

The difference in referencing in Web of Science, Scopus, and Google Scholar

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Abstract

Aims How often a medical article is cited is important for many people because it is used to calculate different variables such as the h-index and the journal impact factor. The aim of this analysis was to assess how the citation count varies between Web of Science (WoS), Scopus, and Google Scholar in the current literature.

Methods We included the top 50 cited articles of four journals ESC Heart Failure; Journal of cachexia, sarcopenia and muscle; European Journal of Preventive Cardiology; and European Journal of Heart Failure in our analysis that were published between 1 January 2016 and 10 October 2019. We recorded the number of citations of these articles according to WoS, Scopus, and Google Scholar on 10 October 2019.

Results The top 50 articles in ESC Heart Failure were on average cited 12 (WoS), 13 (Scopus), and 17 times (Google Scholar); in Journal of cachexia, sarcopenia and muscle 37 (WoS), 43 (Scopus), and 60 times (Google Scholar); in European Journal of Preventive Cardiology 41 (WoS), 56 (Scopus), and 67 times (Google Scholar); and in European Journal of Heart Failure 76 (WoS), 108 (Scopus), and 230 times (Google Scholar). On average, the top 50 articles in all four journals were cited 41 (WoS), 52 (Scopus, 26% higher citations count than WoS, range 8–42% in the different journals), and 93 times (Google Scholar, 116% higher citation count than WoS, range 42–203%).

Conclusion Scopus and Google Scholar on average have a higher citation count than WoS, whereas the difference is much larger between Google Scholar and WoS.

Keywords Web of Science; Scopus; Google Scholar

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Introduction

Scopus currently lists 38 060 different journals, with 320 journals publishing in the field of ‘Cardiology and Cardiovascular Medicine’.¹ Many different scores worldwide try to rank journals with the help of different algorithms. The most important and renown score in Europe and the USA is the Thomson Scientific impact factor. Each summer, it is published for the previous year. For understanding the Thomson Scientific impact factor, one first has to comprehend how it is calculated. For example, the 2018 impact factor for any given

journal was calculated by adding up all citations in 2018 referencing articles published in that journal in 2016 and 2017 and then dividing by the number of original articles and reviews published in 2016 and 2017 in that journal. For counting the number of citations, Thomson Scientific uses the Web of Science (WoS) database.² But there are also other sources for citation information available (e.g. Scopus¹ and Google Scholar³). Because we noticed that the number of citations for articles is often different in WoS, Scopus, and Google Scholar, we followed a structured approach to compare the number of citations and find possible differences.

Table 1 Top 50 of best cited articles published between 2016 until today in Eur J Prev Cardiol

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
1	Kotseva K	EUROASPIRE IV: A European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from 24 European countries	Article	353	427	651	4
2	Eckel N	Metabolically healthy obesity and cardiovascular events: a systematic review and meta-analysis	Review	76	76	96	5
3	Friis-Møller N	An updated prediction model of the global risk of cardiovascular disease in HIV-positive persons: the data-collection on adverse effects of anti-HIV drugs (D:A:D) study	Article	69	70	100	6
4	Kotseva K	Lifestyle and risk factor management in people at high risk of cardiovascular disease. A report from the European Society of Cardiology European Action on Secondary and Primary Prevention by Intervention to Reduce Events (EUROASPIRE) IV cross-sectional survey in 14 European regions	Article	66	78	98	13
5	Rauch B	The prognostic effect of cardiac rehabilitation in the era of acute revascularisation and statin therapy: a systematic review and meta-analysis of randomized and non-randomized studies - The Cardiac Rehabilitation Outcome Study (CROS)	Review	66	77	101	14
6	Price KJ	A review of guidelines for cardiac rehabilitation exercise programmes: is there an international consensus?	Review	61	67	108	15
7	Mont L	Pre-participation cardiovascular evaluation for athletic participants to prevent sudden death: position paper from the EHRA and the EACPR, branches of the ESC. Endorsed by APHRS, HRS, and SOLAECE	Article	51	60	122	16
8	Vigorito C	Frailty and cardiac rehabilitation: a call to action from the EAPC Cardiac Rehabilitation Section	Article	47	51	60	17
9	Bonaccio MF	Adherence to the traditional Mediterranean diet and mortality in subjects with diabetes. Prospective results from the MOLI-SANI study	Article	45	51	65	18
10	Roeters van Lennep EJ	Cardiovascular disease risk in women with premature ovarian insufficiency: a systematic review and meta-analysis	Article	45	46	78	19
11	Cooney MT	Cardiovascular risk estimation in older persons: SCORE O.P.	Article	41	47	53	20
12	Hansen D	The European Association of Preventive Cardiology Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) tool: a digital training and decision support system for optimized exercise prescription in cardiovascular disease. Concept, definitions and construction methodology	Article	40	44	51	21
13	Chu P	The effectiveness of yoga in modifying risk factors for cardiovascular disease and metabolic syndrome: a systematic review and meta-analysis of randomized controlled trials	Review	38	45	103	22
14	Piepoli MF	Challenges in secondary prevention after acute myocardial infarction: a call for action	Review	37	40	84	23
15	Alharbi M	Validation of Fitbit-Flex as a measure of free-living physical activity in a community-based phase III cardiac rehabilitation population	Article	35	40	67	24
16	D'Ascenzi F	Novel echocardiographic techniques for the evaluation of athletes' heart: a focus on speckle-tracking echocardiography	Review	35	37	44	25
17	Fukuta H	Effects of drug and exercise intervention on functional capacity and quality of life in heart failure with preserved ejection fraction: a meta-analysis of randomized controlled trials	Article	35	35	60	26

(Continues)

Table 1 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
18	Hobbs FDR	European Primary Care Cardiovascular Society (EPCCS) consensus guidance on stroke prevention in atrial fibrillation (SPAF) in primary care	Article	34	37	47	27
19	Frederix I	Effect of comprehensive cardiac telerehabilitation on one-year cardiovascular rehospitalization rate, medical costs and quality of life: a cost-effectiveness analysis	Article	33	39	47	28
20	Solberg EE	Sudden cardiac arrest in sports—need for uniform registration: a position paper from the Sport Cardiology Section of the European Association for Cardiovascular Prevention and Rehabilitation	Article	33	34	57	29
21	Groenewegen KA	Vascular age to determine cardiovascular disease risk: a systematic review of its concepts, definitions, and clinical applications	Review	32	35	58	30
22	Sato T	Cardiopulmonary exercise testing as prognostic indicators: comparisons among heart failure patients with reduced, mid-range and preserved ejection fraction	Article	31	37	32	31
23	Pedersen SS	Psychosocial perspectives in cardiovascular disease	Article	31	29	35	32
24	Pallisgaard JL	Risk of atrial fibrillation in diabetes mellitus: a nationwide cohort study	Article	31	26	39	33
25	Uddin J	Predictors of exercise capacity following exercise-based rehabilitation in patients with coronary heart disease and heart failure: a meta-regression analysis	Article	30	35	44	34
26	Bohm P	Data from a nationwide registry on sports-related sudden cardiac deaths in Germany	Article	30	36	63	35
27	Hall AJ	Association between osteoarthritis and cardiovascular disease: systematic review and meta-analysis	Review	29	34	47	36
28	Frederix I	Cardiac telerehabilitation: a novel cost-efficient care delivery strategy that can induce long-term health benefits	Article	29	34	34	37
29	Heida KY	Cardiovascular risk management after reproductive and pregnancy-related disorders: a Dutch multidisciplinary evidence-based guideline	Review	29	33	53	38
30	Huang G	Dose-response relationship of cardiorespiratory fitness adaptation to controlled endurance training in sedentary older adults	Review	29	28	49	39
31	Kraal JJ	Clinical and cost-effectiveness of home-based cardiac rehabilitation compared to conventional, centre-based cardiac rehabilitation: results of the FIT@Home study	Article	28	33	36	40
32	Taggar JS	Accuracy of methods for detecting an irregular pulse and suspected atrial fibrillation: a systematic review and meta-analysis	Review	28	33	48	41
33	Pfaeffli Dale L	The effectiveness of mobile-health behaviour change interventions for cardiovascular disease self-management: A systematic review	Review	27	29	67	42
34	Sandri M	Chronic heart failure and aging—effects of exercise training on endothelial function and mechanisms of endothelial regeneration: results from the Leipzig Exercise Intervention in Chronic heart failure and Aging (LEICA) study	Article	27	34	50	43
35	Kotseva K	Determinants of participation and risk factor control according to attendance in cardiac rehabilitation programmes in coronary patients in Europe: EUROASPIRE IV survey	Article	27	31	28	44
36	Gorenk Chair B	European Heart Rhythm Association (EHRA)/European Association of Cardiovascular Prevention and Rehabilitation (EACPR) position paper on how to prevent atrial fibrillation endorsed by the Heart Rhythm Society (HRS) and Asia Pacific Heart Rhythm Society (APHRS)	Article	27	30	71	45
37	Coppetti T	Accuracy of smartphone apps for heart rate measurement	Article	26	32	35	46

(Continues)

Table 1 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
38	Joshi PH	Association of high-density lipoprotein subclasses and incident coronary heart disease: the Jackson Heart and Framingham Offspring Cohort Studies	Article	26	27	41	47
39	Pogosova N	Psychosocial risk factors in relation to other cardiovascular risk factors in coronary heart disease: results from the EUROASPIRE IV survey. A registry from the European Society of Cardiology	Article	26	26	34	48
40	Ruddox V	Atrial fibrillation and the risk for myocardial infarction, all-cause mortality and heart failure: a systematic review and meta-analysis	Review	25	27	34	49
41	Tschentscher M	High-intensity interval training is not superior to other forms of endurance training during cardiac rehabilitation	Article	25	25	45	50
42	Ekblom-Bak E	Isotemporal substitution of sedentary time by physical activity of different intensities and bout lengths, and its associations with metabolic risk	Article	24	28	35	51
43	Maiorino Mi	Effect of a Mediterranean diet on endothelial progenitor cells and carotid intima-media thickness in type 2 diabetes: follow-up of a randomized trial	Article	24	25	29	52
44	Willeit P	Inflammatory markers and extent and progression of early atherosclerosis: meta-analysis of individual-participant-data from 20 prospective studies of the PROG-IMT collaboration	Article	23	29	52	53
45	Stefler D	Fruit and vegetable consumption and mortality in Eastern Europe: longitudinal results from the Health, Alcohol and Psychosocial Factors in Eastern Europe study	Article	23	28	34	54
46	Ribeiro G	Cardiac rehabilitation programme after transcatheter aortic valve implantation versus surgical aortic valve replacement: systematic review and meta-analysis	Review	23	27	28	55
47	Kozela M	The association of depressive symptoms with cardiovascular and all-cause mortality in Central and Eastern Europe: prospective results of the HAPIEE study	Article	23	26	33	56
48	Auer J	Muscle- and skeletal-related side-effects of statins: tip of the iceberg?	Article	23	26	40	57
49	Heida KY	Cardiovascular disease risk in women with a history of spontaneous preterm delivery: a systematic review and meta-analysis	Review	23	24	36	58
50	Shi Y	Can acetic acid substitute ethanol for the reduction of cardiovascular disease risks?	Letter	23	22	26	59

Table 2 Top 50 of best cited articles published between 2016 until today in J Cachexia Sarcopenia Muscle

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
1	von Haehling S	Ethical guidelines for publishing in the journal of cachexia, sarcopenia and muscle: update 2017	Editorial Material	113	168	178	60
2	Malmstrom T	SARC-F: a symptom score to predict persons with sarcopenia at risk for poor functional outcomes	Article	104	111	170	61
3	Montano-Loza A	Sarcopenic obesity and myosteatosis are associated with higher mortality in patients with cirrhosis	Article	80	90	125	62
4	Anker SD	Welcome to the ICD-10 code for sarcopenia	Editorial Material	73	88	150	63
5	Brown JC	Sarcopenia and mortality among a population-based sample of community-dwelling older adult	Article	66	71	100	64
6	Kalafateli M	Malnutrition and sarcopenia predict post-liver transplantation outcomes independently of the Model for End-stage Liver Disease score	Article	53	61	89	65
7	von Haehling S	Prevalence and clinical impact of cachexia in chronic illness in Europe, USA, and Japan: facts and numbers update 2016	Editorial Material	52	55	87	66
8	Rutten IJ	Loss of skeletal muscle during neoadjuvant chemotherapy is related to decreased survival in ovarian cancer patients.	Article	52	63	71	67
9	Tyrovolas S	Factors associated with skeletal muscle mass, sarcopenia, and sarcopenic obesity in older adults: a multi-continent study	Article	51	59	80	68
10	Buckinx F	Pitfalls in the measurement of muscle mass: a need for a reference standard	Article	46	54	73	69
11	Solheim TS	A randomized phase II feasibility trial of a multimodal intervention for the management of cachexia in lung and pancreatic cancer	Article	44	50	70	70
12	Stewart Coats AJ	Espindolol for the treatment and prevention of cachexia in patients with stage III/IV non-small cell lung cancer or colorectal cancer: a randomized, double-blind, placebo-controlled, international multicentre phase II study (the ACT-ONE trial)	Article	44	60	62	71
13	Loncar G	Cardiac cachexia: hic et nunc	Review	42	43	56	72
14	van Dijk DP	Low skeletal muscle radiation attenuation and visceral adiposity are associated with overall survival and surgical site infections in patients with pancreatic cancer	Article	41	48	58	73
15	Leong DP	Reference ranges of handgrip strength from 125,462 healthy adults in 21 countries: a prospective urban rural epidemiologic (PURE) study	Article	41	49	71	74
16	Sanders KJ	Cachexia in chronic obstructive pulmonary disease: new insights and therapeutic perspective	Review	39	38	60	75
17	Boengler K	Mitochondria and ageing: role in heart, skeletal muscle and adipose tissue	Review	36	38	57	76
18	Rutten IJG	Psoas muscle area is not representative of total skeletal muscle area in the assessment of sarcopenia in ovarian cancer	Article	31	41	49	77
19	Snijders T	Muscle fibre capillarization is a critical factor in muscle fibre hypertrophy during resistance exercise training in older men	Article	30	37	49	78
20	Holeček M	Beta-hydroxy-beta-methylbutyrate supplementation and skeletal muscle in healthy and muscle-wasting conditions	Review	30	34	62	79
21	Barbosa-Silva T	Prevalence of sarcopenia among community-dwelling elderly of a medium-sized South American city: results of the COMO VAI? study	Article	30	38	74	80
22	Foong YC	Accelerometer-determined physical activity, muscle mass, and leg strength in community-dwelling older adults	Article	30	31	41	81

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Table 2 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
23	Sente T	Adiponectin resistance in skeletal muscle: pathophysiological implications in chronic heart failure	Review	30	31	46	82
24	van Vugt JL	A comparative study of software programmes for cross-sectional skeletal muscle and adipose tissue measurements on abdominal computed tomography scans of rectal cancer patients	Article	29	36	47	83
25	Mochamat	A systematic review on the role of vitamins, minerals, proteins, and other supplements for the treatment of cachexia in cancer: a European Palliative Care Research Centre cachexia project	Review	29	31	42	84
26	Sakuma K	p62/SQSTM1 but not LC3 is accumulated in sarcopenic muscle of mice	Article	29	32	42	85
27	Batista ML Jr	Cachexia-associated adipose tissue morphological rearrangement in gastrointestinal cancer patients	Article	29	31	43	86
28	Morley JE	Anorexia of ageing: a key component in the pathogenesis of both sarcopenia and cachexia	Editorial Material	28	26	38	87
29	Nijholt W	The reliability and validity of ultrasound to quantify muscles in older adults: a systematic review	Review	28	36	53	88
30	Brown JL	Mitochondrial degeneration precedes the development of muscle atrophy in progression of cancer cachexia in tumour-bearing mice	Article	27	26	41	89
31	Martone AM	The incidence of sarcopenia among hospitalized older patients: results from the Glisten study	Article	26	27	37	90
32	St-Jean-Pelletier F	The impact of ageing, physical activity, and pre-frailty on skeletal muscle phenotype, mitochondrial content, and intramyocellular lipids in men	Article	26	28	41	91
33	Nederveen JP	Skeletal muscle satellite cells are located at a closer proximity to capillaries in healthy young compared with older men	Article	26	32	41	92
34	Girón MD	Conversion of leucine to β -hydroxy- β -methylbutyrate by α -keto isocaproate dioxygenase is required for a potent stimulation of protein synthesis in L6 rat myotubes	Article	26	27	34	93
35	de Vries NIM	Patient-centred physical therapy is (cost-) effective in increasing physical activity and reducing frailty in older adults with mobility problems: a randomized controlled trial with 6 months follow-up	Article	26	29	42	94
36	Pinto CL	Impact of creatine supplementation in combination with resistance training on lean mass in the elderly	Article	26	24	44	95
37	Nishikawa H	Elevated serum myostatin level is associated with worse survival in patients with liver cirrhosis	Article	25	26	44	96
38	Lipina C	Lipid modulation of skeletal muscle mass and function	Review	25	29	34	97
39	Klassen O	Muscle strength in breast cancer patients receiving different treatment regimes	Article	25	26	41	98
40	Sahebkar A	Curcumin: an effective adjunct in patients with statin-associated muscle symptoms?	Review	25	27	36	99
41	Patel MS	Growth differentiation factor-15 is associated with muscle mass in chronic obstructive pulmonary disease and promotes muscle wasting in vivo	Article	25	28	40	100
42	Lewis A	Increased expression of H19/miR-675 is associated with a low fat-free mass index in patients with COPD	Article	25	30	41	101

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Table 2 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
43	Go SI	Prognostic impact of sarcopenia in patients with diffuse large B-cell lymphoma treated with rituximab plus cyclophosphamide, doxorubicin, vincristine, and prednisone	Article	25	28	34	102
44	Banach M	Discussion around statin discontinuation in older adults and patients with wasting diseases	Editorial Material	25	28	39	103
45	Tieland M	Skeletal muscle performance and ageing	Review	24	26	62	104
46	Dos Santos L	Sarcopenia and physical independence in older adults: the independent and synergic role of muscle mass and muscle function	Article	24	31	46	105
47	Lerner L	MAP 3K1/GDF15 axis is a critical driver of cancer cachexia	Article	24	27	33	106
48	Penna F	Effect of the specific proteasome inhibitor bortezomib on cancer-related muscle wasting	Article	24	26	37	107
49	Gonzalez MC	Bioelectrical impedance analysis for diagnosing sarcopenia and cachexia: what are we really estimating?	Editorial Material	23	27	40	108
50	van de Boel C	A randomized clinical trial investigating the efficacy of targeted nutrition as adjunct to exercise training in COPD	Article	23	26	42	109

Table 3 Top 50 of best cited articles published between 2016 until today in Eur J Heart Fail

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
1	Ponikowski P	2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). Developed with the special contribution of the Heart Failure Association (HFA) of the ESC	Article	751	1980	7001	110
2	Lyon AR	Current state of knowledge on Takotsubo syndrome: a Position Statement from the Taskforce on Takotsubo Syndrome of the Heart Failure Association of the European Society of Cardiology	Review	276	291	431	111
3	Crespo-Leiro MG	Failure Association of the European Society of Cardiology European Society of Cardiology Heart Failure Long-Term Registry (ESC-HF-LT): 1-year follow-up outcomes and differences across regions	Article	124	143	170	112
4	Hajjola VP	Contemporary management of acute right ventricular failure: a statement from the Heart Failure Association and the Working Group on Pulmonary Circulation and Right Ventricular Function of the European Society of Cardiology	Article	110	131	206	113
5	van Riet EE	Epidemiology of heart failure: the prevalence of heart failure and ventricular dysfunction in older adults over time. A systematic review	Review	108	125	224	114
6	Jorsal A	Effect of liraglutide, a glucagon-like peptide-1 analogue, on left ventricular function in stable chronic heart failure patients with and without diabetes (LIVE)-a multicentre, double-blind, randomised, placebo-controlled trial	Article	91	100	121	115
7	Ter Maaten JM	Connecting heart failure with preserved ejection fraction and renal dysfunction: the role of endothelial dysfunction and inflammation	Review	87	93	111	116
8	Jankowska EA	Effects of intravenous iron therapy in iron-deficient patients with systolic heart failure: a meta-analysis of randomized controlled trials	Review	84	110	148	117
9	Pappalardo F	Concomitant implantation of Impella® on top of veno-arterial extracorporeal membrane oxygenation may improve survival of patients with cardiogenic shock	Article	83	84	113	118
10	Chioncel O	Epidemiology and one-year outcomes in patients with chronic heart failure and preserved, mid-range and reduced ejection fraction: an analysis of the ESC Heart Failure Long-Term Registry	Article	83	114	159	119
11	Komajda M	Effect of ivabradine in patients with heart failure with preserved ejection fraction: the EDIFY randomized placebo-controlled trial	Article	78	57	59	120
12	Vegter EL	MicroRNAs in heart failure: from biomarker to target for therapy	Review	78	85	104	121
13	Stiermaier T	Long-term excess mortality in takotsubo cardiomyopathy: predictors, causes and clinical consequences	Article	72	78	101	122
14	Vidán MT	Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure	Article	66	77	64	123
15	Tripodkiadis F	Reframing the association and significance of co-morbidities in heart failure	Review	64	71	101	124
16	Tsuji K	Characterization of heart failure patients with mid-range left ventricular ejection fraction-a report from the CHART-2 Study	Article	63	79	107	125
17	Gyöngyösi M	Myocardial fibrosis: biomedical research from bench to bedside	Review	61	63	84	126
18	Seferović PM	Type 2 diabetes mellitus and heart failure: a position statement from the Heart Failure Association of the European Society of Cardiology	Article	60	82	101	127

(Continues)

Table 3 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
19	Zamorano JL	2016 ESC Position Paper on cancer treatments and cardiovascular toxicity developed under the auspices of the ESC Committee for Practice Guidelines: the Task Force for cancer treatments and cardiovascular toxicity of the European Society of Cardiology (ESC)	Article	58	71	92	128
20	Ovchinnikova ES	Signature of circulating microRNAs in patients with acute heart failure	Article	58	66	67	129
21	Schmidt M	Thirty-year trends in heart failure hospitalization and mortality rates and the prognostic impact of co-morbidity: a Danish nationwide cohort study	Article	57	68	77	130
22	Butler J	The potential role and rationale for treatment of heart failure with sodium-glucose co-transporter 2 inhibitors	Review	56	60	76	131
23	Senni M	Initiating sacubitril/valsartan (LCZ696) in heart failure: results of TITRATION, a double-blind, randomized comparison of two uptitration regimens	Article	54	61	90	132
24	Christ M	Heart failure epidemiology 2000-2013: insights from the German Federal Health Monitoring System	Article	54	59	67	133
25	Vardeny O	Efficacy of sacubitril/valsartan vs. enalapril at lower than target doses in heart failure with reduced ejection fraction: the PARADIGM-HF trial	Article	54	53	67	134
26	Gustafsson F	Left ventricular assist device therapy in advanced heart failure: patient selection and outcomes	Review	53	60	78	135
27	Teerlink J	Serelaxin in addition to standard therapy in acute heart failure: rationale and design of the RELAX-AHF-2 study	Article	53	58	72	136
28	Komajda M	Physicians' adherence to guideline-recommended medications in heart failure with reduced ejection fraction: data from the QUALIFY global survey	Article	53	60	74	137
29	Bauersachs J	Current management of patients with severe acute peripartum cardiomyopathy: practical guidance from the Heart Failure Association of the European Society of Cardiology Study Group on peripartum cardiomyopathy	Article	52	62	85	138
30	Thorvaldsen T	Use of evidence-based therapy and survival in heart failure in Sweden 2003-2012	Article	50	57	64	139
31	Unger ED	Association of chronic kidney disease with abnormal cardiac mechanics and adverse outcomes in patients with heart failure and preserved ejection fraction	Article	48	49	66	140
32	Chioncel O	Clinical phenotypes and outcome of patients hospitalized for acute heart failure: the ESC Heart Failure Long-Term Registry	Article	47	57	72	141
33	Fitchett D	Heart failure outcomes in clinical trials of glucose-lowering agents in patients with diabetes	Review	45	51	63	142
34	Aschauer S	The right heart in heart failure with preserved ejection fraction: insights from cardiac magnetic resonance imaging and invasive haemodynamics	Article	45	51	62	143
35	Anker SD	Effects of ferric carboxymaltose on hospitalisations and mortality rates in iron-deficient heart failure patients: an individual patient data meta-analysis	Article	44	56	89	144

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Table 3 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
36	Sliwa K	Clinical characteristics of patients from the worldwide registry on peripartum cardiomyopathy (PPCM): EURObservational Research Programme in conjunction with the Heart Failure Association of the European Society of Cardiology Study Group on PPCM	Article	43	49	74	145
37	Maggioni AP	The real-world evidence of heart failure: findings from 41 413 patients of the ARNO database	Article	43	52	68	146
38	Chan MM	Growth differentiation factor 15 in heart failure with preserved vs. reduced ejection fraction	Article	42	49	73	147
39	Mann DL	One-year follow-up results from AUGMENT-HF: a multicentre randomized controlled clinical trial of the efficacy of left ventricular augmentation with Algisyl in the treatment of heart failure	Article	42	54	62	148
40	Gorter TM	Right ventricular dysfunction in heart failure with preserved ejection fraction: a systematic review and meta-analysis	Review	42	49	61	149
41	Jansweijer JA	Truncating titin mutations are associated with a mild and treatable form of dilated cardiomyopathy	Article	41	39	54	150
42	Targher G	In-hospital and 1-year mortality associated with diabetes in patients with acute heart failure: results from the ESC-HFA Heart Failure Long-Term Registry	Article	41	45	43	151
43	Marques FZ	The transcardiac gradient of cardio-microRNAs in the failing heart	Article	41	56	64	152
44	Harjola VP	Organ dysfunction, injury and failure in acute heart failure: from pathophysiology to diagnosis and management. A review on behalf of the Acute Heart Failure Committee of the Heart Failure Association (HFA) of the European Society of Cardiology (ESC)	Review	40	44	58	153
45	Ghio S	Different correlates but similar prognostic implications for right ventricular dysfunction in heart failure patients with reduced or preserved ejection fraction	Article	40	46	57	154
46	Demissei BG	Optimizing clinical use of biomarkers in high-risk acute heart failure patients	Article	40	40	46	155
47	Meani P	Modalities and effects of left ventricle unloading on extracorporeal life support: a review of the current literature	Article	39	45	53	156
48	Pearse SG	Sleep-disordered breathing in heart failure	Review	39	43	54	157
49	Meijers WC	Variability of biomarkers in patients with chronic heart failure and healthy controls	Article	38	39	49	158
50	Voors AA	A systems BIOLOGY Study to Tailored Treatment in Chronic Heart Failure: rationale, design, and baseline characteristics of BIOSTAT-CHF	Article	38	38	54	159

Table 4 Top 50 of best cited articles published between 2016 until today in ESC Heart Fail

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
1	Jujo K	Randomized pilot trial comparing tolvaptan with furosemide on renal and neurohumoral effects in acute heart failure	Article	33	37	43	160
2	Springer J	Muscle wasting and sarcopenia in heart failure and beyond: update 2017	Review	32	38	46	161
3	Konishi M	Heart failure epidemiology and novel treatments in Japan: facts and numbers	Editorial Material	25	26	36	162
4	Luedde M	Heart failure is associated with depletion of core intestinal microbiota	Article	24	27	34	163
5	Nagarajan V	Obesity paradox in heart failure: a heavy matter	Review	21	23	37	164
6	Saitoh M	Anorexia, functional capacity, and clinical outcome in patients with chronic heart failure: results from the Studies Investigating Co-morbidities Aggravating Heart Failure (SICA-HF)	Article	19	19	19	165
7	Riley JP	Palliative care in heart failure: facts and numbers	Editorial Material	18	21	27	166
8	Sotiropoulos K	Red cell distribution width and mortality in acute heart failure patients with preserved and reduced ejection fraction	Article	17	18	23	167
9	Arrigo M	Effect of precipitating factors of acute heart failure on readmission and long-term mortality	Article	16	17	27	168
10	Núñez J	Left ventricular ejection fraction recovery in patients with heart failure treated with intravenous iron: a pilot study	Article	16	18	21	169
11	Delepaül B	Who are patients classified within the new terminology of heart failure from the 2016 ESC guidelines?	Article	15	17	20	170
12	Hayashi T	Subclinical hypothyroidism is an independent predictor of adverse cardiovascular outcomes in patients with acute decompensated heart failure	Article	14	15	24	171
13	Barkhadaryan A	Cardiac muscle wasting in individuals with cancer cachexia	Article	13	13	17	172
14	Pascual-Figal D	Rationale and design of TRANSITION: a randomized trial of pre-discharge vs. post-discharge initiation of sacubitril/valsartan	Article	12	14	18	173
15	Sato A	Associations of dipeptidyl peptidase-4 inhibitors with mortality in hospitalized heart failure patients with diabetes mellitus	Article	12	12	11	174
16	Martens P	Insights into implementation of sacubitril/valsartan into clinical practice	Article	11	11	16	175
17	Seropian IM	Neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio as predictors of survival after heart transplantation	Article	11	12	16	176
18	Lauritsen J	Characteristics and long-term prognosis of patients with heart failure and mid-range ejection fraction compared with reduced and preserved ejection fraction: a systematic review and meta-analysis	Review	10	10	11	177
19	Cohen-Solal A	Beta blocker dose and markers of sympathetic activation in heart failure patients: interrelationships and prognostic significance	Article	10	13	13	178
20	Jain A	The renal-cardiac connection in subjects with preserved ejection fraction: a population based study	Article	10	9	12	179
21	Toma M	Differentiating heart failure phenotypes using sex-specific transcriptomic and proteomic biomarker panels	Article	10	10	12	180
22	Morishita T	Association between matrix metalloproteinase-9 and worsening heart failure events in patients with chronic heart failure	Article	10	13	17	181
23	Alma LJ	Shared biomarkers between female diastolic heart failure and pre-eclampsia: a systematic review and meta-analysis	Review	10	13	16	182
24	Amina A	On admission serum sodium and uric acid levels predict 30 day rehospitalization or death in patients with acute decompensated heart failure	Article	10	9	13	183
25	Yoshihisa A	The CHA ₂ DS ₂ -VASc score as a predictor of high mortality in hospitalized heart failure patients	Article	10	10	11	184
26	Mustroph J	Empagliflozin reduces Ca/calmodulin-dependent kinase II activity in isolated ventricular cardiomyocytes	Article	9	8	9	185

(Continues)

Table 4 (continued)

Nr.	First author	Title	Document type	Times cited in Web of Science	Times cited in Scopus	Times cited in Google Scholar	Reference
27	Khan MS	Renin-angiotensin blockade in heart failure with preserved ejection fraction: a systematic review and meta-analysis	Review	9	11	14	186
28	Theidel U	Budget impact of intravenous iron therapy with ferric carboxymaltose in patients with chronic heart failure and iron deficiency in Germany	Article	9	13	13	187
29	Möckel M	The role of procalcitonin in acute heart failure patients	Review	9	9	13	188
30	Searle J	Acute heart failure facts and numbers: acute heart failure populations	Editorial Material	9	8	15	189
31	Aleksova N	Barriers to goals of care discussions with hospitalized patients with advanced heart failure: feasibility and performance of a novel questionnaire	Article	9	10	11	190
32	Hoshida S	Age- and sex-related differences in diastolic function and cardiac dimensions in a hypertensive population	Article	9	9	12	191
33	Porto CM	Association between vitamin D deficiency and heart failure risk in the elderly	Article	8	7	16	192
34	Pappalardo F	Full percutaneous biventricular support with two Impella pumps: the Bi-Pella approach	Article	8	7	14	193
35	Buckley LF	Low NT-proBNP levels in overweight and obese patients do not rule out a diagnosis of heart failure with preserved ejection fraction	Article	8	6	10	194
36	Öhman J	Focused echocardiography and lung ultrasound protocol for guiding treatment in acute heart failure	Article	8	9	10	195
37	Smedema JP	Right ventricular involvement and the extent of left ventricular enhancement with magnetic resonance predict adverse outcome in pulmonary sarcoidosis	Article	8	9	12	196
38	Jaarsma T	Sexual function of patients with heart failure: facts and numbers	Editorial Material	8	9	12	197
39	Keene D	Rationale and design of the randomized multicentre His Optimized Pacing Evaluated for Heart Failure (HOPE-HF) trial	Article	7	8	11	198
40	Pitt B	Evaluation of an individualized dose titration regimen of patiromer to prevent hyperkalaemia in patients with heart failure and chronic kidney disease	Article	7	13	12	199
41	Ferreira JP	Rationale of the FIBROTARGETS study designed to identify novel biomarkers of myocardial fibrosis	Article	7	8	12	200
42	Norberg H	Eligibility of sacubitril-valsartan in a real-world heart failure population: a community-based single-centre study	Article	7	8	10	201
43	Shirakabe A	Worsening renal function definition is insufficient for evaluating acute renal failure in acute heart failure	Article	7	8	10	202
44	Lavall D	Mitral valve interventions in heart failure	Review	7	8	14	203
45	Cattadori G	Exercise and heart failure: an update	Review	7	10	19	204
46	Ancion A	Serum albumin level and hospital mortality in acute non-ischemic heart failure	Article	7	12	14	205
47	Lancellotti P	Protocol update and preliminary results of EACVI/HFA Cardiac Oncology Toxicity (COT) Registry of the European Society of Cardiology	Article	7	9	7	206
48	Peled Y	The impact of gender mismatching on early and late outcomes following heart transplantation	Article	7	6	10	207
49	Ahmed MB	Higher risk for incident heart failure and cardiovascular mortality among community-dwelling octogenarians without pneumococcal vaccination	Article	7	7	9	208
50	Thomsen MM	Varying effects of recommended treatments for heart failure with reduced ejection fraction: meta-analysis of randomized controlled trials in the ESC and ACCF/AHA guidelines	Review	7	7	13	209

Methods

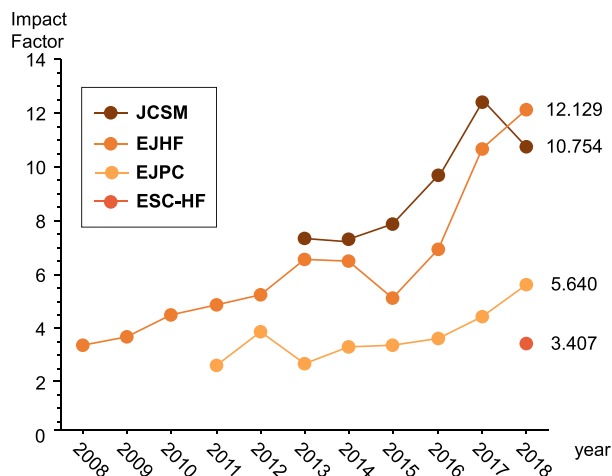
We included four journals in our analyses that focus on different cardiovascular and non-cardiovascular research topics and have differing impact factors. We included two open access journals: the ‘ESC Heart Failure’ (ESC-HF) and the ‘Journal of cachexia, sarcopenia and muscle’ (JCSM) and two standard subscription journals: the ‘European Journal of Heart Failure’ (EJHF) and the ‘European Journal of Preventive Cardiology’ (EJPC). Each of the journals has a different focus: ESC-HF publishes basic, clinical, and translational research concerning heart failure; EJHF focuses on pathophysiologic research, diagnosis, prevention, and treatment development for cardiovascular diseases, with a main interest in heart failure; EJPC has the aim to share the latest knowledge on preventive and rehabilitative strategies of cardiovascular diseases; and JCSM is focused on better understanding the molecular background of wasting disorders with the purpose to improve the recognition and management of these diseases.

In order to get up-to-date numbers for our comparison, we considered the top 50 cited papers of the four journals according to WoS that were published between 1 January 2016 and 10 October 2019 (Tables 1–4). For each of the 50 papers, we recorded the number of citations according to WoS, Scopus, and Google Scholar on 10 October 2019.

Results

Each of the journals has a different impact factor ranging between 3.407 and 12.129. The change of the impact factors

Figure 1 Impact factor of EJHF, ESC-HF, EJPC, and JCSM between 2008 and 2018. EJHF, European Journal of Heart Failure; EJPC, European Journal of Preventive Cardiology; ESC-HF, ESC Heart Failure; JCSM, Journal of cachexia, sarcopenia and muscle.



over the last years (2008–18) are shown *Figure 1*. ESC-HF was founded in 2014 and received its first impact factor in 2018 (3.407), whereas there are no previous impact factors to compare with. EJPC has received its first impact factor in 2011 (2.634) and, since then, steadily increased to 5.640 in 2018. EJHF has been publishing papers since 1999. Since 2008, its impact factor has steadily risen until 3 years ago when it rapidly increased from 5.135 (2015) to 12.129 (2018). JCSM received its first impact factor of 7.413 in 2013 and it increased in the following years to currently 10.754 (2018).

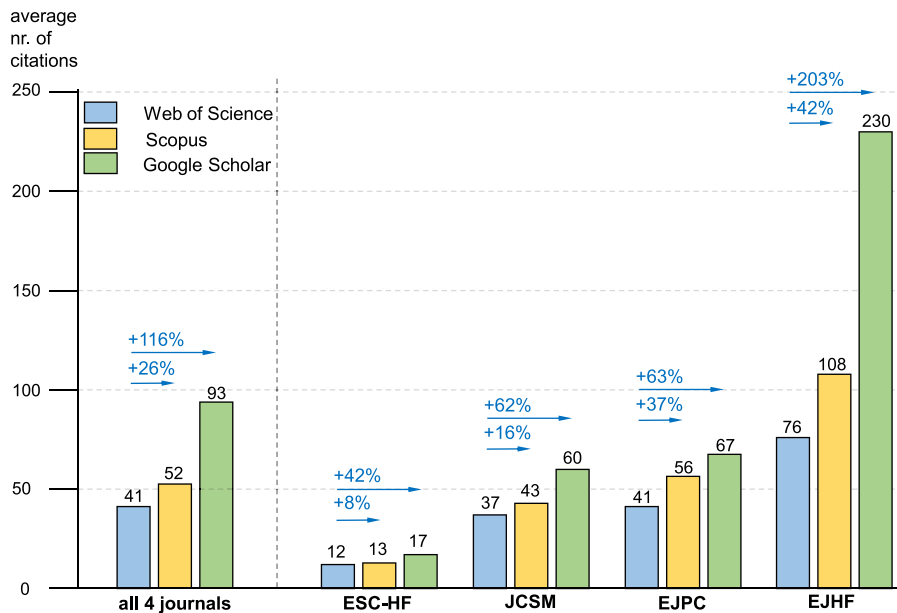
The precise number of citations according to WoS, Scopus, and Google Scholar are shown in *Tables 1–4*. The top 50 articles in ESC-HF were on average cited 12 (WoS), 13 (Scopus), and 17 times (Google Scholar); in JCSM 37 (WoS), 43 (Scopus), and 60 times (Google Scholar); in EJPC 41 (WoS), 56 (Scopus), and 67 times (Google Scholar); and in EJHF 76 (WoS), 108 (Scopus), and 230 times (Google Scholar). On average, the top 50 cited articles in all four journals were cited 41 (WoS), 52 (Scopus, 26% higher citations count than WoS, range 8–42% in the different journals), and 93 times (Google Scholar, 116% higher citation count than WoS, range 42–203% in the different journals, *Figure 2*).

Discussion

We have shown here that Scopus and Google Scholar on average have a higher citation count than WoS, whereas the difference is much larger between Google Scholar and WoS. Another systematic comparison of Google Scholar, Scopus, and WoS found that Google Scholar identified >90% of the citations listed in Scopus and WoS. Of the additional citations that Google Scholar identified, about 50% came from non-journal sources: conference papers, books, theses, and unpublished materials.⁷ While WoS and Scopus predominantly used English literature for their citation count (>90%),⁸ Google Scholar also frequently used non-English literature for their citation count (up to 40% of citations).⁷ Therefore, if one wants to find all possible citations of an article, this can only be achieved by combining all three databases.⁹ *Adriaanse et al.* have shown that WoS and Scopus did not count duplicates of papers, while Google Scholar sometimes counted one paper multiple times—additionally explaining why the citation count in Google Scholar is much higher.¹⁰

Looking at the three analysed journals publishing in the field of cardiovascular research, one can notice a volume effect regarding the ratio between Google Scholar/WoS. The citation count in ESC-HF (average eight citations per article in WoS) is 42% higher for Google Scholar; in EJPC (average 41 citations per article in WoS), the citation count is 63% higher; and in EJHF (average 76 citations per article in WoS), the citation count is 203% higher. We think that one of the main

Figure 2 Average number of citations from 01/2016 to 10/2019 of the top 50 cited papers in EJHF, ESC-HF, EJPC, and JCSM. EJHF, European Journal of Heart Failure; EJPC, European Journal of Preventive Cardiology; ESC-HF, ESC Heart Failure; JCSM, Journal of cachexia, sarcopenia and muscle.



reasons for this is that very frequently cited articles are read in many parts of the world and then are also often cited in non-English speaking literature and non-journal sources. Such citations can be found more often in Google Scholar.⁷ For example, the ‘2016 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure’ by Ponikowski *et al.*¹¹⁰ have received 751 citations in WoS, but 7001 citations (+832%) in Google Scholar so far.

Regarding the 26% higher citation count in Scopus compared with WoS, we think that this might be due to the fact that Scopus has a wider database of journals than WoS

(20 000 vs. 14 000 journals¹¹), and therefore, Scopus has access to more possible citations. Still, it is important to acknowledge that Harzing *et al.*¹² demonstrated that even though all three databases use different algorithms, each citation count shows a stable and consistent growth over time.

Conflict of interest

None declared.

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