointment. The follow-up time for most studies was 6 months[26,27,28]. The studies included used the following scales to measure quality of life: NHP (n=8) and SF36 (n=8). The characteristics of the studies and their main results are presented in Table 1.

3.2. Quality of life before and after a CABG

Studying cardiac, non-cardiac, preoperative and early postoperative factors helps us know the health status of patients and predict their quality of life after surgery[22,26].
The quality of life of patients undergoing cardiac catheterisation improved dramatically between 6 weeks[23] and 3 months[17,26] or 6 months[15,21] after surgery, particularly with regard to the group of items encompassing physical problems[23]. Sexual health problems in men persisted throughout the follow-up period[17,18]. Physical problems improved according to the functional capacity of the patients prior to surgery[14]. Being female[18,29], age, hypertension, obesity, renal failure, cerebrovascular disease, unstable angina[28], being a smoker, and having a psychiatric pathology[16] are all factors that have been shown to delay the recovery of post-surgery quality of life[19,20,24].

Table 1. Characteristics of the included studies (n=16).

Study	Design	Sample	TYPE OF CABG	Quality of life measurement questionnaire	Follow-up	Average (DE) Pre	Average (DE) Post	Main results	EL/RG
Lie et al[22]., 2010 Norway	Prospective Cohorts	185 90% men	Elective	SF 36	Beforehand, after 6 months	MSC 47.7 (11.2) PCS 39.0 (SD 10.2)	MSC 51.3 (10.7) PCS 47.2 (SD 9.8)	Studying cardiac, non-cardiac, preoperative and early postoperative factors helps us predict the quality of life of patients after surgery.	2b/B
Sjöland et al[18]., 1997 Sweden	Prospective Cohorts	Pre: 1160 Post-3 months: 1059, 1 year: 1045, 2 years: 1027 83% men	Emergency and Elective	NHP	Beforehand (at angiography appointment), after 3 months, 1 year, 2 years	20.5	3 months: 11.4 1 year: 11.9 2 years: 10.4	The greatest improvement in quality of life was at 3 months, for physical capacity and patient pain. Sexual problems persisted for two years after the surgery.	2b/B

Sandau et al[14]., 2007 USA	Prospective Cohorts	64 78.1% men	Elective	SF12 (short form of SF36)	72 hours beforehand, after 3 months	MCS 49.6 (9.6) PCS 40.0 (10.6)	MCS 53.2 (9.5) PCS 42.2 (10.3)	Participants gained an average of 2.2 points (PCS) and 3.6 points (MCS). Although these changes appear small, the clinical significance of changes in an individual's score depends largely on the functional capacity associated with the score.	2b/B
Ballan and Lee[23], 2007 Australia	Quasi-experimental	62 87.1 % men	Elective	SF36	Beforehand, after 6 weeks	MSC 53.4 (12.7) PSC 26.1 (8.0)	MSC 53.7 (10.1) PSC 33.5 (10.2)	The PCS scores improved and were statistically significant 6 weeks after surgery. No significant differences were found in MCS scores.	1B/A
Herlitz et al[19]., 2003 Sweden	Prospective Cohorts	1225 (beforehand), 1358 (5 years), 976 (10 years) 98.5% men	Emergency and elective	NHP	Beforehand (during angiography), after 5 years, and 10 years	20.8	12.1 (5 years) 14.5 (10 years)	Patient quality of life improved, generally, at 10 years, despite increasing age. The score for the second and third measurements deteriorated.	2b/B

Oreel et al[24]., 2020 The Netherlands	Prospective Cohorts	48 87.5% men	Elective	SF36	Beforehand, after 6 months	MCS 46.2(-) PCS 36(-)	MCS 51.9(-) PCS 43(-)	Quality of life was lower in women and their physical health improved more slowly than that of male patients.	2b/B
Herlitz et al[20]., 2005 Sweden	Prospective Cohorts	637 75% men	(1) normal waiting list (2) admitted patients (3) patients with unstable angina (4) emergency patients with unstable angiography (5) emergency patients with AMI (6) emergency patients with ventricular fibrillation	NHP	Beforehand, after 10 years	-	-	Being female, age, hypertension, obesity, renal failure, and cerebrovascular disease all play a role in the post-surgery recovery of quality of life.	2b/B

Neto et al[25]., 2010 Poland	Prospective Cohorts	44 59% men	Elective	SF36	Beforehand, after 3 and 6 months	-	-	The older population presents both cardiovascular and quality of life improvement after surgery There are no statistically significant changes in the physical abilities of patients.	2b/B
Edell-Gustafsson et al[21]., 1997 Sweden	Prospective cohorts (Pilot study)	6 beforehand 5 after 100% men	Elective	NHP	Two days beforehand, 1 month after	8.3	5.8	After a month quality of life improved, although wound pain persisted influencing sleep quality.	2b/B
Grady et al[15]., 2011 USA	Prospective cohorts	136 70% men	Elective	SF36	Beforehand, after 3, 6, 12 months. Annually	MSC 51.88 (2.24) PSC 43.33 (2.73)	MSC 54.94 (1.61) PSC 51.65 (1.93)	There was an improvement in the quality of life between 3 and 6 months. After 3 years it remained stable.	2b/B
Sjöland et al[18]., 1999 Sweden	Prospective cohorts	1160 83% men	-	NHP	Beforehand, 3 months, after 1 year, and 2 years	Men 19 Women 28	Men 10.4-8.7 Women 13.9-13.6	The women presented increased concomitant illnesses and a lower quality of life The men encountered greater sexual problems prior to and 2 years after the surgery.	2b/B

Rumsfeld et al[16]., 2004 USA	Prospective cohorts	1973 99 men	-	SF36	Beforehand and after 6 months	MCS 44.3 PCS 33.0	MSC 46.1 PCS 38.2	Being a smoker and presenting a psychiatric pathology influences post-surgery quality of life.	2b/B
Mathisen et al[26]., 2007 Norway	Prospective cohorts	108 81% men	-	SF36 (General-care subscale)	Beforehand, after 3 months, 6 months, and 1 year	57.7 (21.1)	67.2 (19.7)	Quality of life can both influence and be used as a health status outcome after surgery. Most of the improvements in quality of life occurred in the first 3 months.	2b/B
Peric et al[28]., 2006 Serbia	Prospective cohorts	243 80% men	-	NHP	Beforehand and after 6 months	-	-	Patients with a higher degree of angina had worse quality of life both before and after the operation	2b/B
Peric et al[27]., 2005 Serbia	Prospective cohorts	243 80% men	Elective	NHP	Beforehand and after 6 months	-	-	Patients with a high mortality risk according to EUROSCORE have a worse quality of life before surgery and improved perceived energy after surgery.	2b/B
Peric et al[29]., 2010 Serbia	Prospective cohorts	243 80% men	Elective	NHP	Beforehand and after 6 months	-	-	Although the quality of life of both sexes improves after CABG, women have a worse quality of life both before and after surgery.	2b/B

Note: MSC = mental component of quality of life; PCS = physical component of quality of life.

International Journal of Environmental Research and Public Health

MDPI

3.3 Differences in quality of life scores before and after a CABG

The studies that analysed quality of life using the SF questionnaire all showed quality improvements in both physical and mental aspects[14,15,16,22,23,24,25,26]. The least physical improvement was 2.2 points[14] and the most was 8.2 points[15,22]. For the mental aspect of quality of life, the improvement in the score ranged from a maximum of 3.6 points[22] to a minimum of 0.3 points[23]. Studies using the NHP questionnaire all showed improvements in quality of life scores with differences of up to 6 points after 10 years[19], 10 points after two years[17] and, in some cases, the differences in quality of life being greater for women than men[18].

3.4 Meta-analysis for estimating the prevalence of pre- and post-CABG impact on quality of life

Of the studies included in the systematic review, three contained the data necessary to perform the meta-analysis and used the second part of the NHP questionnaire. The total sample for the meta-analysis was n=1997 people who received a CABG. With regard to the impact on the different aspects of quality of life analysed in part 2 of the NHP questionnaire (working life, work/housework, social life, family relationships, sex life, hobbies, and holidays), there was a decrease in the prevalence of impact on the 7 areas before and after CBAG (Table 2). The I^2 of the meta-analyses performed was over 90%. The Annex shows the Forestplots of impact prevalence of the 7 areas before and after CABG (Figures 2-8).

Table 2. Meta-analytical estimate of the impact on quality of life according to the 7 aspects of Part 2 of the NHP (n=1997).

Dimension	Prevalence pre (CI-95%)	Prevalence post (CI-95%)
Impact on working life	17% (2%-42%)	6% (1%-15%)
Impact on work/housework	27% (5%-59%)	11% (3%-23%)
Impact on social life	15% (4%-33%)	4% (1%-10%)
Impact on family relationships	9% (2%-20%)	3% (1%-9%)
Impact on sex life	23% (2%-58%)	14% (1%-40%)
Impact on hobbies	30% (3%-70%)	12% (2%-28%)
Impact on holidays	22% (2%-58%)	8% (1%-20%)

Figure 2. Pre- and Post- impact on working life.

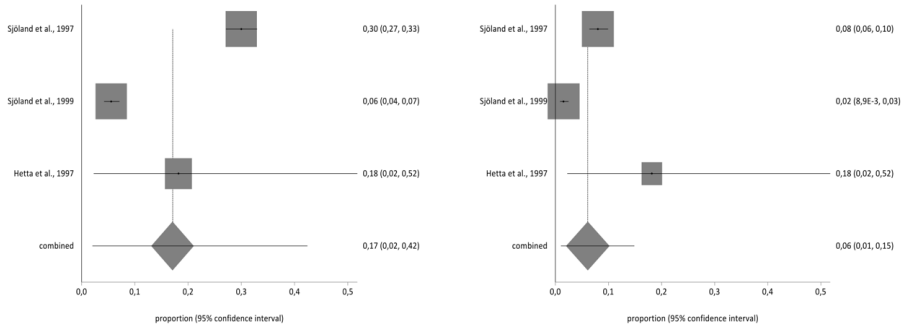


Figure 3. Pre- and Post- impact on work/housework.

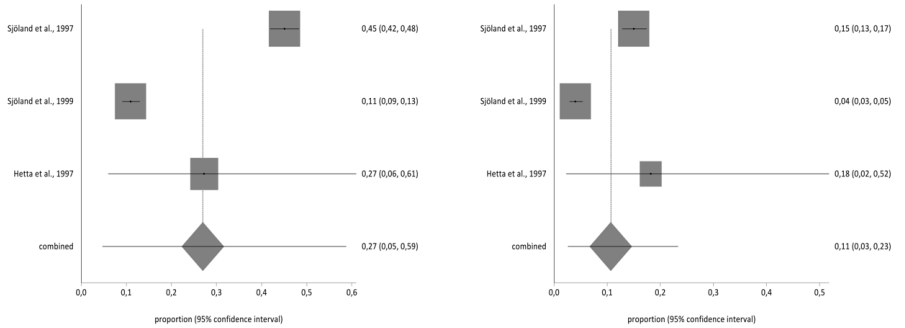


Figure 4. Pre- and Post- impact on social life.

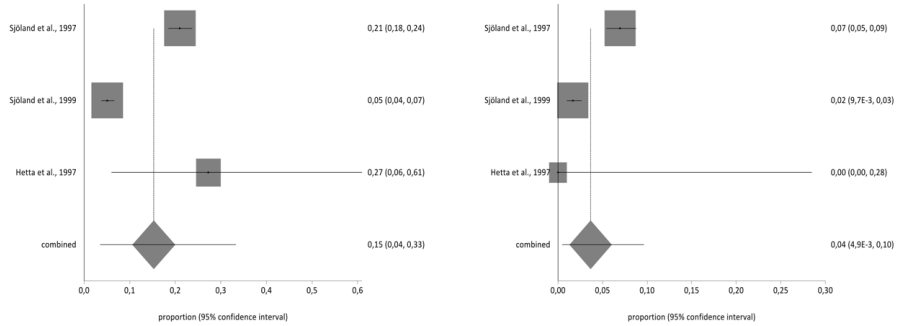


Figure 5. Impact on family relationships.

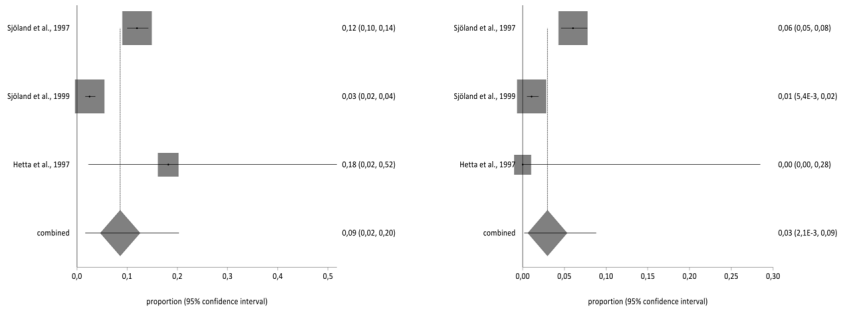


Figure 6. Pre- and Post- impact on sex life.

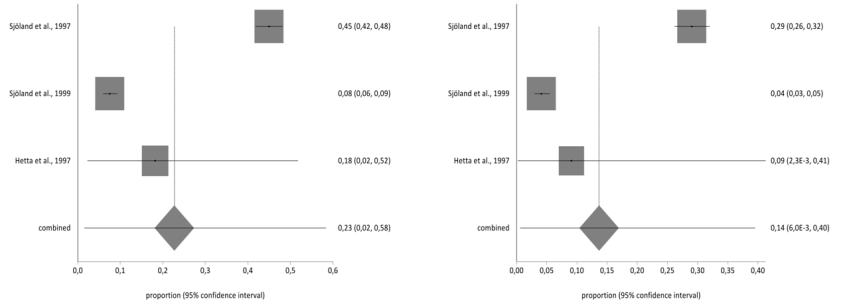


Figure 7. Pre- and Post- impact on hobbies.

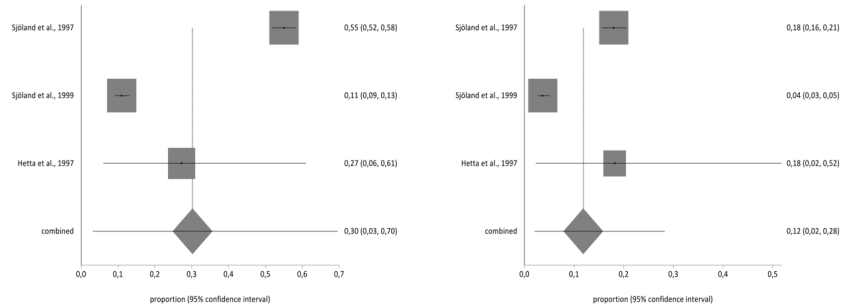
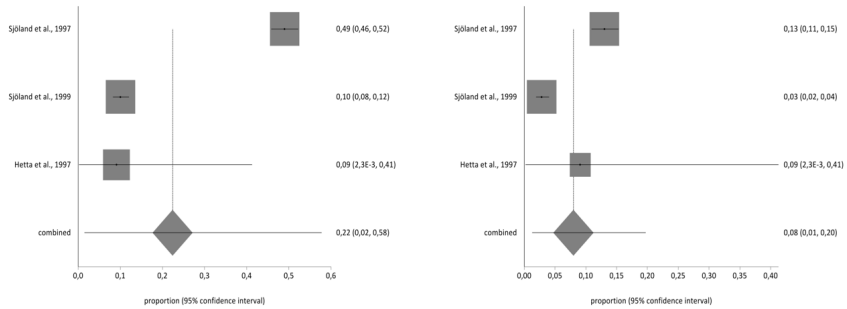


Figure 8. Pre- and Post- impact on holidays.



4. Discussion

The aim of the study was to analyse how coronary artery bypass grafting (CABG) influences quality of life. It has been observed that, in most studies, after CABG, people exhibit significant improvements in the different dimensions of quality of life analysed in the SF and NHP questionnaires. This positive result has also been confirmed by the meta-analytical estimates of the impact on quality of life, with a lower prevalence of impact in all the dimensions of quality of life analysed. Within the SF, the physical dimension seems to improve more than the mental aspect.

A CABG seems to be very beneficial for patients, since in addition to the positive quality of life results, other studies indicate that it positively influences the incidence of depression[30], can lead to the disappearance of symptoms for around 15 years[31], decreases death resulting from other causes, and reduces hospital admission and death due to cardiovascular factors[32]. In addition, mortality in this type of surgery would appear to be declining substantially[32]. Therefore, although surgery still involves risk and the possibility of future complications for individuals, it appears that the benefits are positive and appropriate in relation to the risk. These risks and complications seem to be reduced when the surgery is not performed urgently and when the patient presents no other pathologies[31].

The effects of CABG on more physiological aspects, such as the left ventricular ejection fraction, have also been analysed in other studies, which report improvements in those patients in whom the fraction was diminished before surgery, but a deterioration in those in whom the fraction was at normal levels[33]. Some authors also recommend performing a coronary angiography after the CABG to avoid the appearance of possible post-operative complications, as between 2% and 8% of heart attacks are reported in the perioperative period[34].

From the clinical perspective, this cardiac surgery, one of the most widely performed in the world, has a good scientific basis that supports the improvements it generates in quality of life and other aspects. For this reason, this type of surgery continues to be performed every day across the globe and improvements are being researched involving the application of existing technology, in order to determine the optimal way to operate in the future, in the least invasive manner and with the most lasting effects[4].

The main limitation of the study is that there is variability in the location and countries where the analysed studies were carried out. Therefore, depending on the country where the results are to be analysed or implemented, this factor should be taken into account. Additionally, there was only a limited number of studies with the necessary data to perform the meta-analysis. Future research on the subject should include values correlating quality of life with other variables that allow the meta-analytical estimation of factors that may influence quality of life post-CABG, as well as experimental comparisons of how different CABG techniques or treatments influence quality of life, in order to determine the most cost-effective method.

5. Conclusions

The scientific literature shows that coronary artery bypass grafting improves a patient's quality of life of in both the physical and mental aspects, although this improvement is more extensive with respect to physical factors. This favours the normalisation of the day-to-day lives of these individuals in their personal and working environments, with a decreased prevalence of impact on the various aspects of life of between 18% and 6%. This operation seems to be a good choice for improving the quality of life of people with coronary pathologies once the possible existing risks have been assessed.

Author Contributions: J.S.-R., J.L.G.-U and M.C.-R. conceived and designed the review and meta-analysis; L. A.-G. and M.J.M.-J contributed to the selection process and analysis of the risk of bias; M. A.-E. and J.L.G.-U contributed to the meta-analysis; J.S.-R., M.C.-R. and M. A.-E. contributed to the data extraction; L. A.-G. and M.C.-R wrote the paper; J.S.-R. and J.L.G.-U drafted the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: The results reported in the study are from the doctoral thesis of Moath Abu Ejheisheh and belong to the Clinical Medicine and Health Public Programme (B 12.56.1) of the University of Granada, Spain.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Gierszewska K, Jaworska I, Skrzypek M, Gasior M, Pudlo R, Verwijmeren L, et al. The coronary artery bypass graft surgery trajectory: gender differences revisited. J Cardiothorac Surg. 2018;26(1):575–80.
2. Baptista VC, Palhares LC, de Oliveira PPM, Silveira Filho LM, Vilarinho KA de S, Severino ESB de O, et al. Six-minute walk test as a tool for assessing the quality of life in patients undergoing coronary artery bypass grafting surgery. Rev Bras Cir Cardiovasc. 2012;27(2):231–9.
3. Fatima K, Yousuf-Ul-Islam M, Ansari M, Bawany FI, Khan MS, Khetpal A, et al. Comparison of the Postprocedural Quality of Life between Coronary Artery Bypass Graft Surgery and Percutaneous Coronary Intervention: A Systematic Review. Cardiol Res Pract. 2016.
4. Ludovic M., Gianluca T., Timothy L. , Jean-Luc J. , John D. P. Fifty years of coronary artery bypass grafting. J Thorac Dis 2018;10(3):1960-1967
5. M. Kivimäki, J. Head, J. E. Ferrie, H. Hemingway, M. J. Shipley, J. Vahtera, M. G. Marmot. Working while ill as a risk factor for serious coronary events: the Whitehall II study. Am J Public Health. 2005;95(1):98-10
6. Barrantes M. Factores asociados a la calidad de vida relacionada a la salud en pacientes con cardiopatía coronaria y diabetes mellitus. Rev Med Hered. 2010;21(3):118–27.
7. Soto M, Failde I. La calidad de vida relacionada a la salud como medida de resultados en pacientes con cardiopatía isquémica. Rev Soc Esp Dolor. 2004; 11:505-14.
8. Meyer T, Belnap BH, Herrmann-Lingen C, He F, Mazumdar S, Rollman BL. Benefits of collaborative care for post-CABG depression are not related to adjustments in antidepressant pharmacotherapy. J Psychosom Res. 2014;76(1):28–33.
9. Ware Jr JE, Kosinski M, Gandek B. SF-36 Health Survey. Manual & Interpretation Guide2nd ed. Boston: New England Medical Center; 2000

10. Hunt SM, McKenna SP, McEwen J, Williams J, Papp E. The Nottingham Health Profile: subjective health status and medical consultations. Soc Sci Med 1981;15(1):221–229.
11. Moher, D.; Shamseer, L.; Clarke, M.; Ghersi, D.; Liberati, A.; Petticrew, M.; Shekelle, P.; Stewart, L. Preferredreporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015. Syst Rev. 4.
12. Sanderson, S.; Tatt, I.D.; Higgins, J.P.T. Tools for assessing quality and susceptibility to bias in observationalstudies in epidemiology: A systematic review and annotated bibliography.Int. J. Epidemiol.2007,36, 666–676
13. Howick, J.; Chalmers, I.; Glasziou, P.; Greenhalg, T.; Heneghan, C.; Liberati, A.; Moschetti, I.; Phillips, B.;Thornton, H. The Oxford 2011 Levels of Evidence.
14. Sandau KE, Lindquist RA, Treat-Jacobson D, Savik K. Health-related quality of life and subjective neurocognitive function three months after coronary artery bypass graft surgery. Heart Lung. 2008;37(3):161–72.
15. Grady KL, Lee R, Subacius H, Malaisrie SC, McGee ECJ, Kruse J, et al. Improvements in health-related quality of life before and after isolated cardiac operations. Ann Thorac Surg. 2011;91(3):777–83.
16. Rumsfeld JS, Ho PM, Magid DJ, McCarthy M, Shroyer ALW, Mawhinney S, et al. Predictors of health-related quality of life after coronary artery bypass surgery. Ann Thorac Surg. 2004;77(5):1508–13.
17. Sjoland H, Caidahl K, Wiklund I, BW K, Karlsson T, Winberg L, et al. Effects of age on quality of life before and after coronary artery bypass grafting. Cardiol Elder. 1996;4(5/6):195–200.
18. Sjoland H, Wiklund I, Caidahl K, Haglid M, Westberg S, Herlitz J, et al. Improvement in quality of life and exercise capacity after coronary bypass surgery. Arch Intern Med. 1999;156(3):265–71.
19. Herlitz J, Brandrup-Wognsen G, Caidahl K, Haglid M, Karlson BW, Hartford M, et al. Improvement and factors associated with improvement in quality of life during 10 years after coronary artery bypass grafting. Coron Artery Dis. 2003;14(7):509–17.
20. Herlitz J, Brandrup-Wognsen G, Caidahl K, Hartford M, Haglid M, Karlson BW, et al. Determinants for an impaired quality of life 10 years after coronary artery bypass surgery. Int J Cardiol. 1998;98(3):447–52.
21. Edell-Gustafsson UM, Hetta JE, Aren GB, Hamrin EKF, Edéll-Gustafsson UM, Hetta JE, et al. Measurement of sleep and quality of life before and after coronary artery bypass grafting: a pilot study. Int J Nurs Pract. 1997;3(4):239–46.
22. Lie I, Arnesen H, Sandvik L, Hamilton G, EH B. Predictors for physical and mental health 6months after coronary artery bypass grafting: A cohort study. Eur J Cardiovasc Nurs. 2010;9(4):238–43.
23. Ballan A, Lee G. A comparative study of patient perceived quality of life pre and post coronary artery bypass graft surgery. Aust J Adv Nurs. 2007;24(4):24–8.
24. Oreel TH, Nieuwkerk PT, Hartog ID, Netjes JE, Vonk ABA, Lemkes J, et al. Gender differences in quality of life in coronary artery disease patients with comorbidities undergoing coronary revascularization. PLoS One. 2020;15(6):1–13.
25. Neto JA de F, Reis LMCB, Veras MR, Queiroz LLC, Nunes K de PLN, Miranda P de O, et al. Impact of cardiovascular interventions on the quality of life in the elderly. Brazilian J Cardiovasc Surg. 2015;30(6):626–30.
26. Mathisen L, Andersen MH, Veenstra M, Wahl AK, Hanestad BR, Fosse E. Quality of life can both influence and be an outcome of general health perceptions after heart surgery. Health Qual Life Outcomes. 2007;5.
27. Peric V, Borzanovic M, Jovanovic A, Stolic R, Sovtic S, Trajkovic G. The relationship between EuroSCORE preoperative risk prediction and quality of life changes after coronary artery by-pass surgery. Interact Cardiovasc Thorac Surg. 2005;4(6):622–6.
28. Peric VM, Borzanovic MD, Stolic R V, Jovanovic AN, Sovtic SR. Severity of angina as a predictor of quality of life changes six months after coronary artery bypass surgery. Ann Thorac Surg. 2006;81(6):2115–20.
29. Peric V, Borzanovic M, Stolic R, Jovanovic A, Sovtic S, Djikic D, et al. Quality of life in patients related to gender differences before and after coronary artery bypass surgery. Interact Cardiovasc Thorac Surg. 2010;10(2):232–8.
30. Correa-Rodríguez M., Abu Ejheisheh M., Suleiman-Martos N., Membrive-Jiménez MJ.,Velando-Soriano A., Schmidt-RioValle J., Gómez-Urquiza JL. Prevalence of Depression in Coronary Artery Bypass Surgery: A Systematic Review and Meta-Analysis. J Clin Med. 2020; 26, 9(4):909
31. Harris R., Croce B., Tian DH. Coronary artery bypass grafting. Ann Cardiothorac Surg. 2013; 2(4): 579
32. Murashita T. The role of coronary artery bypass grafting in patients with ischemic cardiomyopathy in the current era. J Thorac Dis. 2016; 8(9): E1032–E1033.

172 33. Koene RJ., Kealhofer JV., Adabag S., Vakil K., Florea VG. Effect of coronary artery bypass graft surgery
173 on left ventricular systolic function. J Thorac Dis. 2017; 9(2): 262-270
174 34. Rupprecht L., Schmid C., Debl K., Lunz D., Flörchinger B., Keyser A. Impact of coronary angiography early
175 after CABG for suspected postoperative myocardial ischemia. Journal of Cardiothoracic Surgery. 2019;
176 54(14).
177

178

PUBLICATION

III. Prior Percutaneous Coronary Intervention is Associated with Low Health-related Quality of Life after Coronary Artery Bypass Graft.

[Abu. Ejheisheh M, Correa Rodríguez M, Fernández Aparicio A, Batran A, Suleiman Martos N, Schmidt RioValle J. (2020). Nursing & Health Sciences. https://doi.org/10.1111/nhs.12761].

Impact Factor in JCR1.269; Nursing category (72/123; Q3/T2).

Research article

Prior percutaneous coronary intervention is associated with low health-related quality of life after coronary artery bypass graft

Running head: Quality of life in CABG

Moath ABU EJHEISHEH[1*], MSN, RN

María CORREA-RODRÍGUEZ[2,3*], PhD, RN

Ángel FERNÁNDEZ-APARICIO[2,3†], MSN, RN

Ahmad BATRAN[4], PhD, RN

Nora SULEIMAN-MARTOS[2], MSN, RN

Jacqueline SCHMIDT-RIOVALLE[2,3], PhD, BSc, RN

[1] Faculty of Health Sciences. PhD student of the Public Health and Clinic Medicine program of the University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain

[2] Department of Nursing, Faculty of Health Sciences, University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain.

[3] CTS-436 Aspectos psicosociales y Transculturales de la Salud y la Enfermedad

[4] Faculty of Nursing, Arab American University, Palestine

[*] These authors contributed equally to this work.

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/nhs.12761

†Corresponding author: Ángel Fernández-Aparicio. Department of Nursing, Faculty of Health Sciences, University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain. Email: anfeapa@ugr.es. ORCID ID: 0000-0002-1298-8349

Acknowledgments: The results reported in the study are from the doctoral thesis of the main author, Moath Abu Ejheisheh, and belong to the Clinical Medicine and Health Public Programme (B 12.56.1) of the University of Granada, Spain.

Conflicts of interest statement

No conflict of interest has been declared by the author(s).

Funding statement

The authors declare that there is no funding associated with this project.

Autorship statement

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors and all authors are in agreement with the manuscript.

Word count: 3000 words.

Abstract

The success of a coronary artery bypass graft surgery has been shown to be related to health-related quality of life, and being able to predict this is extremely useful. We investigate the associations between health-related quality of life and sociodemographic and clinical characteristics, and examine the impact of prior percutaneous coronary

interventions on health-related quality of life in Palestinian patients undergoing a coronary artery bypass graft for the first time. A cross-sectional study was conducted on a convenience sample of 119 Palestinian patients. The Short Form-36 Health Survey was applied one year after the coronary artery bypass graft surgery. An analysis of variance shows that as age increases, health-related quality of life decreases. In contrast, the higher the level of education, job security and salary, the higher the health-related quality of life. Patients who had undergone prior percutaneous endovascular interventions had a worse health-related quality of life than those who had not. In conclusion, a history of prior percutaneous endovascular interventions in addition to sociodemographic factors should be considered by nursing staff so that they can deliver high-quality patient care.

Key words: quality of life; coronary artery bypass graft; percutaneous coronary intervention; nursing care; Palestine

Introduction

Cardiovascular diseases (CVDs) are the most common cause of death around the world, and are predicted to remain so until 2030 (Lehtonen, Hippeläinen, Kattainen, Kouri, & Kujala, 2009; World Health Organization, 2017). According to 2015 data from the World Health Organization (World Health Organization, 2017), 31% of deaths globally were the result of CVDs, and 41.2% of these were due to coronary artery disease (CAD), one of the most prevalent CVDs. In addition, 80 % of deaths in low and middle-income countries are CVD-related. Indeed, CVD was the principal cause of death in 2018 in the Palestinian population, with a death rate of 31.5% (Palestinian Health Information Center-MOH, 2019).

There are currently many methods for treating CAD, including therapeutic medication, percutaneous transluminal coronary angioplasty, and coronary artery bypass graft (CABG) surgery (Staniūtė & Brožaitienė, 2010). The decision to perform a CABG to treat CAD is based on the patient's symptoms, the extent of the coronary artery pathology, and the number of obstructed vessels (Dzayee et al., 2013). The published literature confirms that symptoms are reduced in both type and severity post-surgery. Indeed, a prospective study from Taiwan on post-CABG patients, reports improvements in most symptoms, including angina, dyspnea, fatigue, sleep problems, and other psychological symptoms (Tsai, Tsay, Moser, Huang, & Tsai, 2019). However, the success of the surgery has been shown to be related to the patient's ability to perform daily activities (Viswanathan, Mayurathan, Hildreth, Worthley, & Zaman, 2011) and predicting this is a useful indicator.

Sixty patients undergoing a coronary artery bypass graft (CABG) were admitted to a randomized controlled trial at a large university hospital in Denmark. These patients presented greater compliance with post-operative interventions, including physical exercise and psychoeducation (Højskov et al., 2016). Pre-operative education is considered an essential and effective way to increase a patient's knowledge and establish individualized goals for improving their health-related quality of life (HRQoL) (Ballan & Lee, 2007). For this reason, HRQoL has taken on a significant role in clinical healthcare as it affects patient and healthcare-provider decision making. Predictions of how successful an operation like a CABG will be have been shown to be related to HRQoL (Jokinen, Hippeläinen, Turpeinen, Pitkänen, & Hartikainen, 2010).

A systematic review conducted by Fatima et al. (2016) concluded that quality of life was higher after CABG surgery in comparison to percutaneous coronary interventions (PCI), especially at 6 and 12 months after these procedures. However, a clinical trial performed by Baron et al. (2017) reported a greater quality of life in patients who underwent PCI, rather than CABG, in the short term, although there were no significant differences in the long term. Moreover, the growing incidence of PCI prior to CABG represents an increased risk of postoperative morbidity and, consequently, decreased HRQoL (Niclauss, Colombier, & Prêtre, 2015). Investigating the factors associated with HRQoL in order to optimize the quality of life in patients undergoing a CABG and, consequently, their health, is therefore of special interest. To our knowledge, no previous research has examined the potential factors influencing HRQoL in patients, either with or without a previous history of PCI, who undergo a CABG for the first time.

Aims

We investigated the associations between HRQoL and sociodemographic and clinical characteristics, and examined the impact of prior PCI on HRQoL in Palestinian patients who underwent CABG for the first time.

Method and materials

Study design and participants

A cross-sectional study was conducted in Palestinian Medical Complexes, including An-Najah National University Hospital, Nablus Specialty Hospital, and the Specialized Arab Hospital in Nablus. The clinical records of 192 potential participants who underwent elective CABG surgery for the first time twelve months ago, both with or without a history of prior PCI, were consulted. Several participants were excluded: 15 died; 6 had cognitive impairment; 8 had communication impairment; and 7 were treated with recurrent CABG. 156 participants were therefore contacted via phone, and the nature and purpose of the study was explained to them. 22 potential participants declined to participate and there was no response from a further 15. Ultimately, 119 patients (76.5% males) agreed to participate in our study and were given a date for a face-to face interview. All the patients received the same information on the surgical procedure prior to undergoing CABG surgery. The nursing care also involved a standardized care plan based on postoperative and lifestyle care, including exercise and nutrition. Figure 1 details the sample collection. The exclusion criteria included patients with cognitive impairment, communication deficit, and patients with major comorbidities (cancer and kidney disease, who were undergoing dialysis),

mobility limitations, cerebrovascular disease, and quadriplegia. The latter involves not only disrupted mobility, but further complications that affect HRQoL. Patients treated with recurrent CABG were also excluded.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval for the work was obtained from the Ethics Committees of the An-Najah National University Hospital (approval no. 0419494), Nablus Specialty Hospital (approval no. 2949855), and the Specialized Arab Hospital in Nablus (approval no. 749752).

Sociodemographic and clinical characteristics

Sociodemographic characteristics including gender, age, marital status, educational level, job, and income were obtained from each participant at the baseline assessment. Information on clinical characteristics including hypertension, diabetes mellitus, dyslipidemia, and hypercholesterolemia was obtained from the participants and their medical records. Additionally, lifestyle factors including smoking and coffee consumption were collected, and any history of prior PCI was recorded, including angioplasty and stent placement.

HRQoL

The Short Form-36 Health Survey (SF-36 ®) was used to evaluate HRQoL (McHorney, Ware, & Raczek, 1993; Ware & Sherbourne, 1992). This questionnaire consists of eight multi-item subscales that include physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems,

mental health, energy/vitality, pain, and general health perception. Each of the SF-36 domains is scored on a scale of 0–100. Higher scores report a better HRQoL. The same interviewer administered the SF-36 12 months after CABG surgery, in September 2017, in face-to-face interviews in the patients' homes. These interviews lasted between 15 and 30 minutes, and averaged 20 minutes. An Arabic version of the SF-36, previously validated on a Saudi Arabian population, was used in the interviews (Al Abdulmohsin, Coons, Draugalis, & Hays, 1997; Coons, Alabdulmohsin, Draugalis, & Hays, 1998). The Arabic version of SF-36 questionnaire is in the public domain (RAND, 2020). This questionnaire was highly reliable in our study, with an α-Cronbach score of 0.962 for the total sample. Similarly, in the subgroups of patients who had undergone prior PCI and those who had not, the scores were 0.967 and 0.950, respectively.

Statistical analysis

We described numerical variables using the mean ± standard deviation, while qualitative or nominal variables were described with percentages and frequencies. The independent two-sample t-test, or Mann-Whitney U-test, was used to compare the variables between the groups. Pearson's correlation coefficient (r) was used to test the correlation between prior PCI and all the HRQoL domains. Logistic regression analyses were conducted to determine the association between prior PCI and all the HRQoL domains in the overall population after adjusting for age and sociodemographic characteristics (education level, job, and income). There was no missing data. SPSS Statistics version 21.0 (SPSS. Chicago. IL, USA) was used for all the analyses; p values < 0.05 were considered to be statistically significant.

Results

Baseline characteristics of the participants and their association with HRQoL

The personal and clinical characteristics of the sample are presented in Table 1. A total of 119 patients from three hospitals in Palestine participated in this study. Most participants were males (76.5%), ranging in age between 45-64 years (60.5%). Only 29.4% had a high education level, and 43.7% of participants had a monthly income of between 1500-3000 New Israeli Shekel (NIS). The following comorbidities were present: hypertension (73.1%); diabetes mellitus (55.5%); dyslipidemia (84.0%); and hypercholesterolemia (88.2%). Furthermore, the prevalence of smoking and coffee consumption was 48.7% and 76.5%, respectively. The prevalence of prior PCI was 23.5%.

Sociodemographic factors such as age, educational level, work performed and income present statistically significant differences with respect to HRQoL (Table 1). HRQoL decreases as age increases, as well as in the presence of comorbidities, although statistically significant differences are only seen for dyslipidemia. Higher educational level, job security and income, all increase the HRQoL. It should be noted that smokers and coffee drinkers report a higher HRQoL, and almost two thirds of patients consume coffee. It should also be pointed out that patients who had prior PCI report a statistically worse HRQoL than those CABG patients without a history of prior PCI.

Influence of prior-PCI on HRQoL in one-year post-CABG patients

Table 2 presents the HRQoL domains in the study cohort and shows the results of the domains according to whether the CABG patients had undergone prior PCI, or not. All

the domains were significantly lower in patients with prior PCI compared to patients with no prior PCI ($p<0.05$).

Table 3 presents the correlation analysis between prior PCI and HRQoL domains. Pearson correlations revealed that all HRQoL domains correlated positively with the variable prior PCI ($p<0.05$). The three highest Pearson correlations were found for social functioning ($r= 0.389$), bodily pain ($r= 0.386$), and general health ($r= 0.384$). Role physical and role emotional presented the lowest results, $r= 0.272$ and $r= 0.255$, respectively.

The association analysis involving prior PCI and all HRQoL domains in the overall population, after adjusting for age and sociodemographic characteristics, is provided in Table 4. Logistic regression analysis revealed significant associations between all HRQoL domains, particularly general health ($\beta= -0.023$; $p = 0.008$), emotional wellbeing ($\beta= -0.022$; $p = 0.009$), social functioning ($\beta= -0.021$; $p = 0.006$) and bodily pain ($\beta= -0.020$; $p = 0.007$). Only the role physical and role emotional domains had no significant association.

Discussion

In this study we investigated the associations between HRQoL and sociodemographic and clinical characteristics in 119 Palestinian patients that underwent CABG, in addition to the impact of prior PCI on HRQoL. Our findings support the fact that as age increases HRQoL decreases, while a higher educational level, greater job security, and a higher salary increased HRQoL. Additionally, patients who had undergone a prior PCI reported a worse HRQoL, with all the domains having a significantly lower score.

Our results are consistent with Peric et al., (2015) who reported that patients aged 60-69 showed better improvement in all domains than younger patients, but found that patients under 50 had improved physical mobility, emotional reactions, pain, and sleep parameters. Similarly, Lavdaniti et al. (2015) reported that mental health is influenced by age, as well as educational and occupational status. Also, Najafi et al. (2008) found that older patients had a higher score in the psychological dimension of HRQoL. In contrast, Chen et al. (2017) found that aging had no connection to HRQoL in CABG patients. The inconsistencies between the findings in the various studies could be explained by the fact that the participants were divided into different age groups. Moreover, our research detected no relationship between gender and HRQoL after CABG surgery. However, previous studies have reported contradictory results (Hweidi, Gharaibeh, Al-Obeisat, & Al-Smadi, 2018; Lavdaniti et al., 2015). Hweidi et al. (2018) reported that female patients had higher levels of depression than males, and Lavdaniti et al. (2015) reported that social role was affected by both the gender and occupational status of the patients.

On the other hand, we found an association between educational level, job, and income with HRQoL, but no association with marital status. Hweidi et al. (2018) reported that unemployed patients had a high prevalence of depression; patients who were married had lower depression levels than unmarried individuals; and there was an inverse relationship between depression score and the patient's monthly income. Additionally, El-Baz et al. (2018) found that patients with higher education levels had better physical health outcomes, and Gierszewska et al. (2018) reported that degree of education, marital status, and employment influenced an improved HRQoL.

Of the comorbidities, only dyslipidemia was associated with HRQoL in CABG patients. Our findings therefore contradict previous studies. Kuo et al. (2015) found that patients with chronic kidney disease (CKD) post-CABG surgery had worse physical function and HRQoL than patients not suffering this. Shad et al. (2017) showed that the physical and mental component of HRQoL was better in patients with no comorbidities (diabetes mellitus or hypertension).

In line with Figueiredo et al. (2015), our study found a high frequency of dyslipidemia and hypertension among patients undergoing cardiac surgery. However, in contrast to our findings, other authors, including Taghipour et al. (2011) and Middel et al. (2014), reported a lower prevalence of these comorbidities. Moreover, our research found a higher prevalence of diabetes mellitus among patients who underwent CABG than in previous studies conducted on European (Middel et al., 2014) and American populations (Figueiredo Neto et al., 2015). Nevertheless, the results are similar to those reported by Taghipour et al. (2011) for a study carried out in Iran. The differences in comorbidity prevalence might therefore be due to health standards in the different countries.

In our study, we found a worse HRQoL, and a lower score in all the HRQoL domains, in patients who had a history of prior PCI than those who did not. Numerous published studies involve HRQoL post-PCI vs CABG surgery (Kulik, 2017; McGrath, Norris, Hardwicke-Brown, Welsh, & Bainey, 2017; Wu et al., 2019), but few of these compare HRQoL in post-CABG patients with or without a previous PCI. Rao et al. (2008) concluded that, in the long term, HRQoL decreases after CABG surgery in patients who had a prior PCI. Altarabsheh et al. (2015) suggested that patients undergoing CABG after a

PCI have a higher incidence of mortality in the postoperative period, while Miguel el al. (2020) reported no clear negative influence of previous PCI on mortality and morbidity after CABG surgery. However, according to Mehta et al. (2012), patients with a previous PCI are likely to have a higher risk of developing complications after CABG surgery.

In our study, the differences between post-CABG patients with or without previous PCI are confirmed both in the correlation and the logistic regression analysis. In particular, Pearson's correlation coefficient showed a greater positive correlation between social functioning (r= 0.389), bodily pain (r= 0.386), and general health (r= 0.384) and the prior-PCI variable. Similarly, the logistic regression analyses highlighted significant associations between general health, emotional wellbeing, and social functioning with the prior-PCI variable, suggesting that patients undergoing CABG who have not had a PCI are more likely to have a greater HRQoL than patients with a history of this. It is possible that better results in the emotional wellbeing, social functioning, and general health domains can be explained by the fact that patients undergoing their first cardiac intervention have better emotional health and a greater recovery prospect than patients requiring recurrent cardiac surgery. In addition, role physical (r= 0.272) and role emotional (r= 0.255) domains had the lowest results in the correlation analyses. The β estimations of these two domains were not significant. A possible explanation for the results found in the role physical and role emotional domains is that emotional or physical difficulties in daily activities could be related to economic or social factors.

It is worth noting that HRQoL in patients undergoing CABG has previously been examined in different populations (Figueiredo Neto et al., 2015; Middel et al., 2014;

Taghipour et al., 2011). This work from other countries, also using the SF-36, reported slightly different findings to those of our research. In all these studies, the SF-36 was administered within six months to one year after CABG surgery. The differences could be the result of different health policies and health promotion in various geographical regions. In addition, sociodemographic and clinical differences may explain the disparate HRQoL findings.

Limitations and strengths

This study has certain limitations that should be addressed. The cross-sectional design may have prevented us from measuring any change in HRQoL over time, and it does not allow us to establish causal relationships. In addition, since our study population comprised a well-characterized cohort of Palestinian adults, the results presented may not be generalizable to other ethnicities or age ranges. Moreover, physical activity level was not measured. In addition, there is no data on the time between the PCI and CABG. Strengths of this study include the fact that, to the best of our knowledge, this is the first study to examine HRQoL level in one-year post-CABG patients with or without a history of prior PCI. In addition, we used the SF-36, a reliable and valid method for assessing HRQoL in patients undergoing CABG (Lavdaniti et al., 2015; Najafi et al., 2008; Peric et al., 2015).

Implications for practice

The results of our study are relevant for health professionals, especially nursing professionals. The novelty of our study is the comparison of HRQoL between post-CABG

patients who had a prior PCI and those who did not; our findings reveal a worse HRQoL in the former group. For this reason, it is necessary to comprehensively assess patients undergoing a CABG, to prepare high-quality patient care that enables them to have greater HRQoL and better post-operative rehabilitation. In addition, our study also shows that other factors, such as emotional components and certain sociodemographic factors, importantly influence patients undergoing CABG surgery and these should be considered by the nursing staff when developing nursing care plans.

Conclusion

In conclusion, the presence of prior PCI in CABG patients was associated with low HRQoL in a convenience sample of 119 Palestinian patients. Increased age was also related to low HRQoL, whereas high levels of education and occupational status increase HRQoL. Thus, nurses should consider the importance of these sociodemographic factors, as well as the presence or not of a prior PCI, to prepare plan cares for patients undergoing CABG. Nursing staff should also consider the impact of HRQoL-associated factors, such as emotional parameters, in CABG patients in order to deliver high-quality patient care.

Author contributions

Study design: J.S.-R., M.C.-R. and M.A.E.

Data collection: A.B. and M.A.E.

Data analysis: M.C.-R., N.S.-M. and Á.F-A.

Manuscript writing: J.S.-R., M.C.-R., M.A.E. and Á.F-A.

References

Al Abdulmohsin, S. A., Coons, S. J., Draugalis, J. R., & Hays, R. D. (1997). Translation of the RAND 36 Item Health Survey 1.0 (aka SF-36) into Arabic. In RAND.

Altarabsheh, S. E., Deo, S. V., Hang, D., Haddad, O. K., Cho, Y. H., Markowitz, A. H., & Park, S. J. (2015). Coronary artery bypass grafting after percutaneous intervention has higher early mortality: A meta-analysis. Annals of Thoracic Surgery, 99(6), 2046–2052. https://doi.org/10.1016/j.athoracsur.2014.12.073

Ballan, A., & Lee, G. (2007). A comparative study of patient perceived quality of life pre and post coronary artery bypass graft surgery. The Australian Journal of Advanced Nursing: A Quarterly Publication of the Royal Australian Nursing Federation, 24(4), 24–28. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17682410

Baron, S. J., Chinnakondepalli, K., Magnuson, E. A., Kandzari, D. E., Puskas, J. D., Ben-Yehuda, O., … EXCEL Investigators. (2017). Quality-of-life after everolimus-eluting stents or bypass surgery for left-main disease: results from the EXCEL trial. Journal of the American College of Cardiology, 70(25), 3113–3122. https://doi.org/10.1016/j.jacc.2017.10.036

Chen, Y., Ding, S., Tao, X., Feng, X., Lu, S., Shen, Y., … An, X. (2017). The quality of life of patients developed delirium after coronary artery bypass grafting is determined by cognitive function after discharge: A cross-sectional study. International Journal of Nursing Practice, 23(5). https://doi.org/10.1111/ijn.12563

Coons, S. J., Alabdulmohsin, S. A., Draugalis, J. R., & Hays, R. D. (1998). Reliability of an Arabic Version of the RAND-36 Health Survey and its equivalence to the US-English Version. Medical Care, 36(3), 428–432.

Dzayee, D. A., Ivert, T., Beiki, O., Alfredsson, L., Ljung, R., & Moradi, T. (2013). Short and long term mortality after coronary artery bypass grafting (CABG) is influenced by socioeconomic position but not by migration status in Sweden, 1995-2007. PloS One, 8(5), e63877. https://doi.org/10.1371/journal.pone.0063877

El-Baz, N., Ondusova, D., Studencan, M., Rosenberger, J., Reijneveld, S. A., van Dijk, J. P., & Middel, B. (2018). Differences between Slovak and Dutch patients scheduled for coronary artery bypass graft surgery regarding clinical and psychosocial predictors of physical and mental health-related quality of life. European Journal of Cardiovascular Nursing: Journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology, 17(4), 324–335. https://doi.org/10.1177/1474515117747571

Fatima, K., Yousuf-Ul-Islam, M., Ansari, M., Bawany, F. I., Khan, M. S., Khetpal, A., … Kazani, B. (2016). Comparison of the Postprocedural Quality of Life between Coronary Artery Bypass Graft Surgery and Percutaneous Coronary Intervention: A Systematic Review. Cardiology Research and Practice, 2016, 7842514. https://doi.org/10.1155/2016/7842514

Figueiredo Neto, J. A. de, Reis, L. M. C. B., Veras, M. R., Queiroz, L. L. C., Nunes, K. de P. L. N., Miranda, P. de O., … Nunes, J. K. V. R. S. (2015). Impact of cardiovascular

interventions on the quality of life in the elderly. Brazilian Journal of Cardiovascular Surgery, 30(6), 626–630. https://doi.org/10.5935/1678-9741.20150080

Gierszewska, K., Jaworska, I., Skrzypek, M., Gąsior, M., & Pudlo, R. (2018). Quality of life in patients with coronary artery disease treated with coronary artery bypass grafting and hybrid coronary revascularization. Cardiology Journal, 25(5), 621–627. https://doi.org/10.5603/CJ.a2017.0081

Højskov, I. E., Moons, P., Hansen, N. V, Greve, H., Olsen, D. B., Cour, S. La, … Berg, S. K. (2016). Early physical training and psycho-educational intervention for patients undergoing coronary artery bypass grafting. The SheppHeart randomized 2 × 2 factorial clinical pilot trial. European Journal of Cardiovascular Nursing: Journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology, 15(6), 425–437. https://doi.org/10.1177/1474515115594524

Hweidi, I. M., Gharaibeh, B. A., Al-Obeisat, S. M., & Al-Smadi, A. M. (2018). Prevalence of depression and its associated factors in patients post-coronary artery bypass graft surgery. Journal of Research in Nursing, 23(1), 76–88. https://doi.org/10.1177/1744987117728314

Jokinen, J. J., Hippeläinen, M. J., Turpeinen, A. K., Pitkänen, O., & Hartikainen, J. E. K. (2010). Health-related quality of life after coronary artery bypass grafting: a review of randomized controlled trials. Journal of Cardiac Surgery, 25(3), 309–317. https://doi.org/10.1111/j.1540-8191.2010.01017.x

Kulik, A. (2017). Quality of life after coronary artery bypass graft surgery versus percutaneous coronary intervention: what do the trials tell us? Current Opinion in Cardiology, 32(6), 707–714. https://doi.org/10.1097/HCO.0000000000000458

Kuo, Y.-T., Chiu, K.-M., Tsang, Y.-M., Chiu, C.-M., & Chien, M.-Y. (2015). Influence of chronic kidney disease on physical function and quality of life in patients after coronary artery bypass grafting. Cardiorenal Medicine, 5(4), 237–245. https://doi.org/10.1159/000433447

Lavdaniti, M., Tsiligiri, M., Palitzika, D., Chrysomallis, M., Marigo, M. D., & Drosos, G. (2015). Assessment of health status using SF-36 six months after coronary artery bypass grafting: a questionnaire survey. Health Science Journal, 9(1), 7.

Lehtonen, J.-M., Hippeläinen, M., Kattainen, E., Kouri, J., & Kujala, J. (2009). Speed and quality in coronary artery bypass graft (CABG) surgery: is there a connection? Health Care Management Science, 12(2), 147–154. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19469454

McGrath, B. M., Norris, C. M., Hardwicke-Brown, E., Welsh, R. C., & Bainey, K. R. (2017). Quality of life following coronary artery bypass graft surgery vs. percutaneous coronary intervention in diabetics with multivessel disease: a five-year registry study. European Heart Journal. Quality of Care & Clinical Outcomes, 3(3), 216–223. https://doi.org/10.1093/ehjqcco/qcw055

McHorney, C. A., Ware, J. E., & Raczek, A. E. (1993). The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring

physical and mental health constructs. Medical Care, 31(3), 247–263. https://doi.org/10.1097/00005650-199303000-00006

Mehta, G. S., LaPar, D. J., Bhamidipati, C. M., Kern, J. A., Kron, I. L., Upchurch, G. R., & Ailawadi, G. (2012). Previous percutaneous coronary intervention increases morbidity after coronary artery bypass grafting. Surgery, 152(1), 5–11. https://doi.org/10.1016/j.surg.2012.02.013

Middel, B., El Baz, N., Pedersen, S. S., van Dijk, J. P., Wynia, K., & Reijneveld, S. A. (2014). Decline in health-related quality of life 6 months after coronary artery bypass graft surgery: the influence of anxiety, depression, and personality traits. The Journal of Cardiovascular Nursing, 29(6), 544–554. https://doi.org/10.1097/JCN.0b013e3182a102ae

Miguel, G. S. V., Sousa, A. G., Silva, G. S., Colósimo, F. C., & Stolf, N. A. G. (2020). Does prior percutaneous coronary intervention influence the outcomes of coronary artery bypass surgery? Brazilian Journal of Cardiovascular Surgery, 35(1), 1–8. https://doi.org/10.21470/1678-9741-2019-0234

Najafi, M., Sheikhvatan, M., Montazeri, A., & Sheikhfathollahi, M. (2008). Predictors of quality of life among patients undergoing coronary artery bypass surgery. Acta Cardiologica, 63(6), 713–721. https://doi.org/10.2143/AC.63.6.2033388

Niclauss, L., Colombier, S., & Prêtre, R. (2015). Percutaneous coronary interventions prior to coronary artery bypass surgery. Journal of Cardiac Surgery, 30(4), 313–318. https://doi.org/10.1111/jocs.12514

Palestinian Health Information Center-MOH. (2019). Health Annual Report Palestine 2018. Retrieved from http://healthclusteropt.org/admin/file_manager/uploads/files/1/Health Annual Report Palestine 2018.pdf

Peric, V., Jovanovic-Markovic, S., Peric, D., Rasic, D., Novakovic, T., Dejanovic, B., & Borzanovic, M. (2015). Quality of life in patients of different age groups before and after coronary artery bypass surgery. Annals of Thoracic and Cardiovascular Surgery: Official Journal of the Association of Thoracic and Cardiovascular Surgeons of Asia, 21(5), 474–480. https://doi.org/10.5761/atcs.oa.15-00041

Rao, C., Stanbridge, R. D. L., Chikwe, J., Pepper, J., Skapinakis, P., Aziz, O., … Athanasiou, T. (2008). Does previous percutaneous coronary stenting compromise the long-term efficacy of subsequent coronary artery bypass surgery? A microsimulation study. The Annals of Thoracic Surgery, 85(2), 501–507. https://doi.org/10.1016/j.athoracsur.2007.09.036

RAND. (2020). *36-Item Short Form Survey (SF-36).* Retrieved July 6, 2020, from https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form.html

Shad, B., Ashouri, A., Hasandokht, T., Rajati, F., Salari, A., Naghshbandi, M., & Mirbolouk, F. (2017). Effect of multimorbidity on quality of life in adult with cardiovascular disease: a cross-sectional study. Health and Quality of Life Outcomes, 15(1), 240. https://doi.org/10.1186/s12955-017-0820-8

Staniūtė, M., & Brožaitienė, J. (2010). Changes in health-related quality of life among patients with coronary artery disease: a 2-year follow-up. Medicina (Kaunas,

Lithuania), 46(12), 843–850. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21532289

Taghipour, H. R., Naseri, M. H., Safiarian, R., Dadjoo, Y., Pishgoo, B., Mohebbi, H. A., … Kabir, A. (2011). Quality of life one year after coronary artery bypass graft surgery. Iranian Red Crescent Medical Journal, 13(3), 171–177. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22737458

Tsai, M.-F., Tsay, S.-L., Moser, D., Huang, T.-Y., & Tsai, F.-C. (2019). Examining symptom trajectories that predict worse outcomes in post-CABG patients. European Journal of Cardiovascular Nursing : Journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology, 18(3), 204–214. https://doi.org/10.1177/1474515118809906

Viswanathan, G. N., Mayurathan, G., Hildreth, T., Worthley, S. G., & Zaman, A. G. (2011). Health related quality of life after percutaneous coronary revascularisation in patients with previous coronary artery bypass grafts: A two-year follow up study. Applied Research in Quality of Life, 6(3), 311–324. https://doi.org/10.1007/s11482-010-9130-6

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Medical Care, 30(6), 473–483. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/1593914

World Health Organization. (2017). Cardiovascular diseases (CVDs). Retrieved March 23, 2020, from https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

Wu, X.-Y., Ying, T., Yin, C.-Q., Wang, S., Gao, Y.-L., Cheng, Y.-T., … Li, Z.-Z. (2019). Clinical efficacy of different treatments and their impacts on the quality of life of octogenarians with coronary artery disease. Chinese Medical Journal, 132(22), 2657–2663. https://doi.org/10.1097/CM9.0000000000000504

Figures

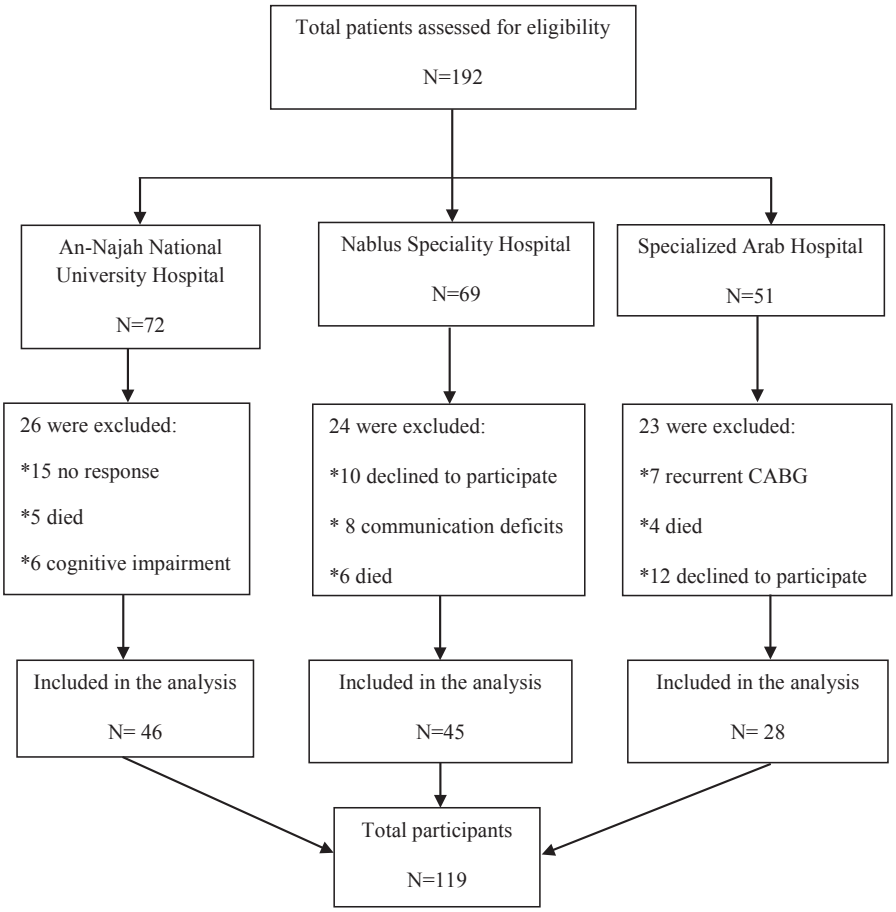


Figure 1. Sample collection.

Tables

Table 1. Sociodemographic and clinical characteristics and global score of HRQoL (n=119).

Items		n	%	SF-36 score	*p value*
Sociodemographic					
Gender	Male	91	76.5	67.2±27.01	0.103
	Female	28	23.5	57.1±32.12	
Age	35-44 year	9	7.6	83.9±15.76	
	45-54 year	32	26.9	74.4±20.97	
	55-64 year	40	33.6	68.3±25.48	<0.001
	65-74	24	20.2	59.6±29.59	
	75 year and above	14	11.8	30.0±28.14	
Marital status	Married	105	88.2	67.2±27.88	
	Single	1	0.8	50.0	0.064
	Widowed	12	10.1	44.6±28.56	
	Divorced	1	0.8	75.0	
Educational level	Illiterate	15	12.6	30.7±26.38	
	Elementary education	41	34.5	65.2±26.70	<0.001
	High school	28	23.5	68.8±26.02	
	High education	35	29.4	75.1±21.26	
Job	Unemployed	35	29.4	39.6±30.75	
	Retired	15	12.6	74.0±23.61	
	Self employed	38	31.9	74.3±21.81	<0.001
	Government employees	17	14.3	74.1±17.52	
	Civil servant	14	11.8	81.1±8.80	
Income	Less than 1500 NIS	30	25.2	44.7±31.26	
	1500 - 3000 NIS	52	43.7	67.2±27.83	
	3001- 4500 NIS	24	20.2	81.5±10.88	<0.001
	More than 4500 NIS	13	10.9	71.2±21.32	
Comorbidities					
Hypertension	Yes	87	73.1	62.5±28.41	0.137
	No	32	26.9	71.25±28.08	
Diabetes Mellitus	Yes	66	55.5	60.7±28.67	0.076
	No	53	44.5	70.0±27.63	
Dyslipidemia	Yes	100	84.0	62.5±29.20	0.040
	No	19	16.0	77.1±20.90	
Hypercholesterolemia	Yes	105	88.2	63.6±29.41	0.187
	No	14	11.8	74.3±18.17	
Lifestyle					
Smoking	Yes	58	48.7	68.8±25.41	0.140
	No	61	51.3	61.1±30.85	
Coffee consumption	Yes	91	76.5	68.3±27.04	0.016
	No	28	23.5	53.6±30.57	
Prior PCI	Yes	28	23.5	45.2±33.73	<0.001
	No	91	76.5	70.9±23.76	

NIS: New Israeli Shekel; PCI: Percutaneous coronary interventions, as angioplasty and stent placement

Table 2. HRQoL assessed by SF-36 of the study population in the overall population and according to the presence or absence of prior percutaneous coronary interventions.

SF-36 domains	**Overall population (n=119)** Mean ±SD	**Prior PCI (n=28)** Mean ±SD	**No prior PCI (n=91)** Mean ±SD	**P value**
Physical functioning	70.2 ± 35.55	46.79 ± 40.44	77.42 ± 30.71	<0.001
Role physical	66.0 ± 47.36	42.86 ± 50.40	73.08 ± 44.29	0.003
Role emotional	65.5 ± 46.93	44.05 ± 49.73	72.16 ± 44.24	0.007
Energy fatigue	65.1 ± 30.24	45.36 ± 33.39	71.21 ± 26.57	<0.001
Emotional wellbeing	66.2 ± 29.40	47.14 ± 32.81	72.04 ± 25.74	<0.001
Social Functioning	77.1 ± 31.15	55.36 ± 37.18	83.79 ± 25.79	<0.001
Bodily pain	78.6 ± 31.03	57.14 ± 36.57	85.25 ± 25.95	<0.001
General health	64.8 ± 28.48	45.18 ± 33.73	70.88 ± 23.76	0.001

PCI: Percutaneous Coronary Interventions

Table 3. Correlations between prior percutaneous coronary interventions and all domains of HRQoL (n=119).

SF-36 domains	**Prior percutaneous coronary interventions**	
	r	P value
Physical functioning	0.367	<0.001
Role physical	0.272	0.003
Role emotional	0.255	0.005
Energy fatigue	0.364	<0.001
Emotional wellbeing	0.361	<0.001
Social Functioning	0.389	<0.001
Bodily pain	0.386	<0.001
General health	0.384	<0.001

Pearson's correlation coefficient (r) was used.

Table 4. Beta estimates and confidence intervals for the association between prior percutaneous coronary interventions and all domains of HRQoL in the overall population (n= 119).

SF-36 domains	Prior percutaneous coronary interventions		
	β	OR (95% CI)	P value
Physical functioning	0.017	1.003, 1.031	0.019
Role physical	0.007	0.997, 1.017	0.193
Role emotional	0.006	0.995, 1.016	0.286
Energy fatigue	0.020	1.005, 1.037	0.011
Emotional wellbeing	0.022	1.005, 1.038	0.009
Social Functioning	0.021	1.006, 1.036	0.006
Bodily pain	0.020	1.006, 1.036	0.007
General health	0.023	1.006, 1.041	0.008

Logistic regression analyses adjusted for age and sociodemographic characteristics (level of education, job and income) were conducted. CI, confidence interval

PUBLICATION

IV. Obesity-Related Parameters are Associated with Blood Pressure in Palestinian Children.

[Abu. Ejheisheh M, Correa Rodríguez M, Fernández Aparicio A, Batran A, Membrive-Jiménez MJ, Schmidt RioValle J. (2020). Biological Research for Nursing. https://doi.org/10.1177/1099800420941074].

Impact Factor in JCR 1.789; Nursing category (35/123 Q2/T1).

Article

Biological Research for Nursing
1-9

DOI: 10.1177/1099800420941074
journals.sagepub.com/home/brn
SAGE

Obesity-Related Parameters Are Associated With Blood Pressure in Palestinian Children

Moath Abu Ejheisheh, RN[1], María Correa-Rodríguez, RN, PhD[1,2], Ángel Fernández-Aparicio, RN[1,2], Ahmad Batran, RN, PhD[3], María José Membrive-Jiménez, RN[4], and Jacqueline Schmidt-RioValle, RN, PhD[1,2]

Abstract

Hypertension has been established as a common health condition in young people. Most studies have focused on the impact of body mass index (BMI), but the relationships between body composition parameters and blood pressure in Palestinian children has not previously been investigated. We aimed to analyze the prevalence of overweight/obesity and elevated blood pressure/hypertension and investigate the associations among obesity-related parameters, including anthropometric and body composition markers and blood pressure levels in a population of 971 Palestinian school children (50% girls; mean age 10.3 $\pm$ 1.1 years). Anthropometric measurements including height, waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), and waist to height ratio (WHtR) were assessed. A body composition analyzer was used to measure body weight, fat mass, and fat-free mass. Blood pressure including systolic (SBP), diastolic (DBP) and mean arterial pressure (MAP) were measured using a Dinamap vital signs monitor. The prevalence of overweight/obesity was 25.3% in the girls and 23.1% in the boys. 26.3% of the children had elevated systolic blood pressure, or systolic hypertension; whereas 23.4% had elevated diastolic blood pressure, or diastolic hypertension. All obesity-related variables, with the exception of WHR and WHtR, showed statistical differences among the normotension, elevated blood pressure and hypertension groups for systolic and diastolic blood pressure ($p < 0.05$). Children with elevated blood pressure or hypertension had significantly higher weight, BMI, WC, HC, fat mass, and fat-free mass values compared to participants with normotension, supporting the direct association between obesity and hypertension in this population. Weight-reduction interventions are essential for reducing the prevalence of childhood hypertension in Palestinian children.

Keywords

blood pressure, body composition, obesity, hypertension, anthropometry, children, Palestinian

Childhood obesity is considered to be a global public health problem because it has reached epidemic levels in both developed and developing countries (World Health Organization, 2019). The alarming rate of childhood obesity has resulted in an increase in the rates of obesity-related co-morbidities, including hypertension, type 2 diabetes mellitus, and metabolic syndrome, which are serious and potentially life-threatening health conditions (Jiang et al., 2016; Pantalone et al., 2017). Moreover, obesity in childhood tracks strongly into adulthood because overweight children are more prone to becoming overweight adults (Biro & Wien, 2010). In fact, it has been estimated that almost half of overweight adults were overweight as children (Deshmukh-Taskar et al., 2006). The etiology of obesity is multifactorial and the mechanisms underlying childhood obesity have still not been fully elucidated. Nevertheless, it is well established that obesity is the consequence of interactions among a complex set of factors, including a positive energy balance, physical inactivity, and a genetic predisposition for weight gain (Hruby & Hu, 2015; Xu & Xue, 2016).

Body mass index (BMI) has been shown to provide a reasonable estimate of adiposity in the healthy pediatric population (Pietrobelli et al., 1998). The Centers for Disease Control and Prevention (CDC) published BMI reference standards for children (CDC, 2014). Thus, overweight is defined as a BMI between the 85th and 95th percentiles for age and sex, and obesity as a BMI at or greater than the 95th percentile for age and sex.

[1] Department of Nursing, Health Sciences Faculty, University of Granada (UGR), Granada, Spain
[2] CTS-436 Aspectos psicosociales y Transculturales de la Salud y la Enfermedad, Granada, Spain
[3] Faculty of Nursing, Arab American University, Jenin, Palestine
[4] University Hospital of Ceuta, Institute of Health Management, Ceuta, Spain

Corresponding Author:
María Correa-Rodríguez, RN, PhD, Department of Nursing, Health Sciences Faculty, University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain.
Email: macoro@ugr.es

However, BMI may slightly overestimate fatness in children who are short or who have a relatively high muscle mass, and may underestimate adiposity in children with reduced muscle mass due to a sedentary lifestyle (Vanderwall et al., 2017).

The prevalence of obesity varies according to racial, ethnic, and socioeconomic factors. In Palestine, according to the Ministry of Health (2018), chronic diseases such as hypertension, type 2 diabetes mellitus, and metabolic syndrome associated with increased obesity account for 50% of deaths. Al-Lahham et al. (2019) reported that the prevalence of obesity among Palestinian children increased from 3% to 6% over a 5-year period, in comparison to the global rise from 1% to 7% over 41 years, suggesting that childhood obesity is a major public health problem in this country.

Due to the global obesity epidemic, hypertension has now been established as one of the most common health conditions in youth (Flynn, 2013). Data from the National Health and Nutrition Examination Survey (NHANES) revealed that 14% of adolescents from 12 to 19 years of age were suffering prehypertension or hypertension (The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, 2004). Interestingly, Al-Agha & Mahjoub (2018) showed that an elevated BMI is associated with increased diastolic and systolic blood pressure among obese children and adolescents in the western region of Saudi Arabia. Nevertheless, the evidence available on the relationship between obesity and hypertension in Palestinian children is limited. Most studies have focused on the impact of BMI or anthropometric measurements on blood pressure, but these studies provide no data on body composition. Thus, the potential relationships among body composition parameters and blood pressure values in a specific cohort of Palestinian children have not been analyzed previously. Measurements of body composition, including fat mass and fat-free mass in addition to anthropometric markers, would provide data to further the understanding of the potential associations between obesity and hypertension in children.

In this context, the aim of this study was to analyze the prevalence of overweight/obesity and elevated blood pressure/hypertension and investigate the potential associations among obesity-related parameters including weight, BMI, waist circumference, hip circumference (HP), waist-to-hip ratio (WHR), waist to height ratio (WHtR), fat mass and fat-free mass, and blood pressure levels in a large population of Palestinian children.

Methods

Study Design and Participants

A cross-sectional study was conducted in a sample consisted of Palestinian school children recruited from eight public education centers in Jenin, Hebron, Nablus and Tulkarem. These cities were selected based on convenience and the public education centers were selected randomly for inclusion. An informational meeting was held, when parents and children were informed of the study purpose and procedures. They received an informed consent form, which included a detailed description of the study. At this meeting, screening for inclusion criteria and informed consent were completed. The inclusion criteria required the participants to be healthy and to not suffer from any type of endocrine dysfunction (thyroid, adrenal, or pancreas), physical disorder, or infectious process. All students who did not meet these criteria were not candidates to participate in the study. At the end of the informal meeting, a total of 971 children aged 9–12 years (486 males and 485 females) were authorized by their parents or legal guardians to participate in this study. Ethical approval for this study was granted by the Ethics and Research Committee of Arab American University (Palestine). Permission has been obtained from Ministry of Education in Palestine. It was performed according to the International Code of Medical Ethics established by the World Medical Association and the Declaration of Helsinki. Written informed consent was obtained for all participants.

After the informal meeting, another meeting was scheduled to collect data with instructions. Measurements were taken in the morning after a 12 hours fast with no consumption of food or beverages, as well as a 24 hours abstention from exercise, under resting conditions. Days before the measurements, children, parents, or legal guardians were informed of these restrictions. Before their body composition was measured, the children were also asked about compliance with these conditions.

Anthropometric Measurements

The anthropometric measurements including height, WC, HC, WHR, and WHtR were included. A Harpenden stadiometer (Harpenden 602 VR, Holtain, Wales, UK®) was used for height measurements. Each participant was asked to stand erect with his/her back, buttocks, and heels in continuous contact with the vertical height rod of the stadiometer and head oriented in the Frankfurt plane. The horizontal head piece was then placed on top of the participant's head to measure his/her height. Height was measured twice without shoes to the nearest 0.5 cm. Waist circumference was measured twice with a Seca automatic roll-up measuring metal tape (precision of 1 mm) using the horizontal plane midway between the lowest rib and the upper border of the iliac crest at the end of a normal inspiration/expiration. Hip circumference was measured twice at the maximum extension of the buttocks as viewed from the right side. The averages of the two values for each measurement were used in the analysis. BMI was calculated as body weight in kilograms divided by the square height in meters, and overweight and obesity were defined by the international standards of Cole et al. (2000), corresponded to values higher than the 85th and 95th percentiles, respectively, for BMI-forage and sex. The anthropometric measurements recorded by a standard procedure ensuring inter observer reliability and were measured by the same anthropometrist according to the International Society for the Advancement of Kinanthropometry (ISAK; Marfell-Jones et al., 2011).

Body Composition Measurements

A body composition analyzer (TANITA BC-418MA®) was used to measure body weight (kg), fat mass (kg), and fat-free mass (kg) to the nearest 0.1 kg. This was done twice when participants were

dressed in light indoor clothing without shoes and the average was used for analysis. The measurement room provides for privacy and was at a comfortable temperature for the participants.

Blood Pressure

Blood pressure including systolic (SBP), diastolic (DBP), mean arterial pressure (MAP) were measured using a Dinamap vital signs monitor (model BP 8800, Critikon, Inc., Tampa, FL.), following the recommendations of the European Heart Society (on the right arm in a semi-flexed position at heart level, with participants in a supine position and after 10 min of rest). Hypertension in children was defined as a systolic or diastolic blood pressure (BP) value $\geq$ 95th percentile. Blood pressure between the 90th and 95th percentile in childhood was designated "elevated blood pressure" (Flynn et al., 2017).

Statistical Analysis

We described numerical variables using $\pm$ standard deviation, while qualitative or nominal variables were described using frequencies and percentages. The Kolmogorov–Smirnov test was used to evaluate whether the distribution of continuous variables was normal, showing that all the examined variables were normally distributed. The independent two-sample *t*-test was used to compare the variables between girls and boys. Linear regression analysis were conducted to determine the associations among blood pressure measurements and anthropometric and body composition variables. In the overall population, regression analyses were adjusted by age and gender and in the stratified analysis by sex, linear regressions were adjusted by age. Comparisons of body composition variables across categories of blood pressure (normotension, elevated blood pressure and hypertension) were based on a one-way ANOVA after adjusted by age and sex in the overall population and adjusted only by age in the stratified analysis. SPSS Statistics version 21.0 (SPSS. Chicago, IL, USA) was used for all the analyses and p values < 0.05 were considered to be statistically significant.

Results

The clinical characteristics of the sample are presented in Table 1. The mean age of the study population was 10.2 $\pm$ 1.1 years. The prevalence of overweight/obesity was 25.3% in girls and 23.1% in boys, and 63.9% of the participants were of normal weight. Note that 26.3% of children had elevated systolic blood pressure or systolic hypertension (10.5% had elevated systolic blood pressure and 15.8% had systolic hypertension), whereas 23.4% had elevated diastolic blood pressure or diastolic hypertension (10.6% had elevated diastolic blood pressure and 12.8% had diastolic hypertension). Significant differences were observed between boys and girls with respect to height, BMI, WC, WHR, fat mass, fat-free mass, SBP, DBP, and MBP ($p <$ 0.05). The boys presented significantly higher values of height, WC, WHR, fat-free mass, SBP, DBP, and MBP than the girls (p < 0.05). In contrast, the girls had significantly higher BMI and fat mass values ($p < 0.05$).

Table 1. Descriptive Characteristics of Study Participants by Gender.

	Girls (n = 486) Mean (SD)	Boys (n = 485) Mean (SD)	Overall (n = 971) Mean (SD)	*p* value*
Age	10.1 (1.1)	10.4 (1.0)	10.2 (1.1)	<0.001
Height	138.3 (9.1)	140.8 (10.7)	139.5 (10.0)	<0.001
Weight	35.6 (9.4)	36.1 (11.2)	35.9 (10.3)	0.414
BMI	18.5 (3.7)	18.0 (3.9)	18.2 (3.8)	0.047
WC	63.4 (8.2)	64.9 (9.8)	64.2 (9.0)	0.009
HC	75.1 (8.9)	73.9 (10.8)	74.5 (9.9)	0.071
WHR	0.8 (0.0)	0.8 (0.0)	0.8 (0.0)	<0.001
WHtR	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.424
Fat mass	8.5 (5.1)	6.8 (6.0)	7.6 (5.6)	<0.001
Fat free mass	27.1 (5.1)	29.3 (6.5)	28.2 (5.9)	<0.001
SBP	111.7 (11.6)	113.6 (9.5)	112.7 (10.6)	0.005
DBP	68.3 (9.9)	70.2 (8.7)	69.3 (9.4)	0.002
MBP	82.8 (9.6)	84.7 (8.0)	83.7 (8.9)	0.001

Note. SD, standard deviation; BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; WHtR, waist to height ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure. *p values are based on the comparison between boys and girls.

The association analyses between the blood pressure measurements and obesity-related parameters in the overall population and by sex are shown in Table 2. In the whole population, MBP and SBP were significantly associated with all anthropometric and body composition variables ($p < 0.05$). Note that all obesity-related markers were associated with DBP except WHR, and WHtR. In girls, the tendency is similar, MBP, SBP, and DBP were significantly related to all anthropometric and body composition variables, except for WHR, which was not related to MBP and DBP. In boys, however, weight, BMI, WC, fat mass, and free mass were significantly associated with blood pressure levels.

Table 3 shows the anthropometric and body composition measurements for the SBP classification groups (normotension, elevated blood pressure and hypertension), for the total sample and stratified by sex. In the total sample, all obesity-related variables, with the exception of WHR and WHtR, showed statistically significant differences between the three groups ($p <$ 0.05). Children with hypertension had significantly higher weight, BMI, WC, HC, fat mass and fat-free mass values compared to participants with normotension ($p < 0.05$). In girls, the values of weight, WC, HC, WHtR, and fat free mass were significantly higher in the hypertension group compared to the normotension group. In boys, fat mass values were significantly higher in participants with systolic hypertension compared to participants with normotension (6.6 ± 5.3 versus 7.2 ± 7.5; $p =$ 0.012). Note that boys with normal SBP values presented significantly higher weight ($p = 0.012$), HC ($p = 0.046$), and fat free mass ($p = 0.006$) values.

Obesity-related measurements for the DBP classification groups (normotension, elevated blood pressure and hypertension), for the total sample and stratified by sex are presented in Table 4. In the total sample, participants with diastolic

Table 2. Association Between Blood Pressure Measurements and Anthropometric and Body Composition.

	Girls (n = 486)						Boys (n = 485)						Overall population (n = 971)					
	MBP		SBP		DBP		MBP		SBP		DBP		MBP		SBP		DBP	
	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value	β (95% CI)	*p* value
Weight	0.187 (0.090, 0.285)	<0.001	0.258 (0.140, 0.375)	<0.001	0.152 (0.051, 0.254)	0.003	0.123 (0.051, 0.196)	0.001	0.165 (0.079, 0.252)	<0.001	0.103 (0.023, 0.182)	0.011	0.144 (0.084, 0.203	<0.001	0.199 (0.127, 0.270)	<0.001	0.116 (0.053, 0.180)	<0.001
BMI	0.289 (0.054, 0.525)	0.016	0.343 (0.059, 0.627)	0.018	0.263 (0.019, 0.507)	0.035	0.271 (0.086, 0.455)	0.004	0.334 (0.115, 0.553)	0.003	0.239 (0.039, 0.439)	0.019	0.276 (0.128, 0.424)	<0.001	0.335 (0.158, 0.513)	<0.001	0.246 (0.089, 0.403)	0.002
WC	0.216 (0.111, 0.320)	<0.001	0.309 (0.184, 0.434)	<0.001	0.169 (0.060, 0.278)	0.002	0,073 (−0.002, 0.149	0.056	0.126 (0.037, 0.215)	0.006	0.047 (−0.034, 0.129)	0.256	0,129 (0.067, 0.192)	<0.001	0.199 (0.124, 0.274)	<0.001	0.094 (0.028, 0.161)	0.005
HC	0.171 (0.072, 0.271)	0.001	0.219 (0.099, 0.338)	<0.001	0.148 (0.045, .251)	0.005	0.054 (−0.022, 0.130)	0.164	0.078 (−0.012, 0.168)	0.090	0.042 (−0.040, 0.124)	0.318	0,094 (0.033, 0.155)	0.003	0.129 (0.056, 0.202)	0.001	0.076 (0.012, 0.141)	0.021
WHR	9.956 (−1.745, 21.657)	0.095	18.416 (4.340, 32.491)	0.010	5.726 (−6.419, 17.871)	0.355	3.284 (−4.851, 11.418)	0.428	9.100 (−0.527, 18.727)	0.064	0.376 (−8.434, 9.185)	0.933	6,919 (0.112, 13.725)	0.046	13.457 (5.331, 21.584)	0.001	3.650 (−3.544, 10.843)	0.320
WHtR	22.014 (5.103, 38.924)	0.011	30.829 (10.455, 51.203)	0.003	17.606 (0.042, 35.171)	0.049	5.929 (−5.807, 17.665)	0.321	12.088 (−1.815, 25.990)	0.088	2.850 (−9.862, 15.562)	0.660	12,613 (2.655, 22.570)	0.013	19.823 (7.922, 31.725)	0.001	9.008 (−1.518, 19.533)	0.093
Fat mass	0.263 (0.094, 0.432)	0.002	0.342 (0.138, 0.546)	0.001	0.223 (0.048, 0.399)	0.013	0.133 (0.012, 0.254)	0.031	0.225 (0.082, 0.367)	0.002	0.087 (−0.044, 0.218)	0.193	0,186 (0.085, 0.287)	<0.001	0.273 (0.152, 0.394)	<0.001	0.142 (0.035, 0.250)	0.009
Fat free mass	0.430 (0.236, 0.624)	<0.001	0.643 (0.411, 0.874	<0.001	0.323 (0.121, 0.526)	0.002	0.267 (0.128, 0.406)	<0.001	0.334 (0.169, 0.500)	<0.001	0.233 (0.082, 0.385)	0.003	0.309 (0.194, 0.425)	<0.001	0.438 (0.301, 0.576)	<0.001	0.245 (0.122, 0.367)	<0.001

Note. MBP, mean blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; WHtR, waist to height ratio. Data were adjusted by age and gender in the overall population and only by age in the stratified analysis by sex.

Table 3. Anthropometric and Body Composition Variables Across SBP Categories.

	Girls (n = 486)				Boys (n = 485)				Overall (n = 971)			
	Normotension (n = 368) Mean (SD)	Elevated blood pressure (n = 43) Mean (SD)	Hypertension (n = 75) Mean (SD)	*p* value	Normotension (n = 348) Mean (SD)	Elevated blood pressure (n = 59) Mean (SD)	Hypertension (n = 78) Mean (SD)	*p* value	Normotension (n = 716) Mean (SD)	Elevated blood pressure (n = 102) Mean (SD)	Hypertension (n = 153) Mean (SD)	*p* value
Weight	35.4 (9.4)	35.2 (7.7)	36.7 (10.3)	0.002	36.5 (10.5)	33.7 (9.8)	36.4 (14.4)	0.012	35.9 (10.0)	34.3 (9.0)	36.6 (12.5)	<0.001
BMI	18.4 (3.7)	18.4 (3.2)	18.7 (3.5)	0.252	17.9 (3.7)	18.0 (3.8)	18.2 (4.8)	0.088	18.2 (3.7)	18.2 (3.6)	18.5 (4.2)	0.039
WC	62.9 (8.3)	63.8 (7.5)	65.7 (8.0)	0.001	65.1 (9.3)	63.2 (9.8)	65.2 (11.8)	0.387	64.0 (8.8)	63.5 (8.8)	65.5 (10.1)	0.002
HC	74.8 (8.7)	74.7 (8.7)	76.8 (9.7)	0.002	74.4 (10.6)	71.3 (10.5)	73.8 (12.0)	0.046	74.6 (9.6)	72.7 (9.9)	75.3 (11.0)	<0.001
WHR	0.8 (0.0)	0.8 (0.0)	0.8 (0.0)	0.224	0.8 (0.0)	0.8 (0.1)	0.8 (0.1)	0.236	0.8 (0.0)	0.8 (0.0)	0.8 (0.1)	0.937
WHtR	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.048	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.991	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.245
Fat mass	8.3 (5.0)	8.35 (4.2)	9.1 (5.9)	0.055	6.6 (5.3)	7.6 (7.5)	7.2 (7.5)	0.012	7.5 (5.2)	7.9 (6.3)	8.1 (6.8)	0.003
Fat free mass	27.0 (5.1)	27.0 (4.0)	27.7 (5.6)	<0.001	29.8 (6.3)	27.1 (5.7)	29.2 (7.7)	0.006	28.3 (5.9)	27.1 (5.0)	28.5 (6.7)	<0.001

Note. Data are shown as mean ± SD. Data were adjusted by age and gender in the overall population and only by age in the stratified analysis by sex. BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; WHtR, waist to height ratio. *p values are based on the comparison between normotension and elevated blood pressure/hypertension.

Table 4. Anthropometric and Body Composition Variables Across DBP Classification.

	Girls (n = 486)				Boys (n = 485)				Overall sample (n = 971)			
	Normotension (n = 379)	Elevated blood pressure (n = 30)	Hypertension (n = 77)		Normotension (n = 365)	Elevated blood pressure (n = 73)	Hypertension (n = 47)		Normotension (n = 744)	Elevated blood pressure (n = 103)	Hypertension (n = 124)	
	Mean (SD)	Mean (SD)	Mean (SD)	*p* value	Mean (SD)	Mean (SD)	Mean (SD)	*p* value	Mean (SD)	Mean (SD)	Mean (SD)	*p* value
Weight	35.4 (9.3)	34.6 (8.7)	37.1 (10.1)	0.005	35.9 (10.7)	36.4 (12.0)	37.2 (13.5)	0.026	35.7 (10.0)	35.9 (11.1)	37.1 (11.5)	<0.001
BMI	18.3 (3.3)	18.6 (3.3)	19.2 (5.1)	0.017	17.8 (3.8)	18.5 (4.0)	18.5 (4.5)	0.048	18.0 (3.5)	18.6 (3.8)	18.9 (4.9)	0.001
WC	63.0 (8.3)	63.4 (6.9)	65.6 (8.1)	0.003	64.8 (9.7)	65.4 (10.3)	65.0 (9.7)	0.439	63.9 (9.0)	64.8 (9.4)	65.4 (8.7)	0.006
HC	74.7 (8.7)	74.7 (7.4)	77.1 (9.9)	0.003	73.9 (11.0)	74.0 (9.7)	74.2 (11.2)	0.129	74.3 (9.9)	74.2 (9.1)	76.0 (10.4)	<0.001
WHR	0.8 (0.0)	0.8 (0.0)	0.8 (0.0)	0.743	0.8 (0.0)	0.8 (0.1)	0.8 (0.0)	0.522	0.8 (0.0)	0.8 (0.1)	0.8 (0.0)	0.322
WHtR	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.055	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.422	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.078
Fat mass	8.3 (5.0)	8.4 (4.7)	9.3 (5.9)	0.048	6.7 (5.9)	7.1 (6.1)	7.4 (6.9)	0.323	7.5 (5.5)	7.4 (5.7)	8.6 (6.4)	0.014
Fat free mass	27.1 (5.0)	26.1 (4.4)	27.7 (5.6)	0.001	29.3 (6.3)	29.3 (6.9)	29.8 (7.6)	0.009	28.2 (5.8)	28.4 (6.4)	28.5 (6.5)	<0.001

Note. Data are shown as mean ± SD. Data were adjusted by age and gender in the overall population and only by age in the stratified analysis by sex. BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; WHtR, waist to height ratio. **p* values are based on the comparison between normotension and elevated blood pressure/hypertension.

hypertension had significantly higher values for obesity-related parameters, with the exception of WHR and WHtR, compared to the normotension group ($p < 0.05$). This tendency was similar in girls, and there were also significant differences in all anthropometric outcomes, with the exception of WHR and WHtR, between the groups ($p < 0.05$). For boys, the weight, BMI, and fat free mass values were significantly higher in participants with diastolic hypertension compared to normotension participants ($p < 0.05$).

Discussion

Based on a large sample of 971 Palestinian children, we found that all obesity-related parameters, with the exception of WHR and WHtR, presented statistical differences between the normotension, elevated blood pressure, and hypertension groups for systolic and diastolic blood pressure. Thus, children with elevated blood pressure or hypertension have significantly higher weight, BMI, WC, HC, fat mass, and fat-free mass values compared to participants with normotension, supporting the direct association between high values for obesity related-parameters and high blood pressure values in children from Palestine. These findings are clinically relevant since obesity and hypertension are both linked to a high risk of cardiovascular disease, increasing related morbidity and mortality in adulthood (Brady et al., 2016; Morrison et al., 2007).

Hypertension is a growing health issue in children, mainly due to its association with obesity (Orlando et al., 2018). Similar to our findings, previous studies have also evidenced an association between anthropometric parameters and blood pressure values in childhood (Brady, 2017). A retrospective study conducted on subjects from 3 to 17 years of age in the United States also reported a statistically significant association between increased BMI percentile and increased blood pressure percentile, with the risk of incident hypertension associated primarily with obesity (Parker et al., 2016). Likewise, a study on a cohort of Portuguese children reported that WC is itself a risk factor predictor for hypertension in children and adolescents (Burgos et al., 2013), and other research from China also showed that a child's BMI, WC, and WHtR were positively associated with their SBP and DBP, showing that obese children were 3 to 6 times more likely to suffer hypertension (Zhao et al., 2017). Additionally, an elevated BMI was associated with increased diastolic and systolic blood pressure in 300 obese children in the western region of Saudi Arabia (Al-Agha & Mahjoub, 2018). However, this is the first study to evaluate the link between body composition parameters and blood pressure in a cohort of Palestinian children. The positive relationship between obesity-related markers, including fat mass and blood pressure levels in this cohort, evidences the need to develop effective strategies to prevent overweight and obesity in this population.

Hypertension in children will easily become hypertension in adults, and this is an important cardiovascular risk factor which increases the risk of cardiovascular disease (Urbina et al., 2019). Interestingly, a recent study found that obesity-related hypertension in children was related to increased cardiovascular morbidity and mortality (Wühl, 2019). Thus, interventions aimed at weight reduction that include lifestyle modification with a multidisciplinary approach are essential for reducing childhood hypertension. With regard to the potential mechanisms underlying the link between obesity and elevated blood pressure, it has been proposed that the sympathetic nervous system, the renin–angiotensin–aldosterone system, the amount of intra-abdominal and intra-vascular fat, and sodium retention leading to increased renal reabsorption, might all play an important role in the pathogenesis of obesity-related hypertension (Brady, 2017).

On the other hand, in our study, 26.3% of children had elevated systolic blood pressure or systolic hypertension, whereas 23.4% had elevated diastolic blood pressure or diastolic hypertension. In a cross-sectional study conducted on a large population of young people 6 to 17 years of age from Southern California, the prevalence of elevated blood pressure and hypertension were 31.4% and 2.1%, respectively (Koebnick et al., 2013). Moreover, children 3 to 17 years of age from Nigeria, the prevalence of hypertension and elevated blood pressure was found to be 3.5% and 2.5%, respectively (Okpokowuruk et al., 2017). Interestingly, data obtained from a prospective national survey in China showed that the overall prevalence of elevated blood pressure and hypertension were 6.0% and 10.6%, respectively (Fan et al., 2019). The differences in ethnicity and age range between the various studies may account for the disparity in the reported prevalence. For this reason, further studies on children from Palestine are required in order to verify and compare our results.

The prevalence of overweight/ obesity in our study was 25.3% in girls and 23.1% in boys. A previous cross-sectional study conducted among school-age Palestinian children reported that the prevalence of overweight and obesity was approximately 14.5% and 15.7%, respectively, which supports an accelerated increase in the prevalence of overweight/obesity (Al-Lahham et al., 2019). Similarly, findings from marginalized Palestinian schools in the West Bank showed that the 34% of adolescents were overweight or obese (85th percentile or over; Amer et al., 2019) and a systematic review of childhood obesity in the Middle East and North Africa (MENA) region concluded that the obesity rate in children and adolescents is rising rapidly (Farrag et al., 2017). Thus, the countries in the MENA region should endorse strategies and programs to prevent and manage this problem in an effective way. Family-based lifestyle changes, including decreasing total caloric intake, increasing physical activity and decreasing sedentary time, have been proposed as the cornerstone of weight management in children (Kumar & Kelly, 2017), and should be implemented in Palestinian children. Interestingly, a recent study on Palestinian children found that living in the city, maternal and paternal BMI, WC, modes of transport, and chocolate and sweet intake, were significantly associated with the BMI of children (Al-Lahham et al., 2019). Those authors concluded that the increased prevalence of childhood obesity might be due to the rapid urbanization and transition from conventional to western lifestyles. Furthermore, the fluctuations and instability of Palestinian societal and

political life could affect the nutrition status of children, since access to health services is complicated and people are exposed to food insecurity in some regions of Palestine (Mataria et al., 2009; Qlalweh et al., 2012).

One limitation of this study is its cross-sectional design, which cannot infer causality. In addition, since our study population comprised a well-characterized cohort of Palestinian children, this may limit the generalizability of the results to other populations. Its strengths are that, to the best of our knowledge, this is the first study to examine the relationship between obesity-related parameters, including body composition parameters and blood pressure levels, in a cohort of Palestinian children. Additionally, body composition measurements were performed using a body composition analyzer (TANITA BC-418MA). Bioelectrical impedance analysis (BIA) has been postulated as a valuable tool for measuring body composition, and is a significantly more cost-effective method than dual-energy X-ray absorptiometry (DXA; Beeson et al., 2010).

Conclusion

The prevalence of overweight/obesity was 25.3% in girls and 23.1% in boys, and 26.3% of Palestinian children have elevated systolic blood pressure/hypertension whereas 23.4% have elevated diastolic blood pressure/hypertension. Palestinian children with elevated blood pressure or hypertension have significantly higher weight, BMI, WC, HC, fat mass, and fat-free mass values than the participants with normotension, supporting a direct association between high values of obesity related-parameters and high blood pressure values. Our results therefore highlight the need for a serious focus on obesity in Palestinian children and reveal the need for community-based programs to manage this health problem. Weight reduction interventions are essential to reduce the prevalence of related disorders, such as childhood hypertension, and, for this reason, the prevention of childhood obesity should be a national public health priority in Palestine.

Acknowledgments

This manuscript is part of the PhD thesis developed by Moath Abu Ejheisheh, included in the Official PhD Program of Clinical Medicine and Public Health at the University of Granada, Spain.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

María Correa-Rodríguez https://orcid.org/0000-0001-9165-4349

References

Al-Agha, A. E., & Mahjoub, A. O. (2018). Impact of body mass index on high blood pressure among obese children in the western region of Saudi Arabia. *Saudi Medical Journal*, *39*(1), 45–51. https://doi.org/10.15537/smj.2018.1.20942

Al-Lahham, S., Jaradat, N., Altamimi, M., Anabtawi, O., Irshid, A., Alqub, M., Dwikat, M., Nafaa, F., Badran, L., Mohareb, R., Haji, R., Aqqad, T., Jayyab, S., Ghosh, B. A., Taher, R., & Al Zabadi, H. (2019). Prevalence of underweight, overweight and obesity among Palestinian school-age children and the associated risk factors: a cross sectional study. *BMC Pediatrics*, *19*(483). https://doi.org/10.1186/s12887-019-1842-7

Amer, S., Kateeb, E., Hassan, A., & Musa, F. (2019). Dietary habits, energy drink consumption, obesity, and physical activity in marginalised Palestinian schools in the West Bank: A cross-sectional study. *The Lancet*, *393*(S13). https://doi.org/10.1016/S0140-6736(19)30599-9

Beeson, W. L., Batech, M., Schultz, E., Salto, L., Firek, A., Deleon, M., Balcazar, H., & Cordero-Macintyre, Z. (2010). Comparison of body composition by bioelectrical impedance analysis and dual-energy X-ray absorptiometry in hispanic diabetics. *International Journal of Body Composition Research*, *8*(2), 45–50.

Biro, F. M., & Wien, M. (2010). Childhood obesity and adult morbidities. *American Journal of Clinical Nutrition*, *91*(5), 1499S–1505S. https://doi.org/10.3945/ajcn.2010.28701B

Brady, T. M. (2017). Obesity-related hypertension in children. *Frontiers in Pediatrics*, *5*, 197. https://doi.org/10.3389/fped.2017.00197

Brady, T. M., Appel, L. J., Holmes, K. W., Fivush, B., & Miller, E. R. (2016). Association between adiposity and left ventricular mass in children with hypertension. *Journal of Clinical Hypertension*, *18*(7), 625–633. https://doi.org/10.1111/jch.12717

Burgos, M. S., Burgos, L. T., Camargo, M. D., Franke, S. I. R., Prá, D., da silva, A. M. V., Borges, T. S., Todendi, P. F., Reckziegel, M. B., & Reuter, C. P. (2013). Associação entre medidas antropométricas e fatores de risco cardiovascular em crianças e adolescentes. *Arquivos Brasileiros de Cardiologia*, *101*(4), 288–296. https://doi.org/10.5935/abc.20130169

Centers for Disease Control and Prevention (CDC). Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion. (2014). Using BMI-for-age as a Screening Tool—BMI for Age Training Course. Retrieved April 19, 2020, from https://www.cdc.gov/nccdphp/dnpao/growthcharts/training/bmiage/page2.html

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ (Clinical Research Ed.)*, *320*(7244), 1240–1243. https://doi.org/10.1136/BMJ.320.7244.1240

Deshmukh-Taskar, P., Nicklas, T. A., Morales, M., Yang, S. J., Zakeri, I., & Berenson, G. S. (2006). Tracking of overweight status from childhood to young adulthood: The Bogalusa Heart Study. *European Journal of Clinical Nutrition*, *60*(1), 48–57. https://doi.org/10.1038/sj.ejcn.1602266

Fan, Z., Liao, Z., Zong, X., & Zhang, S. (2019). Differences in prevalence of prehypertension and hypertension in children and

adolescents in the eastern, central and western regions of China from 1991-2011 and the associated risk factors. *PLoS ONE*, *14*(1). https://doi.org/10.1371/journal.pone.0210591

Farrag, N. S., Cheskin, L. J., & Farag, M. K. (2017). A systematic review of childhood obesity in the Middle East and North Africa (MENA) region: Health impact and management. *Advances in Pediatric Research*, *4*, 6. https://doi.org/10.12715/apr.2017.4.6

Flynn, J. (2013). The changing face of pediatric hypertension in the era of the childhood obesity epidemic. *Pediatric Nephrology*, *28*(7), 1059–1166. https://doi.org/10.1007/s00467-012-2344-0

Flynn, J. T., Kaelber, D. C., Baker-Smith, C. M., Blowey, D., Carroll, A. E., Daniels, S. R., de Ferranti, S. D., Dionne, J. M., Falkner, B.,, Flinn, S. K., Gidding, S. S., Goodwin, C., Leu, M. G., Powers, M. E., Rea, C., Samuels, J., Simasek, M., Thaker, V. V., Urbina, E. M., & Okechukwu, K. (2017). Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics*, *140*(3), e20171904. https://doi.org/10.1542/peds.2017-1904

Hruby, A., & Hu, F. B. (2015). The epidemiology of obesity: A big picture. *PharmacoEconomics*, *33*(7), 673–689. https://doi.org/10.1007/s40273-014-0243-x

Jiang, S. Z., Lu, W., Zong, X. F., Ruan, H. Y., & Liu, Y. (2016). Obesity and hypertension. *Experimental and Therapeutic Medicine*, *12*(4), 2395–2399. https://doi.org/10.3892/etm.2016.3667

Koebnick, C., Black, M. H., Wu, J., Martinez, M. P., Smith, N., Kuizon, B. D., Jacobsen, S. J., & Reynolds, K. (2013). The prevalence of primary pediatric prehypertension and hypertension in a real-world managed care system. *Journal of Clinical Hypertension*, *15*(11), 784–792. https://doi.org/10.1111/jch.12173

Kumar, S., & Kelly, A. S. (2017). Review of childhood obesity: From epidemiology, etiology, and comorbidities to clinical assessment and treatment. *Mayo Clinic Proceedings*, *92*(2), 251–265. https://doi.org/10.1016/j.mayocp.2016.09.017

Marfell-Jones, M., Olds, T., & Stewart, A. (2011). *International standards for anthropometric assessment*. International Society for the Advancement of Kinanthropometry. https://doi.org/10.1152/japplphysiol.00187.2013

Mataria, A., Khatib, R., Donaldson, C., Bossert, T., Hunter, D. J., Alsayed, F., & Moatti, J. P. (2009). The health-care system: An assessment and reform agenda. *The Lancet*, *373*(9670), 1207–1217. https://doi.org/10.1016/S0140-6736(09)60111-2

Morrison, J. A., Friedman, L. A., & Gray-McGuire, C. (2007). Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: The Princeton lipid research clinics follow-up study. *Pediatrics*, *120*(2), 340–345. https://doi.org/10.1542/peds.2006-1699

Okpokowuruk, F. S., Akpan, M. U., & Ikpeme, E. E. (2017). Prevalence of hypertension and prehypertension among children and adolescents in a semi-urban area of Uyo Metropolis, Nigeria. *Pan African Medical Journal*, *28*, 303. https://doi.org/10.11604/pamj.2017.28.303.14396

Orlando, A., Cazzaniga, E., Giussani, M., Palestini, P., & Genovesi, S. (2018). Hypertension in children: Role of obesity, simple carbohydrates, and uric acid. *Frontiers in Public Health*, *6*, 129. https://doi.org/10.3389/fpubh.2018.00129

Pantalone, K. M., Hobbs, T. M., Chagin, K. M., Kong, S. X., Wells, B. J., Kattan, M. W., Bouchard, J., Sakurada, B., Milinovich, A., Weng, W., Bauman, J., Misra-Hebert, A. D., Zimmerman, R. S., & Burguera, B. (2017). Prevalence and recognition of obesity and its associated comorbidities: Cross-sectional analysis of electronic health record data from a large US integrated health system. *BMJ Open*, *7*(11). https://doi.org/10.1136/bmjopen-2017-017583

Parker, E. D., Sinaiko, A. R., Kharbanda, E. O., Margolis, K. L., Daley, M. F., Trower, N. K., Sherwood, N. E., Greenspan, L. C., Lo, J. C., Magid, D. J, & O'Connor, P. J. (2016). Change in weight status and development of hypertension. *Pediatrics*, *137*(3). https://doi.org/10.1542/peds.2015-1662

Pietrobelli, A., Faith, M. S., Allison, D. B., Gallagher, D., Chiumello, G., & Heymsfield, S. B. (1998). Body mass index as a measure of adiposity among children and adolescents: A validation study. *Journal of Pediatrics*, *132*(2), 204–210. https://doi.org/10.1016/S0022-3476(98)70433-0

Qlalweh, K., Duraidi, M., & Brønnum-Hansen, H. (2012). Health expectancy in the occupied Palestinian territory: Estimates from the Gaza Strip and the West Bank: Based on surveys from 2006 to 2010. *BMJ Open*, *2*(6). https://doi.org/10.1136/bmjopen-2012-001572

State of Palestine. Ministry of Health. (2018). *Health Annual Report*. Palestine.

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. National Heart, Lung, and Blood Institute (NHLBI). (2004). *Pediatrics*, *114*, 555–576. https://www.nhlbi.nih.gov/health-topics/fourth-report-on-diagnosis-evaluation-treatment-high-blood-pressure-in-children-and-adolescents

Urbina, E. M., Khoury, P. R., Bazzano, L., Burns, T. L., Daniels, S., Dwyer, T., Hu, T., Jacobs, D. R Jr., Juonala, M., Prineas, R., Raitakari, O., Steinberger, J., Venn, A., Woo, J. G., & Sinaiko, A. (2019). Relation of blood pressure in childhood to self-reported hypertension in adulthood. *Hypertension*, *73*(6), 1224–1230. https://doi.org/10.1161/HYPERTENSIONAHA.118.12334

Vanderwall, C., Randall Clark, R., Eickhoff, J., & Carrel, A. L. (2017). BMI is a poor predictor of adiposity in young overweight and obese children. *BMC Pediatrics*, *17*(1). https://doi.org/10.1186/s12887-017-0891-z

World Health Organization. (2019). Facts and figures on childhood obesity.

Wühl, E. (2019). Hypertension in childhood obesity. *Acta Paediatrica, International Journal of Paediatrics*, *108*, 37–43. https://doi.org/10.1111/apa.14551

Xu, S., & Xue, Y. (2016). Pediatric obesity: Causes, symptoms, prevention and treatment (review). *Experimental and Therapeutic Medicine*, *11*(1), 15–20. https://doi.org/10.3892/etm.2015.2853

Zhao, Y., Wang, L., Xue, B., & Wang, Y. (2017). Associations between general and central obesity and hypertension among children: The Childhood Obesity Study in China Mega-Cities. *Scientific Reports*, *7*(1). https://doi.org/10.1038/s41598-017-16819-y

PUBLICATION

V. Correlation between Anthropometric Measurements and Blood Pressure in a Population of Palestinian Adults.

[Abu. Ejheisheh M, Correa Rodríguez M, Fernández Aparicio A, Batran A, Gómez-Urquiza JL, Schmidt RioValle J. (2020). African Health Sciences, under review].

Impact Factor in JCR 0.840. Medicine, General & Internal category position (137/165 Q4/T3).

Correlation between Anthropometric Measurements and Blood Pressure in a population of Palestinian Adults

Moath Abu Ejheisheh[1†], María Correa-Rodríguez[2,3], Ángel Fernández-Aparicio[2,3], Ahmad Batran[4],José Luis Gómez-Urquiza[2], Jacqueline Schmidt-RioValle[2,3]

[1] Faculty of Health Sciences, PhD student of the Public Health and Clinic Medicine program of the University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain.

[2] Department of Nursing, Faculty of Health Sciences, University of Granada (UGR), Avenida de la Ilustración s/n, 18100-Armilla (Granada), Spain.

[3] CTS-436 Aspectos psicosociales y Transculturales de la Salud y la Enfermedad.

[4] Faculty of Nursing, Arab American University, Palestine.

[†]Corresponding author: Moath Abu Ejheisheh. Department of Nursing, Faculty of Health Sciences, University of Granada (UGR), Avenida de la Ilustración 60, 18016 Granada, Spain.Email: moad.ibrahem@hotmail.com.

Abstract

Background: Obesity can be a major problem due to its potential to cause a number of health issues, including high blood pressure and diabetes. Many reports have come out of Palestine on overweight and obesity and their direct link to non-communicable diseases, although there is only limited evidence available on the connection between obesity and hypertension in Palestinian adults.

Aim: We aimed to look at the associations between anthropometric and body composition variables and blood pressure in a large population of Palestinian adults (1337 subjects) and determine which anthropometric indices most strongly correlate with high blood pressure. Methods: Anthropometric measurements including height, waist circumference (WC), hip circumference (HC), body mass index (BMI), and total body fat (TBF) were assessed. A body composition analyzer was used to measure body weight, fat mass and fat-free mass. Systolic (SBP) and diastolic (DBP) blood pressure were measured using a Dinamap vital signs monitor.

Results: In both males and females, all the anthropometric measurements showed significant strong positive correlations with mean SBP and mean DBP ($p<0.01$). SBP correlated the most strongly with waist circumference in all subjects ($r = 0.444$ in females, $r =0.422$ in males), while DBP correlated the most strongly with WC in males($r = 0.386$), but with TBF in females ($r = 0.256$).

Conclusions: By controlling fat percentage, WC, HC, and BMI, which are affected by extra weight and lack of exercise, blood pressure levels can be regulated.

Key words: blood pressure; body composition; anthropometry; adults; Palestinian.

Introduction

Globally, obesity is increasing dramatically and may cause many diseases and health problems, including high blood pressure, type 2 diabetes, and certain types of cancer (Bhurosy&Jeewon, 2014). In 2016, the World Health Organization announced that almost two billion adults worldwide were overweight and about 650 million were obese (World Health Organization, 2020).Obesity is one of the leading causes of cardiovascular diseases (CVD)and all cause for death(Flegal et al., 2007), and this, together with overweight, are the main adjustable risk factors for high blood pressure (Badaruddoza, 2011). Obesity could be a major problem due to its potential to cause a number of health issues, including high blood pressure and diabetes (Hruby et al., 2016), indeed, many studies report that high blood pressure is related to increased obesity (Reddy et al., 2010). Nevertheless, there is limited evidence available on the connection between obesity and hypertension in Palestinian adults. This has led researchers to look at various anthropometric measurements, including waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), and visceral fat (VF), as well as skin fold thickness (Qorbani et al., 2013; Van Dijk et al., 2012; Chen et al., 2007) to determine which variables correlate most closely with CVD or are useful for assessing risk. Measurements of body fat have traditionally been limited to simple assessments such as WC, HC, WHR, and BMI.

Palestine consists of two separate areas, the Gaza Strip and the West Bank, with 2.72 million people in the West Bank and 1.70 million in the Gaza Strip (Husseini et al., 2009).Obesity and overweight are enormous public health problems in Palestine (Abdeen et al., 2012) and a study of Palestinian adults in a rural community estimated the prevalence of obesity as being 58.7% and 71.3% among males and females, respectively (Bayyari et al., 2013).The

first national survey of overweight and obesity in Palestine (Abdeen et al., 2012)revealed that over 60% of the Palestinian population aged between 18 and 64 is overweight (38.0%) or obese (24.4%), similar to the results of an earlier study of Palestinians in rural areas of the West Bank that found obesity levels of 37%in women and 18% in men (Population Reference Bureau, 2006). Indeed, there are many reports from Palestine that directly associate overweight and obesity with non-communicable diseases (Ellulu et al., 2014).Many anthropometric indicators are used to measure obesity, but there is no consensus on which of these human indicators best defines obesity and determines an increased risk of high blood pressure (Nahar et al., 2012). The aim of this study was to try to ascertain which anthropometric index most strongly correlates with high blood pressure in the Palestinian population.

To elucidate this issue, we therefore looked at the associations between anthropometric and body composition variables (weight, BMI, WC, HC, and TBF) and blood pressure in a large population of Palestinian adults. There exists a need for an easy and effective obesity measurement to aid in assessing risk, informing the most appropriate management approaches, and developing preventive strategies. However, the simplest measure of obesity often helps predict the risk factors for cardiovascular disease (Van Dijk et al., 2012; Saeed & Al-Hamdan, 2013; Zhu et al., 2018).

Method

Study design and participants

A cross-sectional study was conducted from October 2018 to December 2018 on a sample of Palestinian adults recruited from public health centers in the West Bank (Hebron, Nablus, and Ramallah). These cities were selected based on convenience and therefore the public

health centers were selected randomly for inclusion. Recruitment days were announced through health centers in each city. Possible study participants were informed about the aim of the study and its procedures and received a consent form, including an in-depth description of the study. The inclusion criteria required that the participants had healthy movement or were not taking anticonvulsants, and did not suffer from any kind of physical disorder or infection where cramping could occur or the person could fall suddenly while the body measurements were being taken, or that due to a lack of normal movement they were unable to stand on the body composition analyzer. In total, 1337 adults aged 40 to 64participated in this study.

The research protocol was approved by the ethical committee of the Arab American University-Palestine involved in the study (approval no. 1626952020). Prior to data collection, each participant was informed that this interview and anthropometric measurements would be completely voluntary, no identification was required, and there was no risk involved with participating in this study. Permission for the study was obtained from Palestinian Ministry of Health and it was performed according to the International Code of Medical Ethics established by the World Medical Association and the Declaration of Helsinki.

Anthropometric measurements

The anthropometric measurements were recorded by trained nurses using a standard procedure ensuring inter-observer reliability. They included height, WC, HC, WHR, and WHtR. Anthropometric indicators were assessed for all the participants, using standardized equipment and methods. While collecting this data, all the participants wore light clothing; all measurements were taken twice and the mean was recorded. Each participant's height measurement was taken twice in the standing position, without shoes, using a portable

stadiometer. WC was measured twice with a metric tape over light clothing at the level of the umbilicus, halfway between the lower rib margin and the iliac crest, with no pressure being put on the skin. During this measurement, the participants were asked to stand upright, breathe normally, and relax their abdomen. HC was measured twice at the maximum width of the buttocks in a standing position with the feet together. The means of the two values for each measurement were used in the analysis. Height and weight measurements were utilized to determine BMI by using weight (kg) divided by height squared (m^2) expressed as kg/m^2according to international standards.

Body composition measurements

A body composition analyzer (TANITA BC-418MA®) was used to measure body weight (kg), fat mass (kg), percentage of fat mass (%), and fat-free mass (kg) to the nearest 0.1 kg. This was done twice while participants were dressed in light clothing, without shoes. Measurements were taken in the morning when no food had been consumed and no exercise had been undertaken in the preceding 8 hours, under resting conditions.

Blood pressure

Systolic (SBP) and diastolic (DBP) blood pressure were measured using a Dinamap vital signs monitor (Model BP 8800, Critikon, Inc., Tampa, Florida), following the recommendations of the European Heart Society (on the right arm in a semi-flexed position at heart level, with the participants in a supine position and after 10 minutes of rest). Readings of SBP ≥130 mmHg and DBP≥80 mmHg in adults are taken as being hypertensive; readings of SBP <120 mmHg and DBP<80 mmHg are normotensive (Whelton et al., 2018).

Statistical analysis

We described numerical variables using the mean ± standard deviation, while qualitative or nominal variables were described using percentages and frequencies. The independent two-sample t-test was used to compare the variables between female and male study participants. Pearson and partial correlation coefficient analyses (r) were used to test the relationships between human variables, body composition variables, and blood pressure values. Linear regression analysis was conducted to determine the association between blood pressure measurements and body composition variables. Body composition variables were compared according to blood pressure categories (normal or hypertensive). SPSS Statistics version 26.0 (SPSS. Chicago. IL, USA) was used for all the analyses; p values < 0.05 were considered to be statistically significant.

Results

One thousand three hundred thirty-seven participants were recruited into the study. The average age of the participants was 47.25±7.37 years though the females were significantly younger than males ($p<0.05$), as well as being significantly shorter and lighter (Table 1).

Males tended to have a higher WC compared to females although the differences were not statistically significant. Males also had significantly larger WHR and greater total fat (%), but females had significantly larger BMI and HC than males (31.22±6.45 kg/m^2 and 108.82±12.92 cm vs 28.24±4.96 kg/m^2 and 101.64±10.80 cm, respectively; $p<0.01$). Although females were shorter than males, they had a significantly higher WHtR (0.60±0.09 vs 0.56±0.07, $p<0.01$). Males on the other hand had significantly higher SBP (133.86±14.68 mmHg vs

130.34±16.52 mmHg, $p<0.01$) and DBP (84.39±8.09 mmHg vs 82.88±8.76 mmHg, $p<0.01$) compared to females.

Sex-specific analysis showed that more males were normotensive compared to females (52.0% vs 48.0%). The overall prevalence of hypertension in the males was 61.7% compared to 38.3% in females.

The differences in anthropometric data between normotensive and hypertensive subjects are explored in Table 3.Hypertensive participants were older than the normotensive subjects and had a significantly higher BMI (31.98±6.00 kg/m^2 vs 28.35±5.39 kg/m^2), WC (103.60±10.89 cm vs 93.45±12.86 cm), and HC (109.53±11.47 cm vs 102.47±12.06 cm).

Differences in human body measurements were detected between the normotensive and hypertensive population, as can be seen in Table 4. The mean values of BMI, WC,HC, and TBF were significantly higher in hypertensive compared to normotensive participants for both sexes ($p<0.01$).

The relationship between the anthropometric measurements (BMI, WC, HC, and TBF) and both mean systolic and mean diastolic blood pressure was explored through partial correlation coefficients (Table 5). In both males and females, all the anthropometric measurements showed a significant strong positive correlation with mean SBP and mean DBP ($p<0.01$).WC had the strongest correlation with SBP ($r = 0.444$ in females, $r =0.422$ in males), although WC had the strongest correlation with DBP in males($r = 0.386$); in females total body fat had the strongest correlation with DBP($r = 0.256$).The next-strongest correlation with SBP was BMI in females, and TBF in males. The next-strongest correlation with DBP was WC in females, while in males this was with HC.

The presence of hypertension correlated significantly with all of the anthropometric measurements (BMI, WC, HC, and TBF) in both males and females. (Table 6)

Discussion

It is important to identify the anthropometric measurements that may be useful for predicting the risk of cardiovascular disease associated with obesity in adults. In this study we assessed four anthropometric measurements, BMI, WC, HC, and TBF.

We found differences in the mean values of anthropometric measurements in addition to mean systolic and diastolic blood pressures in males and females, in line with the findings of other authors (Nkeh-Chungag et al., 2015; Anwar et al., 2019) who reported different mean values of WC, HC, BMI, height, weight, SBP, and DBP. These differences in height, weight and other anthropometric measurements are normal due to sexual dimorphism in humans. Our results found that there was a difference between normotension and hypertension according to the age and anthropometric measurements of the participants, which supports other studies conducted in this field (Batiha et al., 2015; Azzeh et al., 2017). However, these studies used WC, BMI, HC and WHR data.

The major findings of this study are that SBP and DBP correlate in a statistically significant way with all the anthropometric measurements studied (BMI, WC, HC, and TBF). Our results are comparable with previous studies from different countries, in terms of a significant relationship between anthropometric measurements and increased SBP and DBP (Batiha et al., 2015; Anwar et al., 2019). Likewise a study of urban black South African adults that reported association between various adiposity indices and blood pressure and hypertension, where all body composition parameters studied, including WC, BMI, and body fat %, were

positively associated with SBP and DBP in both sexes (Pisa et al., 2018).These results should motivate healthcare providers in Palestine to conduct anthropometric evaluations to determine risk of hypertension in patients.

WC correlated strongly with SBP in both females and males, and also correlated well with DBP in males. Indeed Choy et al. found an association between increased waist circumference and high blood pressure (Choy et al., 2011).This result agrees with a cross-sectional study aimed at determining human measurements, which reported that WC predicts high blood pressure among adults in the Kingdom of Saudi Arabia, in addition to being an important indicator for SBP and DBP levels as well as all types of high blood pressure subtypes, with the exception of isolated diastolic hypertension (Saeed & Al-Hamdan, 2013).Our results for WC also agree with a study of young South African adults that investigated the influence of various anthropometric variables on blood pressure. The main result of that study was that the presence of hypertension or pre-hypertension was significantly associated with WC in both sexes (Nkeh-Chungag et al., 2015). Moreover, a study of Brazilian men was conducted to assess which body measurements are most closely related to high blood pressure. That work reported a consistent increase in systolic and diastolic blood pressure with increased WC and BMI (Cassani et al., 2009). It is clear, then, that weight reduction interventions which include lifestyle modifications are necessary to reduce adult hypertension.

In our study, all the anthropometric measurements were significantly higher in hypertensive participants of both sexes. Another study supporting this finding reported a positive relationship between BMI and hypertension (Gutierrez et al., 2018). In addition, data from a cohort study indicated that BMI was one of the main factors related to hypertension (Guwatuddeet al., 2015). A further study (Masmiquel et al., 2016) found a positive relationship

between BMI and WC and blood pressure. In addition, a study involving the impact of sex-specific body composition on cardiovascular risk factors in a Chinese population reported that WC and HC were both positively associated with the presence of hypertension, dyslipidemia, and diabetes (Thomas et al., 2006). The positive relationship between obesity markers, including WC, BMI, HC and blood pressure levels, demonstrates the need to develop effective strategies to prevent overweight and obesity in Palestinian adults.

Conclusion

Average WC, HC, total body fat, and BMI values were significantly higher in both male and female study participants with high blood pressure than in those who were normotensive. We found a positive correlation between all the anthropometric indicators and systolic and diastolic blood pressure. High values for anthropometric indicators such as HC, WC, fat mass percentage, and BMI are linked to high blood pressure. This work highlights the importance of using these simple human body measurements to predict high blood pressure in both males and females. By controlling the percentage of fats, WC, HC, and BMI, which are affected by extra weight and lack of exercise, blood pressure levels can be regulated.

Acknowledgments

This manuscript is part of the PhD research developed by Moath Abu Ejheisheh, included in the Official PhD Program of Clinical Medicine and Public Health at the University of Granada, Spain.

Declaration of Conflicting Interests

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Tables

Table 1. Demographic information and anthropometric measurements of the participants

	Males	**Females**	**Total**
No. of participants	n=739 (55.3%)	n=598 (44.7%)	n=1337 (100%)
	Mean(SD)	Mean(SD)	Mean(SD)
Age (years)	47.70± 7.34	46.70± 7.37	47.25± 7.37*
Height (cm)	173.28±5.91	159.04±6.58	166.91±9.42*
Weight (kg)	84.86±15.61	78.76±15.91	82.13±16.03*
WC(cm)	97.59± 12.36	96.00± 13.99	96.88± 13.13*
HC(cm)	101.64 ±10.80	108.82±12.92	104.85±12.32*
BMI (kg/m^2)	28.24± 4.96	31.22± 6.45	29.58±5.86*
WHR	0.96±0.06	0.88± 0.08	0.93±0.08*
WHtR	0.56±0.07	0.60±0.09	0.58±0.08*
Total Fat (%)	37.6±8.76	23.52± 8.35	29.81± 11.04*
Mean SBP (mmHg)	133.86±14.68	130.34 ±16.52	132.29±15.62*
Mean DBP (mmHg)	84.39± 8.09	82.88± 8.76	83.72± 8.43*

WC = waist circumference; HC = hip circumference; BMI = body mass index; WHR = waist-to-hipratio; WHtR = waist-to-height ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure.
*p<0.05

Table 2. Prevalence of hypertension and normotension

	Males	**Females**	**Total**
Sample size	739	598	1337
Normotensive (n) %	460 (52.0%)	425 (48.0%)	885 (66.2%)
Hypertensive(n) %	279 (61.7%)	173 (38.3%)	452 (33.8%)

*Hypertensive is where SBP ≥130 mmHg and DBP≥80 mmHg; Normotensive is where SBP <120 mmHg and DBP<80 mmHg(Whelton et al., 2018).

Table 3. Comparison of anthropometric data between normotensive and hypertensive subjects

	Normotensive	**Hypertensive**	p-value
Age (yrs)	45.65± 6.72	50.40± 7.58	<0.01
BMI (kg/m^2)	28.35± 5.39	31.98± 6.00	<0.01
WC (cm)	93.45± 12.86	103.60±10.89	<0.01
HC (cm)	102.47±12.06	109.53±11.47	<0.01
TBF (%)	28.85± 11.19	31.69± 10.49	<0.01

BMI = body mass index; WC = waist circumference; HC = hip circumference; TBF =total body fat.

Table 4. Anthropometric indicators in hypertensive vs normotensive study participants

	Males			**Females**		
	Normotensive (Mean ± S.E)	Hypertensive (Mean ± S.E)	P value	Normotensive (Mean ± S.E)	Hypertensive (Mean ± S.E)	p value
BMI	27.00± 4.8	30.29± 4.6	0.001	29.81± 5.6	34.70± 7.0	0.001
WC	94.06± 12.5	103.41±9.6	0.001	92.78±13.2	103.91±12.7	0.001
HC	98.77± 10.9	106.37±8.8	0.001	106.47±12.0	114.61±13.4	0.001
TBF	18.5365±9.4	23.9986±9.3	0.001	28.1115±10.7	36.4988±12.6	0.001

BMI = body mass index; WC = waist circumference; HC = hip circumference; TBF =total body fat.

Table 5. Partial correlation coefficient between anthropometric indicators and blood pressure

	SBP				**DBP**			
	Male		**Female**		**Male**		**Female**	
	R	P value	R	P value	R	P value	R	P value
BMI	0.321	0.001	0.383	0.001	0.321	0.001	0.226	0.001
WC	0.422	0.001	0.444	0.001	0.386	0.001	0.243	0.001
HC	0.358	0.001	0.338	0.001	0.349	0.001	0.196	0.001
TBF	0.365	0.001	0.285	0.001	0.208	0.001	0.256	0.001

BMI = body mass index; WC = waist circumference; HC = hip circumference; TBF = total body fat; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Table 6. Correlation between hypertension and anthropometric measurements

	Correlation coefficient/p value	
	Males	Females
BMI (kg/m^2)	0.322/0.001	0.345/0.001
WC (cm)	0.367/0.001	0.361/0.001
HC (cm)	0.341/0.001	0.286/0.001
TBF	0.304/0.001	0.299/0.001

BMI = body mass index; WC = waist circumference; HC = hip circumference; TBF = total body fat.

References

Abdeen, Z., Jildeh, C., Dkeideek, S., Qasrawi, R., Ghannam, I., & Al Sabbah, H. (2012). Overweight and obesity among Palestinian adults: Analyses of the anthropometric data from the first national health and nutrition survey (1999-2000). *Journal of Obesity*, *2012*, 1-12. https://doi.org/10.1155/2012/213547

Anwar, S., Hamed Rashid, H., Aleem, B., Jamal Moslhey, G., & Said Al Rashdi, A. (2019). Correlation between anthropometric measurements and hypertension in Oman. *Journal of Preventive Medicine and Holistic Health*, *4*(2), 83-87. https://doi.org/10.18231/2454-6712.2018.0018

Azzeh, F. S., Bukhari, H. M., Header, E. A., Ghabashi, M. A., Al-Mashi, S. S., &Noorwali, N. M. (2017). Trends in overweight or obesity and other anthropometric indices in adults aged 18–60 years in western Saudi Arabia. *Annals of Saudi Medicine*, *37*(2), 106-113. https://doi.org/10.5144/0256-4947.2017.106

Badaruddoza. (2011). Association of anthropometric and metabolic variables with cardiovascular disease among urban and rural origin. *American Journal of Applied Sciences*, *8*(10), 953-961. https://doi.org/10.3844/ajassp.2011.953.961

Batiha, A., AlAzzam, M., ALBashtawy, M., Tawalbeh, L., Tubaishat, A., &Alhalaiqa, F. N. (2015). The relationship between hypertension and anthropometric indices in a Jordanian population. *Advanced Studies in Biology*, *7*, 233-243. https://doi.org/10.12988/asb.2015.5214

Bayyari, W., Henry, L., & Jones, C. (2013). Dieting behaviours, obesity and predictors of dieting among female college students at Palestinian universities. *Eastern Mediterranean Health Journal*, *19*(01), 30-36. https://doi.org/10.26719/2013.19.1.30

Bhurosy, T., &Jeewon, R. (2014). Overweight and obesity epidemic in developing countries: A problem with diet, physical activity, or socioeconomic status? *The Scientific World Journal*, *2014*, 1-7. https://doi.org/10.1155/2014/964236

Cassani, R. S., Nobre, F., Pazin-Filho, A., & Schmidt, A. (2009). Relationship between blood pressure and anthropometry in a cohort of Brazilian men: A cross-sectional study. *American Journal of Hypertension*, *22*(9), 980-984. https://doi.org/10.1038/ajh.2009.104

Chen, L., Peeters, A., Magliano, D. J., Shaw, J. E., Welborn, T. A., Wolfe, R., Zimmet, P. Z., & Tonkin, A. M. (2007). Anthropometric measures and absolute cardiovascular risk estimates in the Australian diabetes, obesity and lifestyle (AusDiab) study. *European Journal of Cardiovascular Prevention & Rehabilitation*, *14*(6), 740-745. https://doi.org/10.1097/hjr.0b013e32816f7739

Choy, C., Chan, W., Chen, T., Shih, C., Wu, L., & Liao, C. (2011). Waist circumference and risk of elevated blood pressure in children: A cross-sectional study. *BMC Public Health*, *11*(1). https://doi.org/10.1186/1471-2458-11-613

Ellulu, M., Rahmat, A., & Abed, Y. (2014). Updates of overweight and obesity status and their consequences in Palestine. *Pakistan Journal of Nutrition*, *13*(2), 116-121. https://doi.org/10.3923/pjn.2014.116.121

Flegal, K. M., Graubard, B. I., Williamson, D. F., & Gail, M. H. (2007). Cause-specific excess deaths associated with underweight, overweight, and obesity. *JAMA*, *298*(17), 2028. https://doi.org/10.1001/jama.298.17.2028

WHO, "Obesity and overweight", World Health Organization, Geneva, 3 March 2020. https://www.who.int/news-room/fact-sheets/detail/obesity-andoverweight. Accessed 15 Mar.2020.

Gutierrez, J., Alloubani, A., Mari, M., &Alzaatreh, M. (2018). Cardiovascular disease risk factors: Hypertension, diabetes mellitus and obesity among Tabuk citizens in Saudi Arabia. *The Open Cardiovascular Medicine Journal*, *12*(1), 41-49. https://doi.org/10.2174/1874192401812010041

Guwatudde, D., Nankya-Mutyoba, J., Kalyesubula, R., Laurence, C., Adebamowo, C., Ajayi, I., Bajunirwe, F., Njelekela, M., Chiwanga, F. S., Reid, T., Volmink, J., Adami, H., Holmes, M. D., &Dalal, S. (2015). The burden of hypertension in sub-Saharan Africa: A four-country cross sectional study. *BMC Public Health*, *15*(1). https://doi.org/10.1186/s12889-015-2546-z

Hruby, A., Manson, J. E., Qi, L., Malik, V. S., Rimm, E. B., Sun, Q., Willett, W. C., & Hu, F. B. (2016). Determinants and consequences of obesity. *American Journal of Public Health*, *106*(9), 1656-1662. https://doi.org/10.2105/ajph.2016.303326

Husseini, A., Abu-Rmeileh, N. M., Mikki, N., Ramahi, T. M., Ghosh, H. A., Barghuthi, N., Khalili, M., Bjertness, E., Holmboe-Ottesen, G., &Jervell, J. (2009). Cardiovascular diseases, diabetes mellitus, and cancer in the occupied Palestinian territory. *The Lancet*, *373*(9668), 1041-1049. https://doi.org/10.1016/s0140-6736(09)60109-4

Masmiquel, L., Leiter, L. A., Vidal, J., Bain, S., Petrie, J., Franek, E., Raz, I., Comlekci, A., Jacob, S., Van Gaal, L., Baeres, F. M., Marso, S. P., &Eriksson, M. (2016). LEADER 5: Prevalence and cardiometabolic impact of obesity in cardiovascular high-risk patients with type 2 diabetes mellitus: baseline global data from the LEADER trial. *Cardiovascular Diabetology*, *15*(1). https://doi.org/10.1186/s12933-016-0341-5

Nahar, N., Dubey, S., Joshi, A., Phadnis, S., & Sharma, V. (2012). Association of anthropometric indices of obesity with diabetes, hypertension and dyslipidemia: A study from central India. *Indian Journal of Medical Specialities*, *3*(1). https://doi.org/10.7713/ijms.2012.0003

Nkeh-Chungag, B., Mxhosa, T., &Mgoduka, P. (2015). Association of waist and hip circumferences with the presence of hypertension and pre-hypertension in young South African adults. *African Health Sciences, 15*(3), 908. https://doi.org/10.4314/ahs.v15i3.27

Pisa, P. T., Micklesfield, L. K., Kagura, J., Ramsay, M., Crowther, N. J., & Norris, S. A. (2018). Different adiposity indices and their association with blood pressure and hypertension in middle-aged urban Black South African men and women: Findings from the AWI-GEN South African Soweto site. *BMC Public Health*, *18*(1). https://doi.org/10.1186/s12889-018-5443-4

Population Reference Bureau. (2006). *A first glimpse at the 2004 Palestinian demographic and health survey – Population reference bureau*. Population Reference Bureau – Inform, Empower, Advance. https://www.prb.org/firstglimpse2004palestiniandhs/

Qorbani, M., Kelishadi, R., Farrokhi-Khajeh-Pasha, Y., Motlagh, M., Aminaee, T., Ardalan, G., Asayesh, H., Shafiee, G., Taslimi, M., Poursafa, P., Heshmat, R., &Larijani, B. (2013). Association of anthropometric measures with cardiovascular risk factors and metabolic syndrome in normal-weight children and adolescents: The caspian III study. *Obesity Facts*, *6*(5), 483-492. https://doi.org/10.1159/000356011

Reddy, K., Reddy, K., &Sudha, G. (2010). Overall and abdominal adiposity on blood pressure: Consistency and evaluation of their association in an adult Indian population. *Journal of Life Sciences*, *2*(2), 117-125. https://doi.org/10.1080/09751270.2010.11885161

Saeed, A. A., & Al-Hamdan, N. A. (2013). Anthropometric risk factors and predictors of hypertension among Saudi adult population – A national survey. Journal of Epidemiology and Global Health, 3(4), 197. https://doi.org/10.1016/j.jegh.2013.08.004

Thomas, G. N., McGhee, S. M., Schooling, M., Ho, S. Y., Lam, K. S., Janus, E. D., & Lam, T. H. (2006). Impact of sex-specific body composition on cardiovascular risk factors: The Hong Kong cardiovascular risk factor study. Metabolism, 55(5), 563-569. https://doi.org/10.1016/j.metabol.2005.08.004

Van Dijk, S. B., Takken, T., Prinsen, E. C., &Wittink, H. (2012). Different anthropometric adiposity measures and their association with cardiovascular disease risk factors: A meta-analysis. *Netherlands Heart Journal*, *20*(5), 208-218. https://doi.org/10.1007/s12471-011-0237-7

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., … Wright, J. T. (2018). 2017 ACC/AHA/Aapa/Abc/Acpm/Ags/Apha/Ash/Aspc/Nma/Pcna guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: Executive summary: A report of the American College of Cardiology/American Heart

Association task force on clinical practice guidelines. *Hypertension*, *71*(6), 1269-1324. https://doi.org/10.1161/hyp.0000000000000066

World Health Organization. (2020). *Obesity and overweight*. WHO | World Health Organization. https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

Zhu, Q., Wang, X., Yao, Y., Ning, C., Chen, X., Luan, F., & Zhao, Y. (2018). Association between anthropometric measures and cardiovascular disease (CVD) risk factors in Hainan centenarians: Investigation based on the centenarian's health study. *BMC Cardiovascular Disorders*, *18*(1). https://doi.org/10.1186/s12872-018-0810-8

IV

SUMMARY OF RESULTS AND DISCUSSION

SUMMARY OF RESULTS AND DISCUSSION

The main objective of this doctoral thesis was to examine the impact on the prevalence of depression and the quality of life in patients undergoing CABG surgery and to provide an overview of health in the Palestinian population considering factors related to quality of life in patients undergoing CABG, as well as analysing the associations between obesity-related parameters and blood pressure levels in Palestinian children and adults.

In the first systematic-review we found a prevalence of depression that varied between 19% and 37% prior to surgery, and between 15% and 33% after surgery, depending on the measurement tool used. Other studies combining CABG with valve replacement have reported similar percentages, with a depression prevalence ranging from 15% pre-CABG (Botzet et al., 2017) to 37.7% post-CABG (Horne et al., 2013; Boyer et al., 2012). Normal levels of pre-CABG depression are observed, although other studies have indicated higher levels, from moderate to severe (Poole et al., 2016). Note that high levels of depression prior to the operation predict a worse quality of life (Kendel et al., 2011;Bjørnnes et al., 2018), worse survival rate after a CABG (Stenman et al., 2016; Geulayov et al., 2018), and more symptoms up to six months after surgery (Lie et al., 2010).While this study found an overall improvement in depressive symptoms post-CABG, depression persists after the surgery for the majority of patients. Thus, given the prevalence of depression and its impact, early detection is crucial, as this enables at-risk patients to be identified through a clinical interview that uses validated measurement tools.

This allows health professionals to implement preventive strategies and monitor the development of the depression.

In the second systematic-review and meta-analysis study, we observed that CABG surgery improves people's quality of life both physically and mentally, although this improvement is more extensive in physical terms. In most previous studies, after a CABG, patients report significant improvements in the different quality of life dimensions analysed using the Short-Form Health Questionnaire (SF-HQ) and the Nottingham Health Profile (NHP) questionnaire. This positive result was also observed in the meta-analysis estimates of quality of life impairment, with a lower prevalence of impairment in all the quality of life dimensions analysed. CABG seems to be very beneficial, since in addition to the positive quality of life results, other studies that indicate that it reduces depression, with the symptoms disappearing for about 15 years (Harris et al., 2013); death from other causes; and admission or death due to cardiovascular issues (Murashita, 2016). CABG may facilitate the normalisation of the day-to-day life of these people in both their personal and work environments, with a decrease in the prevalence of impact in the different aspects of life of between 18% and 6%. This surgery therefore seems to be a good choice for improving the quality of life of people with coronary disease, once the possible existing risks have been assessed.

In the original research investigating the associations between HRQoL and sociodemographic and clinical characteristics in Palestinian patients who underwent CABG surgery, we showed that HRQoL decreases as age increases, whereas HRQoL increases with a higher educational level, greater job security, and a higher salary. Additionally, patients who had undergone a PCI reported worse HRQoL, with all domains having a significantly lower score. These findings are similar to those reported by Peric et al. (2015) who found that patients aged 60–69 showed better improvement in all domains than younger patients, but found that patients under 50 had improved physical mobility, emotional reactions, pain, and sleep parameters. Similarly, (Lavdaniti et al., 2015) reported that mental health is influenced by age, as well as educational and occupational status. In contrast, Chen et al. (2017) found that ageing had no connection to HRQoL in CABG patients. The inconsistencies between the findings in the various studies could be explained by differences in the division of participants into age groups. The results of this study are relevant for health professionals, particularly nursing professionals, since they reveal that comprehensive assessments of individuals undergoing a CABG are necessary to prepare high-quality patient care that allows them a greater HRQoL

and better post-operative rehabilitation. This study also shows that other factors, such as emotional components and certain sociodemographic variables, have an important influence on patients undergoing CABG surgery, and these should be considered by the nursing staff when developing nursing care plans.

On the other hand, in the original study conducted on a cohort of children, we found that all obesity-related parameters, with the exception of WHR and WHtR, presented statistical differences between the normotension, elevated blood pressure, and hypertension groups for systolic and diastolic blood pressure. Thus, children with elevated blood pressure or hypertension have a significantly higher weight, BMI, WC, HC, fat mass, and fat-free mass compared to participants with normotension, supporting the direct association between high values for obesity related-parameters and high blood pressure values in children from Palestine. These findings are clinically relevant since obesity and hypertension are both linked to a high risk of CVD, increasing related morbidity and mortality in adulthood (Brady et al., 2015; Morrison et al., 2007). Similarly, other studies have reported an association between anthropometric parameters and blood pressure values in childhood (Brady, 2017). A retrospective study conducted in the United States showed a statistically significant association between increased BMI percentile and increased blood pressure percentile, with the risk of incident hypertension associated primarily with obesity (Parker et al., 2016). Other research from China also showed that a child's BMI, WC, and WHtR were positively associated with their SBP and DBP, showing that obese children were 3 to 6times more likely to suffer hypertension (Zhao et al., 2017). Along the same lines, an elevated BMI was associated with increased diastolic and systolic blood pressure in 300 obese children in the western region of Saudi Arabia (Al-Agha &Mahjoub, 2018). Nevertheless, our study is the first to evaluate the link between body composition parameters and blood pressure in a cohort of Palestinian children.

Similarly, in the study conducted in the adult cohort, we found that in both males and females all the anthropometric measurements presented a significant strong positive correlation with systolic and diastolic blood pressure. This research highlights the potential use of anthropometric measurements to predict high blood pressure in both males and females. Our results are comparable with previous studies from different countries, in terms of a significant relationship between anthropometric measurements and increased systolic and diastolic blood pressure (Batiha et al., 2015; Anwar et al., 2019).The positive relationship between obesity-related markers, including fat mass and blood pressure levels in this cohort,

evidences the need to develop effective strategies for preventing overweight and obesity in this population. Our results therefore highlight the need for a serious focus on obesity and hypertension in Palestinian population as well as community-based programmes to manage this health problem. Weight reduction interventions are essential for reducing the prevalence of related disorders, including childhood or adulthood hypertension, and, for this reason, the prevention of obesity should be a national public health priority in Palestine. Policies that promote healthy food habits and active lifestyles should continue to be implemented in order to prevent the development of chronic diseases such as obesity and hypertension in both early stages of life and adulthood.

Limitations

This doctoral thesis has certain limitations that should be mentioned. With regard to the systematic-review and meta-analysis study focused on the prevalence of depression in CABG, it should be noted that the heterogeneity reported in terms of prevalence is due to different estimation methods over time, differences in the timing of the assessment and demographic differences between the samples, different uses of cut-offs in questionnaire measures, and the use of several tools for assessing the symptoms of depression. In addition, the measuring tools assess the severity of depression symptoms, but are not a substitute for a formal clinical diagnosis. With regard to the systematic-review and meta-analysis investigating the quality of life in patients undergoing CABG surgery, we found that there was only a very limited number of studies that supplied the necessary data to perform the meta-analysis. There was also variability in the location or countries where the studies were carried out. For this reason, depending on the country where the results are to be analysed or implemented, this factor should be taken into account.

The main limitations of the original studies included in his thesis are their cross-sectional designs, so they cannot be used to infer causality. In addition, since our study population comprised a well-characterised cohort of Palestinian children and adults, the generalisability of the results to other populations and other age ranges may be limited. However, the strengths of these studies are that body composition measurements were performed using a body composition analyser (TANITA BC-418MA). Bioelectrical impedance analysis (BIA) has been postulated as a valuable tool for measuring body composition, and is a significantly more cost-effective method than dual-energy X-ray absorptiometry (Beeson et al., 2010).

Future perspectives

This doctoral thesis furthers the characterisation of the state of health in relation to obesity and hypertension in Palestinian children and adults. We also report data on the associations between HRQoL and sociodemographic and clinical characteristics in Palestinian patients who have undergone a CABG. This is of interest since, to date, research conducted on the Palestinian population is very limited.

This work was pilot research with a limited sample size, further studies with larger representative samples that include all the Palestinian provinces and minority groups and which cover a broad age range are therefore needed. Note that we included cohorts of children and adults but no other target populations such as adolescents, young adults, or older adults were examined. Moreover, future research should incorporate data on the lifestyle habits of the Palestinian population, including dietary intake, physical activity, and tobacco and alcohol use. Likewise, data based on longitudinal studies from childhood to adulthood are required to evaluate how obesity-related markers influence blood pressure.

Furthermore, it is necessary to continue investigating the relationships between HRQoL and sociodemographic and clinical characteristics in Palestinian patients who have undergone a CABG, since CVD are considered to be the leading cause of mortality in Palestine and CABG is still the most common operation performed by cardiac surgeons today.

V

CONCLUSIONS

CONCLUSIONS

1. The prevalence of depression pre-CABG ranges from 19–37%, and post-CABG from 15–33%. There is a high presence of depression both before and after CABG surgery. While there is an overall improvement in depressive symptoms after CABG, depression persists after the surgery in the majority of patients. The depression levels present prior to the operation may affect postoperative recovery. Given the prevalence of depression and its impact, early detection is crucial, since it enables the identification of at-risk patients and allows health professionals to implement preventive strategies.

2. CABG surgery improves people's quality of life both physically and mentally, although this improvement is more extensive in physical terms. This favours the normalisation of the day-to-day life of these people in both their personal and work environments, and there is a decrease in the prevalence of impact on the different aspects of life of between 18% and 6%. This surgery therefore seems to be a good choice for improving the quality of life of people with coronary disease, once the possible existing risks have been assessed.

3. HRQoL decreases as age increases, whereas HRQoL increases with a higher educational level, greater job security, and a higher salary in Palestinian patients undergoing a CABG. Additionally, patients who had undergone a prior PCI reported a worse HRQoL, with all the domains having a significantly lower score. For this reason, it is necessary to comprehensively

assess patients undergoing a CABG, in order to prepare high-quality patient care that enables them to have greater HRQoL and better post-operative rehabilitation.

4. The prevalence of overweight/obesity was 25.3% in girls and 23.1% in boys. 26.3% of Palestinian children have elevated systolic blood pressure/ hypertension whereas 23.4% have elevated diastolic blood pressure/ hypertension. In adults, the prevalence of hypertension was 61.7% in males and 38.3% in females. These findings highlight the need for a serious focus on obesity and hypertension in the Palestinian population and community-based programmes formanaging these health problems.

5. Palestinian children and adults with elevated blood pressure or hypertension have a significantly higher weight, body mass index, waist circumference, hip circumference, fat mass, and fat-free mass than individuals with normotension, supporting a direct association between high values of obesity related-parameters and high blood pressure values. Weight reduction interventions are essential for reducing the prevalence of related disorders, such as childhood or adulthood hypertension, and, for this reason, the prevention of obesity should be a national public health priority in Palestine.

CONCLUSIONES

1. La prevalencia de depresión antes del CABG varía del 19% al 37% y después del 15% al 33%. Existe una alta presencia de depresión tanto antes como después de la cirugía de CABG. Si bien hay una mejora general de los síntomas depresivos después del CABG, la depresión persiste después de la cirugía en la mayoría de los pacientes. Los niveles de depresión presentes antes de la operación pueden afectar la recuperación posoperatoria. Dada la prevalencia de la depresión y su impacto, la detección precoz es crucial, ya que permite identificar a los pacientes en riesgo y permite a los profesionales de la salud implementar estrategias preventivas.

2. La cirugía CABG mejora la calidad de vida de las personas tanto física como mentalmente, aunque esta mejora es más evidente en términos físicos. Esto favorece la normalización del día a día de estas personas tanto en su entorno personal como laboral y se produce una disminución de la prevalencia de impacto en los diferentes aspectos de la vida de entre un 18% y un 6%. Por tanto, esta cirugía parece ser una buena opción para mejorar la calidad de vida de las personas con enfermedad coronaria, una vez valorados los posibles riesgos existentes.

3. La HRQoL disminuye a medida que aumenta la edad, mientras que la HRQoL aumenta con un mayor nivel educativo, una mayor seguridad laboral y un mayor salario en los pacientes palestinos sometidos a CABG. Además, los pacientes que se habían sometido a una PCI informaron de una peor HRQoL,

con todos los dominios con una puntuación significativamente más baja. Por ello, es necesario evaluar de forma integral a los pacientes sometidos a un CABG, con el fin de implementar una atención al paciente de alta calidad que les permita tener una mayor HRQoL y una mejor rehabilitación postoperatoria.

4. La prevalencia de sobrepeso / obesidad fue del 25,3% en las niñas y del 23,1% en los niños. El 26,3% de los niños palestinos tiene hipertensión / presión arterial sistólica elevada, mientras que el 23,4% tiene hipertensión / presión arterial diastólica elevada. En adultos, la prevalencia de hipertensión fue del 61,7% en hombres y del 38,3% en mujeres. Estos hallazgos destacan la necesidad de un enfoque prioritario sobre la obesidad y la hipertensión en la población palestina así como poner en marcha lprogramas comunitarios para abordar estos problemas de salud.

5. Los niños y adultos palestinos con presión arterial elevada o hipertensión tienen un peso, índice de masa corporal, circunferencia de la cintura, circunferencia de la cadera, masa grasa y masa libre de grasa significativamente más altos que las personas con normotensión, lo que sugiere una asociación directa entre valores altos de parámetros asociados a la obesidad y valores de presión arterial alta. Las intervenciones de reducción de peso son esenciales para disminuir la prevalencia de patologías asociadas, como la hipertensión en la niñez o en la edad adulta. Por esta razón, la prevención de la obesidad debe ser una prioridad de salud pública nacional en Palestina.

REFERENCES

Abdeen, Z., Jildeh, C., Dkeideek, S., Qasrawi, R., Ghannam, I., & Al Sabbah, H. (2012). Overweight and obesity among Palestinian adults: Analyses of the anthropometric data from the first national health and nutrition survey (1999-2000). *Journal of Obesity*, 1-12. https://doi.org/10.1155/2012/213547

Afana, A., Qouta, S., & Sarraj, E. (2004). Mental health needs in Palestine. *Humanitarian Exchange Magazine*. https://odihpn.org/magazine/mental-health-needs-in-palestine/

Al Sabbah, H., Vereecken, C., Kolsteren, P., Abdeen, Z., &Maes, L. (2007). Food habits and physical activity patterns among Palestinian adolescents: Findings from the national study of Palestinian schoolchildren (HBSC-WBG2004). *Public Health Nutrition*, *10*(7), 739-746. https://doi.org/10.1017/s1368980007665501

Al-Agha, A., &Mahjoub, A. (2018). Impact of body mass index on high blood pressure among obese children in the western region of Saudi Arabia. *Saudi Medical Journal*, *39*(1), 45-51. https://doi.org/10.15537/smj.2018.1.20942

Al-Lahham, S., Jaradat, N., Altamimi, M., Anabtawi, O., Irshid, A., AlQub, M.,

Dwikat, M., Nafaa, F., Badran, L., Mohareb, R., Haji, R., Aqqad, T., Jayyab, S., Ghosh, B. A., Taher, R., & Al Zabadi, H. (2019). Prevalence of underweight, overweight and obesity among Palestinian school-age children and the associated risk factors: A cross sectional study. *BMC Pediatrics*, *19*(1). https://doi.org/10.1186/s12887-019-1842-7

Amer, S., Kateeb, E., Hassan, A., & Musa, F. (2019). Dietary habits, energy drink consumption, obesity, and physical activity in marginalised Palestinian schools in the West Bank: A cross-sectional study. *The Lancet*, *393*, S13. https://doi.org/10.1016/s0140-6736(19)30599-9

Anwar, S., Hamed Rashid, H., Aleem, B., Jamal Moslhey, G., & Said Al Rashdi, A. (2019). Correlation between anthropometric measurements and hypertension in Oman. *Journal of Preventive Medicine and Holistic Health*, *4*(2), 83-87. https://doi.org/10.18231/2454-6712.2018.0018

Azzeh, F. S., Bukhari, H. M., Header, E. A., Ghabashi, M. A., Al-Mashi, S. S., &Noorwali, N. M. (2017). Trends in overweight or obesity and other anthropometric indices in adults aged 18–60 years in western Saudi Arabia. *Annals of Saudi Medicine*, *37*(2), 106-113. https://doi.org/10.5144/0256-4947.2017.106

Baracco, R., Kapur, G., Mattoo, T., Jain, A., Valentini, R., Ahmed, M., & Thomas, R. (2012). Prediction of primary vs secondary hypertension in children. *The Journal of Clinical Hypertension*, *14*(5), 316-321. https://doi.org/10.1111/j.1751-7176.2012.00603.x

Batiha, A., AlAzzam, M., ALBashtawy, M., Tawalbeh, L., Tubaishat, A., &Alhalaiqa, F. N. (2015). The relationship between hypertension and anthropometric indices in a Jordanian population. *Advanced Studies in Biology*, *7*, 233-243. https://doi.org/10.12988/asb.2015.5214

Beeson, W. L., Batech, M., Schultz, E., Salto, L., Firek, A., Deleon, M., Balcazar, H., & Cordero-Macintyre, Z. (2010). Comparison of body composition by bioelectrical impedance analysis and dualenergy X-ray absorptiometry in hispanic diabetics. *InternationalJournal of Body Composition Research*, 8(2), 45–50.

Bhaiwala, Z. (2015). *Health under occupation: Constraints on access to healthcare in the Palestinian territories – Mondoweiss*. Mondoweiss. https://mondoweiss.net/2015/08/constraints-palestinian-territories

Bjørnnes, A. K., Parry, M., Lie, I., Falk, R., Leegaard, M., &Rustøen, T. (2018). The association between hope, marital status, depression and persistent pain in men and women following cardiac surgery. *BMC Women's Health*, *18*(1). https://doi.org/10.1186/s12905-017-0501-0

Botzet, K., Dalyanoglu, H., Schäfer, R., Lichtenberg, A., Schipke, J., &Korbmacher, B. (2017). Anxiety and depression in patients undergoing mitral valve surgery: A prospective clinical study. *The Thoracic and Cardiovascular Surgeon*, *66*(07), 530-536. https://doi.org/10.1055/s-0037-1604461

Boyer, B. A., Matour, S. J., Crittenden, K. B., Larson, K. A., Cox, J. M., & Link, D. D. (2012). Appraisals of fear, helplessness, and perceived life-threat during emergent cardiac surgery: Relationship to pre-surgical depression, trauma history, and posttraumatic stress. *Journal of Clinical Psychology in Medical Settings*, *20*(2), 173-185. https://doi.org/10.1007/s10880-012-9330-3

Brady, T. M., Appel, L. J., Holmes, K. W., Fivush, B., & Miller, E. R. (2015). Association between adiposity and left ventricular mass in children with hypertension. *The Journal of Clinical Hypertension*, *18*(7), 625-633. https://doi.org/10.1111/jch.12717

Brady, T. M. (2017). Obesity-related hypertension in children. *Frontiers in Pediatrics*, *5*. https://doi.org/10.3389/fped.2017.00197

British Nutrition Foundation. (2011). *Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers*. Just a moment. https://www.nutrition.org.uk/

Chalabi, M. (14th October 2013). How does Palestine's economy work? The Guardian. https://www.theguardian.com/news/datablog/2013/oct/14/palestine-economy-how-does-it-work

Chen, Y., Ding, S., Tao, X., Feng, X., Lu, S., Shen, Y., Wu, Y., & An, X. (2017). The quality of life of patients developed delirium after coronary artery bypass grafting is determined by cognitive function after discharge: A cross-sectional study. *International Journal of Nursing Practice*, *23*(5), e12563. https://doi.org/10.1111/ijn.12563

Cho, Y., Lee, J. K., Kim, D., Park, J., Choi, M., Kim, H., Nam, M., Lee, K., Han, K., & Park, Y. (2019). Factors associated with quality of life in pa-

tients with depression: A nationwide population-based study. *PLOS ONE*, *14*(7), e0219455. https://doi.org/10.1371/journal.pone.0219455

Damiri, B., Aghbar, A., Alkhdour, S., & Arafat, Y. (2018). Characterization and prevalence of metabolic syndrome among overweight and obese young Palestinian students at an-najah national University. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *12*(3), 343-348. https://doi.org/10.1016/j.dsx.2017.12.021

Dimitry, L. (2011). A systematic review on the mental health of children and adolescents in areas of armed conflict in the Middle East. *Child: Care, Health and Development*, *38*(2), 153-161. https://doi.org/10.1111/j.1365-2214.2011.01246.x

El Ansari, W., & Berg-Beckhoff, G. (2017). Country and gender-specific achievement of healthy nutrition and physical activity guidelines: Latent class analysis of 6266 University students in Egypt, Libya, and Palestine. *Nutrients*, *9*(7), 738. https://doi.org/10.3390/nu9070738

Ewald, D. R., & Haldeman, L. A. (2016). Risk factors in adolescent hypertension. *Global Pediatric Health*, *3*, 2333794X1562515. https://doi.org/10.1177/2333794x15625159

Felman, A. (2019). *Hypertension: Causes, symptoms, and treatments*. Medical and health information. https://www.medicalnewstoday.com/articles/150109

Flynn, J. (2013). The changing face of pediatric hypertension in the era of the childhood obesity epidemic. *Pediatric Nephrology*, *28*(7), 1059-1066. https://doi.org/10.1007/s00467-012-2344-0

Flynn, J. T., Kaelber, D. C., Baker-Smith, C. M., Blowey, D., Carroll, A. E., Daniels, S. R., De Ferranti, S. D., Dionne, J. M., Falkner, B., Flinn, S. K., Gidding, S. S., Goodwin, C., Leu, M. G., Powers, M. E., Rea, C., Samuels, J., Simasek, M., Thaker, V. V., & Urbina, E. M. (2017). Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics*, *140*(3), e20171904. https://doi.org/10.1542/peds.2017-1904

Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., Alexander, L., Estep, K., Hassen Abate, K., Akinyemiju, T. F., Ali, R., Alvis-Guzman, N., Azzopardi, P., Banerjee, A., Bärnighausen, T., Basu, A., Bekele, T., Bennett, D. A., Biadgilign, S., … Murray, C. J. (2017). Glob-

al burden of hypertension and systolic blood pressure of at least 110 to 115 Mm Hg, 1990-2015. *JAMA*, *317*(2), 165. https://doi.org/10.1001/jama.2016.19043

Fanack.com. *Geography of Palestine*. (2020). https://fanack.com/palestine/geography/

Geulayov, G., Novikov, I., Dankner, D., &Dankner, R. (2018). Symptoms of depression and anxiety and 11-year all-cause mortality in men and women undergoing coronary artery bypass Graft (CABG) surgery. *Journal of Psychosomatic Research*, *105*, 106-114. https://doi.org/10.1016/j.jpsychores.2017.11.017

Ghrayeb, F.A.W., Rusli, A.M., Al Rifai, A., Ismail, M.I. (2013).Youth in Trouble: Tobacco use among School Students in Palestine. Canadian Journal of Basic and Applied Science, 1(2):58-67.

Ghrayeb,F.A.W., Rusli,A.M., Al Rifai, A., Ismail, M.I. (2014).Non-Communicable Diseases Behavioral Risk Factors among Palestinian Adolescents: A Descriptive Study from a Rural Community of Tarqumia. World Journal of Medical Sciences, 10 (3): 267-274.

Giacaman, R., Shannon, H. S., Saab, H., Arya, N., & Boyce, W. (2007). Individual and collective exposure to political violence: Palestinian adolescents coping with conflict. *The European Journal of Public Health*, *17*(4), 361-368. https://doi.org/10.1093/eurpub/ckl260

Harris, R., Croce, B., & Tian, D. H. (2013). Coronary artery bypass grafting. *Annals of cardiothoracic surgery*, *2*(4), 579. https://doi.org/10.3978/j.issn.2225-319X.2013.07.05

Horne, D., Kehler, S., Kaoukis, G., Hiebert, B., Garcia, E., Duhamel, T. A., &Arora, R. C. (2013). Depression before and after cardiac surgery: Do all patients respond the same? *The Journal of Thoracic and Cardiovascular Surgery*, *145*(5), 1400-1406. https://doi.org/10.1016/j.jtcvs.2012.11.011

Hruby, A., Manson, J. E., Qi, L., Malik, V. S., Rimm, E. B., Sun, Q., Willett, W. C., & Hu, F. B. (2016). Determinants and consequences of obesity. *American Journal of Public Health*, *106*(9), 1656-1662. https://doi.org/10.2105/ajph.2016.303326

Husseini, A., Abu-Rmeileh, N. M., Mikki, N., Ramahi, T. M., Ghosh, H. A., Barghuthi, N., Khalili, M., Bjertness, E., Holmboe-Ottesen, G., &Jervell, J.

(2009). Cardiovascular diseases, diabetes mellitus, and cancer in the occupied Palestinian territory. *The Lancet*, *373*(9668), 1041-1049. https://doi.org/10.1016/s0140-6736(09)60109-4

Isbaih, M. A. N. (2009). *Prevalence of overweight and obesity among school-age children in Nablus City* (Doctoral dissertation).

JameeShahwan, A., Abed, Y., Desormais, I., Magne, J., Preux, P. M., Aboyans, V., & Lacroix, P. (2019). Epidemiology of coronary artery disease and stroke and associated risk factors in Gaza community –Palestine. *PLOS ONE*, *14*(1), e0211131. https://doi.org/10.1371/journal.pone.0211131

Kendel, F., Dunkel, A., Müller-Tasch, T., Steinberg, K., Lehmkuhl, E., Hetzer, R., &Regitz-Zagrosek, V. (2011). Gender differences in health-related quality of life after coronary bypass surgery: Results from a 1-Year follow-up in propensity-matched men and women. *Psychosomatic Medicine*, *73*(3), 280-285. https://doi.org/10.1097/psy.0b013e3182114d35

Khdour, M. R., Hallak, H. O., Shaeen, M., Jarab, A. S., & Al-Shahed, Q. N. (2013). Prevalence, awareness, treatment and control of hypertension in the Palestinian population. *Journal of Human Hypertension*, *27*(10), 623-628. https://doi.org/10.1038/jhh.2013.26

Kliegman, R. M., Stanton, B. F., St. Geme, J. W., & Schor, N. F. (2011). Preface. *Nelson Textbook of Pediatrics*, xxxiii. https://doi.org/10.1016/b978-1-4377-0755-7.00714-4

Lauvergeon, S., Burnand, B., &Peytremann-Bridevaux, I. (2012). Chronic disease management: A qualitative study investigating the barriers, facilitators and incentives perceived by Swiss healthcare stakeholders. *BMC Health Services Research*, *12*(1). https://doi.org/10.1186/1472-6963-12-176

Lavdaniti, M., Tsiligiri, M., Manousaridou, E., Zioga, E., Papapetrou, S., Zyga, S., &Sapountzi-Krepia, D. (2015). 1722 quality of life assessment in Greek breast cancer patients six months after chemotherapy based on an SF-36 questionnaire. *European Journal of Cancer*, *51*, S255. https://doi.org/10.1016/s0959-8049(16)30736-5

Lehtonen, J., Hippeläinen, M., Kattainen, E., Kouri, J., &Kujala, J. (2008). Speed and quality in coronary artery bypass Graft (CABG) surgery: Is there a connection? *Health Care Management Science*, *12*(2), 147-154. https://doi.org/10.1007/s10729-008-9075-6

Lie, I., Arnesen, H., Sandvik, L., Hamilton, G., & Bunch, E. H. (2010). Predictors for physical and mental health 6 months after coronary artery bypass grafting a cohort study. *European Journal of Cardiovascular Nursing*, *9*(4), 238-243. https://doi.org/10.1016/j.ejcnurse.2010.02.001

Lien, N., Lytle, L. A., &Klepp, K. (2001). Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Preventive Medicine*, *33*(3), 217-226. https://doi.org/10.1006/pmed.2001.0874

Lim, G. Y., Tam, W. W., Lu, Y., Ho, C. S., Zhang, M. W., & Ho, R. C. (2018). Prevalence of depression in the community from 30 countries between 1994 and 2014. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-21243-x

Malhi, G. S., & Mann, J. J. (2018). Depression. *The Lancet*, *392*(10161), 2299-2312. https://doi.org/10.1016/s0140-6736(18)31948-2

Martin, B. (2020). What are the Risk Factors for Depression?. *Psych Central*. Retrieved on September 14, 2020, from https://psychcentral.com/lib/what-are-the-risk-factors-for-depression/

Massad, S., Deckelbaum, R. J., Gebre-Medhin, M., Holleran, S., Dary, O., Obeidi, M., Bordelois, P., & Khammash, U. (2016). Double burden of Undernutrition and obesity in Palestinian schoolchildren. *Food and Nutrition Bulletin*, *37*(2), 144-152. https://doi.org/10.1177/0379572116637720

McAuley, P. A., Artero, E. G., Sui, X., Lee, D., Church, T. S., Lavie, C. J., Myers, J. N., España-Romero, V., & Blair, S. N. (2012). The obesity paradox, cardiorespiratory fitness, and coronary heart disease. *Mayo Clinic Proceedings*, *87*(5), 443-451. https://doi.org/10.1016/j.mayocp.2012.01.013

Merom, D., Sinnreich, R., Aboudi, V., Kark, J. D., & Nassar, H. (2012). Lifestyle physical activity among urban Palestinians and israelis: A cross-sectional comparison in the Palestinian-Israeli Jerusalem risk factor study. *BMC Public Health*, *12*(1). https://doi.org/10.1186/1471-2458-12-90

Meyer, C. (2004). Depressive disorders were the fourth leading cause of global disease burden in the year 2000. *Evidence-Based Mental Health*, *7*(4), 123-123. https://doi.org/10.1136/ebmh.7.4.123

Mikki, N., Abdul-Rahim, H. F., Awartani, F., & Holmboe-Ottesen, G. (2009). Prevalence and sociodemographic correlates of stunting, underweight, and overweight among Palestinian school adolescents (13-15 years) in two

major governorates in the West Bank. *BMC Public Health*, *9*(1). https://doi.org/10.1186/1471-2458-9-485

Mikki, N., Abdul-Rahim, H. F., Shi, Z., & Holmboe-Ottesen, G. (2010). Dietary habits of Palestinian adolescents and associated sociodemographic characteristics in Ramallah, Nablus and Hebron governorates. *Public Health Nutrition*, *13*(9), 1419-1429. https://doi.org/10.1017/s1368980010000662

Ministry of Health- Palestinian Health Information Center. (2016). Health Status, Palestine, 2015. https://site.moh.ps/Content/Books/NWNJXX7R-J92Bn4f5EGYiH43a2tjAAzKBnseGnEUCaqWqYZndsbCcPy_JQWgu-vkHTR4Xk4zUpdT45ooWxH11BhIbVAxwpGWy2wiwHdGcM5K7aZ.pdf

Ministry of Health - Palestinian Health Information Center. (2017). *Annual Health Report - Palestine 2016*. http://site.moh.ps/Content/Books/ZxRcynmi-UofNqt66u4CrHRgmJR6Uv7z77srjjIEAho6xnz5V3rgLTu_RhO7xf2j-2VusNiIvWkjwp84yXHLdGleB97gKrHHI5iZ9oPJ25owGEN.pdf

Ministry of Health- *Palestinian Health Information Center.* (2018). *Health Status, Palestine, 2017*. https://site.moh.ps/Content/Books/38pf7Q9KpsHKGjW-ZxroQEuJ1OZeOJw8mhssgDKBJGnoAu5C4oKFpoW_kUFGingMuntf-G2fm4rVu2grDremJD77xH9P5xgfSFQPvvxcOPgeyD7.pdf

Ministry of Health- Palestinian Health Information Center. (2019). *Health Annual Report, 2018*. http://site.moh.ps/Content/Books/fE4zsafxsjNVhJntidJn-qnnEHUibMuC1NYu66TNEmoNUJ1ZxeRcCm3_Iei1j8d4YesYKxRyE-hD6PZqdxzBa4z91pIhALGXoDGEhlEIPai9X9O.pdf

Ministry of Health, State of Palestine. (2016). *Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan*. Report submitted to the Sixty-ninth World Health Assembly of the World Health Organization. 2016. https://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_INF6-en.pdf

Morrison, J. A., Friedman, L. A., & Gray-McGuire, C. (2007). Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: The Princeton lipid research clinics follow-up study. *Pediatrics*, *120*(2), 340-345. https://doi.org/10.1542/peds.2006-1699

Mosleh, M. (2018). Burden of chronic diseases in the Palestinian healthcare sector using disability-adjusted life years (DALY), Palestine. *Diversity & Equality in Health and Care*, *13*(3). https://doi.org/10.21767/2049-5471.100061

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Huffman, M. D. (2015). Executive summary: heart disease and stroke statistics—2015 update: a report from the American Heart Association. Circulation, 131(4), 434-441. (2020). Correction to: Heart disease and stroke statistics—2019 update: A report from the American Heart Association. *Circulation*, *141*(2). https://doi.org/10.1161/cir.0000000000000746

Murashita, T. (2016). The role of coronary artery bypass grafting in patients with ischemic cardiomyopathy in the current era. *Journal of Thoracic Disease*, *8*(9), E1032-E1033. https://doi.org/10.21037/jtd.2016.08.37

Palestine Economic Policy Research Institute (MAS). (2017). *Strategic review of food and nutrition security in Palestine, 2017*. Food Security Cluster. https://fscluster.org/sites/default/files/documents/strategic_review_of_food_and_nutrition_security_in_palestine_2017.pdf

Palestinian Central Bureau of Statistic, Food Security Sector. (2016). *Socio-Economic & Food Security Survey 2014*. UNISPAL-United Nations Information System on the Question of Palestine. https://unispal.un.org/pdfs/FSS__Survey2014.pdf

Palestinian Central Bureau of Statistics (PCBS). (2017). *Press Release on the Results of the Labour Force Survey, 2016*. ReliefWeb - Informing humanitarians worldwide. https://reliefweb.int/sites/reliefweb.int/files/resources/Press_En_13-2-2019-LF-y-en.pdf

Palestinian Central Bureau of Statistics. (2018). *Labour Force Survey: (January-March, 2018) Round, (Q1/2018). Press Report on the Labour Force Survey Results*. Ramallah - Palestine. https://www.pcbs.gov.ps/portals/_pcbs/PressRelease/Press_En_8-5-2018-LF-en.PDF

Palestinian Central Bureau of Statistics. (2018). *Palestinians at the End of 2018*. Ramallah - Palestine. https://pcbs.gov.ps/Downloads/book2400.pdf

Palestinian Health Information Center. (2019). *Health Annual Report 2018*. Health Cluster OPT. https://healthclusteropt.org/admin/file_manager/uploads/files/1/Health%20Annual%20Report%20Palestine%202018.pdf

Parker, E. D., Sinaiko, A. R., Kharbanda, E. O., Margolis, K. L., Daley, M. F., Trower, N. K., Sherwood, N. E., Greenspan, L. C., Lo, J. C., Magid, D. J., & O'Connor, P. J. (2016). Change in weight status and development of hypertension. *Pediatrics*, *137*(3), e20151662. https://doi.org/10.1542/peds.2015-1662

Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition*, *24*(2), 83-92. https://doi.org/10.1080/07315724.2005.10719448

Peric, V., Jovanovic-Markovic, S., Peric, D., Rasic, D., Novakovic, T., Dejanovic, B., &Borzanovic, M. (2015). Quality of life in patients of different age groups before and after coronary artery by-pass surgery. *Annals of Thoracic and Cardiovascular Surgery*, *21*(5), 474-480. https://doi.org/10.5761/atcs.oa.15-00041

Poole, L., Ronaldson, A., Kidd, T., Leigh, E., Jahangiri, M., & Steptoe, A. (2016). Pre-surgical depression and anxiety and recovery following coronary artery bypass Graft surgery. *Journal of Behavioral Medicine*, *40*(2), 249-258. https://doi.org/10.1007/s10865-016-9775-1

Rao, G. (2016). Diagnosis, epidemiology, and management of hypertension in children. *Pediatrics*, *138*(2), e20153616. https://doi.org/10.1542/peds.2015-3616

Rasmussen, M., Krølner, R., Klepp, K., Lytle, L., Brug, J., Bere, E., & Due, P. (2006). Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *International Journal of Behavioral Nutrition and Physical Activity*, *3*(1), 22. https://doi.org/10.1186/1479-5868-3-22

Sarraj, E. E., &Qouta, S. (2005). The Palestinian experience. *Disasters and Mental Health*, 229-237. https://doi.org/10.1002/047002125x.ch16

Sawe, B. E. (2019). *Religious beliefs in Palestine*. WorldAtlas. https://www.worldatlas.com/articles/religious-beliefs-in-palestine.html

Sousa, C., & Hagopian, A. (2011). Conflict, health care and professional perseverance: A qualitative study in the West Bank. *Global Public Health*, *6*(5), 520-533. https://doi.org/10.1080/17441692.2011.574146

Staniūtė, M., & Brožaitienė, J. (2010). Changes in health-related quality of life among patients with coronary artery disease: A 2-year follow-up. *Medicina*, *46*(12), 843. https://doi.org/10.3390/medicina46120118

Stene, L., Giacaman, R., Abdul-Rahim, H., Husseini, A., Norum, K., &Holmboe-Ottesen, G. (1999). Food consumption patterns in a Palestinian West Bank population. *European Journal of Clinical Nutrition*, *53*(12), 953-958. https://doi.org/10.1038/sj.ejcn.1600878

Stenman, M., Holzmann, M. J., &Sartipy, U. (2016). Association between preoperative depression and long-term survival following coronary artery bypass surgery — A systematic review and meta-analysis. *International Journal of Cardiology*, *222*, 462-466. https://doi.org/10.1016/j.ijcard.2016.07.216

Tailakh, A., Evangelista, L. S., Mentes, J. C., Pike, N. A., Phillips, L. R., &Morisky, D. E. (2013). Hypertension prevalence, awareness, and control in Arab countries: A systematic review. *Nursing & Health Sciences*, *16*(1), 126-130. https://doi.org/10.1111/nhs.12060

The World Bank. (2018). *Annual Report 2018*. Documents & Reports - All Documents | The World Bank. https://documents1.worldbank.org/curated/en/630671538158537244/pdf/The-World-Bank-Annual-Report-2018.pdf

United Nation. (2012).United Nations Information System on the question of Palestine (UNISPAL) [Online]. United Nations Website. 2012. Available at: UNISPAL. un.org.

United Nations Conference on Trade & Development. (2015). *The Besieged Palestinian Agricultural Sector*. UNCTAD. https://unctad.org/en/PublicationsLibrary/gdsapp2015d1_en.pdf

United Nations. (2019). *Israel and the occupied territories - Amnesty Intl. Annual report 2015/16/Non-UN document*. Question of Palestine. https://www.un.org/unispal/document/auto-insert-197591/

United Nations. (2019). *Palestinian economic development - Expert meeting - Report*. Question of Palestine. https://www.un.org/unispal/document/auto-insert-177282/

United Nations. (2020). *Welcome to the United Nations*. https://www.un.org/

Urbina, E. M., Khoury, P. R., Bazzano, L., Burns, T. L., Daniels, S., Dwyer, T., Hu, T., Jacobs, D. R., Juonala, M., Prineas, R., Raitakari, O., Steinberger, J., Venn, A., Woo, J. G., & Sinaiko, A. (2019). Relation of blood pressure in childhood to self-reported hypertension in adulthood. *Hypertension*, *73*(6), 1224-1230. https://doi.org/10.1161/hypertensionaha.118.12334

Üstün, T. B., Ayuso-Mateos, J. L., Chatterji, S., Mathers, C., & Murray, C. J. (2004). Global burden of depressive disorders in the year 2000. *British Journal of Psychiatry*, *184*(5), 386-392. https://doi.org/10.1192/bjp.184.5.386

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D.

W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., … Wright, J. T. (2018). 2017 ACC/AHA/Aapa/Abc/Acpm/Ags/Apha/Ash/Aspc/Nma/Pcna guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: Executive summary: A report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. *Hypertension*, *71*(6), 1269-1324. https://doi.org/10.1161/hyp.0000000000000066

WHO. (2000). *Obesity: Preventing and managing the global epidemic*. WHO | World Health Organization. https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

WHO. (2008). Inequalities in young people's health: HBSC international report from the 2005/2006 survey. https://www.euro.who.int/en/publications/abstracts/inequalities-in-young-peoples-health.-hbsc-international-report-from-the-20052006-survey

WHO. (2010). *Global Recommendations on Physical Activity for Health*. WHO | World Health Organization. https://www.who.int/dietphysicalactivity/global-PA-recs-2010.pdf

WHO. (2010). *Nutrition Challenges*. https://www.who.int/nutrition/challenges/en/

WHO. (2011). *Global status report on noncommunicable diseases 2010*. World Health Organization. https://www.who.int/nmh/publications/ncd_report2010/en/

WHO. (2014). *Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan*. https://apps.who.int/gb/ebwha/pdf_files/WHA67/A67_41-en.pdf

WHO. (2014). 2013 joint child malnutrition estimates - Levels and trends. https://www.who.int/nutgrowthdb/estimates2013/en/

WHO. (2017). Country Cooperation Strategy for WHO and the Occupied Palestinian Territory 2017–2020. WHO/OMS: Extranet Systems. https://extranet.who.int/iris/restricted/bitstream/handle/10665/259862/WHO-EM-PME-008-E-eng.pdf;sequence=1

WHO. (2020). *Obesity and overweight*. WHO | World Health Organization. https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

WHO. (2020). Preventing noncommunicable diseases. WHO | World Health Organization. https://www.who.int/activities/preventing-noncommunicable-diseases

WHO. (2020). *Occupied Palestinian territory*. WHO EMRO. https://www.emro.who.int/pse/who-presence-in-palestine/

World Bank. (2011). *West Bank and Gaza - Coping and conflict: poverty and inclusion (English)*. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/561491468327943264/west-bank-and-gaza-coping-and-conflict-poverty-and-inclusion

World Bank. (2017). *Economic monitoring report to the ad hoc liaison committee- May 2017*. https://www.worldbank.org/en/country/westbankandgaza/publication/economic-monitoring-report-to-the-ad-hoc-liaison-committee-may-2017

Wühl, E. (2018). Hypertension in childhood obesity. *Acta Paediatrica*, *108*(1), 37-43. https://doi.org/10.1111/apa.14551

Zarani, F., Besharat, M. A., Sarami, G., &Sadeghian, S. (2011). An information–motivation–Behavioral skills (IMB) model-based intervention for CABG patients. *International Journal of Behavioral Medicine*, *19*(4), 543-549. https://doi.org/10.1007/s12529-011-9193-2

Zayed, A. A., Beano, A. M., Haddadin, F. I., Radwan, S. S., Allauzy, S. A., Alkhayyat, M. M., Al-Dahabrah, Z. A., Al-Hasan, Y. G., & Yousef, A. F. (2016). Prevalence of short stature, underweight, overweight, and obesity among school children in Jordan. *BMC Public Health*, *16*(1). https://doi.org/10.1186/s12889-016-3687-4

Zhao, Y., Wang, L., Xue, B., & Wang, Y. (2017). Associations between general and central obesity and hypertension among children: The childhood obesity study in China mega-cities. *Scientific Reports*, *7*(1). https://doi.org/10.1038/s41598-017-16819-y

APPENDIX

APPENDIX

Appendix I. Depression Assessment Instruments (Study 1).

Table S1. Depression Assessment Instruments Used by the 65 Studies Included in the Systematic Review

Depression instrument	Studies	Range score	Score
Beck Depression Inventory (BDI) [9]	N = 17	0–63	0–9: normal 10–16: mild depression 17–29: moderate depression 30–63: severe depression Cut-off score for depression ≥10
Cardiac Depression Scale (CDS) [108]	N = 2	26–182	Higher scores indicate higher depression levels
Center for Epidemiological Studies Depression Scale (CES-D) [109]	N = 4	0–60	<16: normal 16–26: mild depression ≥ 27 severe depression Cut-off score for depression > 16
Cardiac Symptom Survey (CSS) [110]	N = 3	0–10	Higher scores indicate higher depression levels
Depression, Anxiety, Stress Scale (DASS) (depression subscale) [111]	N = 3	0–42	0–9: normal 10–13: mild 14–20: moderate 21–27: severe >28: extremely severe
Depression scales of the Cognitive Behavioural Assessment (CBA 2.0-D)[112]	N = 1	-	Higher scores indicate higher depression levels
Geriatric Depression Scale (GDS) [113]	N = 2	0–30	0–9: normal 10–19: mild depression 20–30: severe depression
Hamilton Rating Scale for Depression (HAM-D)[114]	N = 4	0–52	0–7: normal 8–16: mild depression 17–23: moderate depression >24: severe depression