­Table 1. Gender-related differences in the prevalence of and relevant molecules to vascular calcification

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Authors | Country | Time | CKD stages | Sample size | Findings | Data | Calcification assessment method | Ref |
| Ahmed *et al.* | United States | 2001 | 5D | 10 | Female common | Male vs. female, 10% vs. 90%, *p* < 0.02 | Calciphylaxis on skin biopsy | (1) |
| Alayoud *et al* | France | 2020 | 5D (HD) | 28 | Male more likely to progress | Progression vs. stable, male 83.3% vs. 36.4%, *p* = 0.02 | Coronary artery calcification (Agatston score) | (2) |
| Al-Rifai *et al.* | Lebanon | 2011 | 5D (HD) | 43 | Neutral | No association between VC and gender | Hand X-rays | (3) |
| Asci *et al.* | Turkey | 2010 | 5D (HD) | 207 | Male common and more severe | Score >0 vs. 0, male 57% vs. 41%, *p* = 0.05  Score >400 vs. 101-400 vs. 1-100, male 61% vs. 72% vs. 38%, *p* = 0.005 | Coronary artery calcification (Agatston score) | (4) |
| Avramovski et al. | Macedonia | 2019 | 5D | 112 | Neutral | No association between VC and gender | Lumbar spine lateral radiography | (5) |
| Bae *et al.* | Korea (multicenter) | 2016 | 5D (HD) | 423 | Male common and more severe | Male vs. female, positive CAC 69.37% vs. 53.95%, *p* = 0.001  Male vs. female, CAC scores 44.1 vs. 5.15, *p* = 0.0041 | Coronary artery calcification (Agatston score) | (6) |
| Ballotta *et al.* | Italy | 2004 | 5D | 143 | Neutral | With vs. without, male 78% vs. 74%, *p* = 0.59 | Calcified vessels determined intra-operatively | (7) |
| Bellasi *et al.* | United States | 2012 | 5D (HD) | 141 | Neutral | Cardiovascular calcification index score 8–11 vs. 5–7 vs. 3–4 vs. 0–2, male 62% vs. 39% vs. 52% vs. 49%, *p* = 0.57 | Lumbar spine lateral radiography (Kaupilla score) and echocardiography-derived valve calcification | (8) |
| Bundy *et al.* | United States (CRIC) | 2019 | 2-4 | 3404 | Neutral | Quartile 1 (severe) vs. 2 vs. 3 vs. 4, female 47% vs. 48% vs. 44% vs. 41%, *p* > 0.05 | T50 (propensity of calcification) | (9) |
| Chandra *et al.* | India | 2020 | 5D | 90 | Neutral | With vs. without, male 67.5% vs. 62%, *p* = 0.59 | Coronary artery calcification (Agatston score) and thoracic aortic calcification by computed tomography | (10) |
| Chang *et al* | South Korea | 2012 | 5D (HD) | 289 | Neutral | Severe vs. modest calcification, male 41.8% vs. 44.7%, *p* = 0.066 | Lumbar spine lateral radiography | (11) |
| Chao *et al.* | Taiwan | 2020 | 5D (HD) | 96 | Neutral | With vs. without, male 47% vs. 43%, *p* = 0.711 | Aortic arch calcification on chest radiography | (12) |
| Chao *et al.* | Taiwan | 2017 | 5D (HD) | 88 | Neutral | With vs. without, male 59% vs. 66%, *p* = 0.54 | Aortic arch calcification on chest radiography | (13) |
| Charitaki *et al.* | United Kingdom | 2014 | 5D (HD) | 303 | Male more severe | Correlation with female, r = -0.124, *p* = 0.031 | Pulse wave velocity | (14) |
| Chen *et al* | Sweden | 2017 | 5D, 5T | 240 | Neutral | Score > 100 vs. ≤ 100, male 68% vs. 57%, *p* = 0.052 | Coronary artery calcification (Agatston score) | (15) |
| Chen *et al.* | United States | 2017 | 1-4 | 1541 | Male more severe | Scores >100 vs. 0-100 vs. 0, male 65.2% vs. 54.3% vs. 41.7%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (16) |
| Chiu *et al* | United States | 2010 | Proteinuric (1-5) | 225 | Neutral | Group 4 (severe) vs. 3 vs. 2 vs. 1, male 61% vs. 64% vs. 47% vs. 45%, *p* = 0.09 | Coronary artery calcification (Agatston score) | (17) |
| Choi *et al.* | Korea | 2019 | 5D (HD) | 97 | Male more likely to progresses | Progression vs. stable, male 50.9% vs. 29.5%, *p* = 0.033 | Lateral lumbar radiography (Kauppila score) | (18) |
| Chue *et al.* | United Kingdom | 2012 | 3 | 120 | Male common | Male vs. Female, 67% vs. 43%, *p* = 0.01 | Lumbar spine lateral radiography | (19) |
| Claes *et al.* | Belgium | 2013 | 5T | 115 | Neutral | No differences in scores between genders | Lateral lumbar radiography (Kauppila score) | (20) |
| Coen *et al.* | Italy | 2006 | 5D (HD) | 132 | Male more severe | Score >1000 vs. 400-1000 vs. 1-400 vs. 0-1, male 74.6% vs. 61.9% vs. 61.3% vs. 38.4%  Scores correlated with male gender (*p* < 0.05) | Coronary artery calcification (Agatston score) | (21) |
| Coll *et al.* | Spain | 2010 | 5D | 232 | Male more common | With vs. without linear calcification, male 65% vs. 41%, *p* = 0.01 | Vascular ultrasound for carotid, femoral, or brachial arteries | (22) |
| Craver *et al* | Spain | 2013 | 3-4 | 178 | Male more severe | Scores >5 vs. 1-5 vs. 0, male 83% vs. 80% vs. 70%, *p* = 0.017 | Lateral lumbar radiography (Kauppila score) | (23) |
| Davis *et al.* | United States | 2016 | 5T | 131 | Neutral | Regression between scores and male gender, r = -0.16~0.051, *p* > 0.05 | Iliac arteries calcification by computed tomography | (24) |
| DeLoach *et al.* | United States | 2009 | 5T | 112 | Neutral | With vs. without, male 68.4% vs. 58.1%, *p* = 0.29 | Coronary artery calcification (Agatston score) and aortic calcification by computed tomography | (25) |
| Di Iorio *et al.* | Italy | 2006 | 4-5, 5D | 44 | Male more severe | Scores >400 vs.<400, male 75% vs. 42%, *p* = 0.05 | Coronary artery calcification (Agatston score) | (26) |
| Disthabanchong *et al.* | Thailand | 2018 | 2-5D, 5T | 419 | Female more severe (subgroup) | AAC score > 6 vs. ≤ 6 in CKD stage 2 -5, male 44.4% vs. 62.6, p < 0.05  In male with stage 5D, 50% vs. 50.5% (P > 0.05)  In male with stage 5T, 67.9% vs. 58.5% (p > 0.05) | Lateral lumbar radiography (Kauppila score) | (27) |
| El Amrani *et al.* | Morocco | 2015 | 5D (HD) | 49 | More male with CAC | With vs. without, male 64.7% vs. 26,6 %, *p* = 0.014 | Coronary artery calcification (Agatston score) | (28) |
| Etta *et al.* | India | 2017 | 4-5 | 95 | Neutral | With vs. without, 70% vs. 71.8%, p = 0.58 | Lumbar spine lateral radiography | (29) |
| Fabbian *et al.* | Italy | 2005 | 5D (HD) | 132 | Neutral | No difference between genders | Aortic arch calcification on chest radiography | (30) |
| Fayed *et al.* | Egypt | 2019 | 5 | 172 | Neutral | Intimal vs. medial vs. none, male 37.9% vs. 64.9% vs. 58.1% | Arterial wall calcification based on intraoperative arterial biopsy | (31) |
| Gunen Yilmaz *et al.* | Turkey | 2019 | 5D (HD) | 60 | Neutral | With vs. without, male 53.3% vs. 53.3%, p = 0.25 | Carotid artery calcification on plain radiography and ultrasound | (32) |
| Harada *et al* | Brazil | 2014 | 2-5 | 117 | Male more severe | Score >0 vs. score =0, male 78.7% vs. 42.9%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (33) |
| He *et al.* | China | 2018 | 5D (HD) | 150 | Neutral | With vs. without, male 61.1% vs. 76.2%, *p* = 0.099 | Lateral lumbar radiography (Kauppila score) | (34) |
| He *et al.* | United States | 2012 | 2-4 | 2018 | Male more severe | Score >100 vs. 0-100 vs. 0, male 63.6% vs. 53.3% vs. 41.9%, *p* < 0.0001 | Coronary artery calcification (Agatston score) | (35) |
| Hou *et al* | Taiwan | 2019 | 5D (HD) | 120 | Neutral | High vs. low, male 52.8% vs. 47.8%, *p* = 0.851 | Pulse wave velocity | (36) |
| Humoud *et al.* | Kuwait | 2005 | 5D | 129 | Neutral | With vs. without, male 58.8% vs. 45.3%, *p* = 0.175 | Hand X-rays | (37) |
| Jankovic *et al* | Serbia | 2017 | 5D (HD) | 90 | Male common | With vs. without, male 66.1% vs. 35.3%, *p* = 0.008 | Forearm AVF plain radiography | (38) |
| Jankovic *et al.* | Serbia | 2015 | 5D (HD) | 90 | Male gender | Scores 8-11 vs. 4-7 vs. 0-3, 76.7% vs. 50% vs. 38.9%, *p* = 0.008 | Plain radiography of pelvis and hands (Adragao score) + forearm AVF plain radiography | (39) |
| Jansson *et al* | Sweden | 2019 | 3-4 | 84 | Neutral | With vs. without, male 79% vs. 67%, *p* = 0.351 | Abdominal aortic calcification on computed tomography | (40) |
| Jean *et al* | France | 2016 | 5D (HD) | 227 | Neutral | Group 3 (severe) vs. 2 vs. 1, male 59.7% vs. 55.6% vs. 59.2%, *p* > 0.05 | Lumbar spine lateral radiography | (41) |
| Jean *et al* | France | 2009 | 5D (HD) | 161 | Male more severe | High score (3) vs. no (score 0), male 77% vs. 45%, *p* < 0.05 | Multi-site plain radiography involving pelvis, lumbar, knee, right hand, right arm, chest, skull, and orthopantomogram | (42) |
| Jean *et al.* | France | 2012 | 5D (HD) | 85 | Neutral | Progression vs. stable, male 56% vs. 48%, *p* > 0.05 | Multi-site plain radiography involving pelvis, lumbar, knee, right hand, right arm, chest, skull, and orthopantomogram | (43) |
| Jiménez Villodres *et al.* | Spain | 2018 | 3 | 139 | Male more common | With and without abdominal aortic calcification, male 80% vs. 63%, *p* < 0.05  With and without KI, male 69% vs. 72%, *p* > 0.05 | Lateral lumbar radiography (Kauppila score) and abdominal aortic calcification on computed tomography | (44) |
| Kahn *et al* | Austria | 2017 | 5T | 205 | Male more severe, segment-specific | Aorta: male vs. female, 2.0 vs. 1.5, *p* = 0.511  Right common iliac artery: male vs. female, 1.0 vs. 1.0, *p* = 0.139  Total iliac artery: male vs. female, 1.00 vs. 0.50, *p* = 0.003  External iliac artery: male vs. female, 1.0 vs. 0.0, *p* <0.001 | Pelvic computed tomography | (45) |
| Keyzer *et al.* | Netherlands | 2015 | 5T | 699 | Neutral | Tertile 1 (severe) vs. 2 vs. 3, male 58% vs. 55% vs. 57%, *p* = 0.73 | T50 (propensity of calcification) | (46) |
| Kim *et al.* | Korea | 2019 | 5D | 47 | Neutral | With vs. without, male 83.3% vs. 69%, *p* = 0.324 | AVF anastomotic segment medial calcification by ultrasound | (47) |
| Kim *et al.* | Korea | 2011 | 5D | 184 | Neutral | Progression vs. stable, 44% vs. 41%, *p* = 0.657 | Aortic arch calcification on chest radiography | (48) |
| Kimura *et al.* | Japan | 1999 | 5D (HD) | 137 | Male more common early during lifetime | With calcification during age 40s, male vs. female 4.0% vs. 3.7%, *p* < 0.01 | Abdominal aortic calcification by computed tomography | (49) |
| Komatsu *et al* | Japan | 2014 | 5D (HD) | 301 | Female common | Grade 2+3 vs. 1 vs. no calcification, male 58.7% vs. 56.3% vs. 77.8%, *p* = 0.0009 | Aortic arch calcification on chest radiography | (50) |
| Lee e*t al* | Taiwan | 2014 | 5D (HD) | 712 | Neutral | Group 3 (severe) vs. 2 vs. 1 vs. none, male 38.1% vs. 42.2% vs. 45.7% vs. 43.8%, *p* = 0.606 | Aortic arch calcification on chest radiography | (51) |
| Lee *et al.* | Taiwan | 2019 | 5D (HD) | 61 | Neutral | With vs. without, male 52% vs. 37%, p = 0.240 | Lateral lumbar radiography (Kauppila score) | (52) |
| Lee *et al.* | Korea | 2006 | 2-5 | 1078 | Male more common | With vs. without, male 73.7% vs. 54.4%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (53) |
| Lioufas *et al.* | Multicenter (IMPROVE-CKD) | 2020 | 3b-4 | 278 | Male more common | With vs. without, male 73% vs. 55%, *p* = 0.02 | Abdominal aortic calcification by computed tomography | (54) |
| Liu *et al.* | China | 2016 | 5D | 41 | Neutral | With vs. without, male 66.67% vs. 59.38%, *p* = 0.993 | Immunohistochemical analysis of radial arterial calcium deposition | (55) |
| Lockhart *et al.* | United States | 2004 | 5D (HD) | 32 | Neutral | Scores high vs. low, male 67% vs. 42%, *p* = 0.28 | Abdominal aorta, common iliac, external iliac and common  femoral artery calcification on computed tomography | (56) |
| London *et al.* | France | 2013 | 5D (HD) | 155 | Neutral | With vs. without, male-to-female ratio 1.38 vs. 1.44, *p* > 0.05 | Common carotid artery calcification by ultrasound | (57) |
| Maharem *et al* | Egypt | 2013 | 5, 5D, 5T | 73 | Neutral | VC presence vs. absence, male 57.9% vs. 31.6%, *p* = 0.056 | Pelvic and hand plain radiography | (58) |
| Mazzaferro *et al.* | Italy | 2007 | 5D, 5T | 100 | Male more severe | Male dialysis vs. male transplant vs. female dialysis vs. female transplant, 1944 vs. 945 vs. 157 vs. 35, *p* < 0.02 | Coronary artery calcification (Agatston score) | (59) |
| Merjanian *et al.* | United States | 2003 | 3-5 | 32 | Male more severe | Male vs female, 619 vs. 232, *p* < 0.001 | Coronary artery calcification (Agatston score) | (60) |
| Miyatake *et al.* | Japan | 2020 | 5T | 50 | Neutral | Male vs. female 1.72 vs. 0.00, *p* > 0.05 | Abdominal aortic calcification by computed tomography | (61) |
| Mizuiri *et al.* | Japan | 2018 | 2-5 | 145 | Neutral | Coronary calcification quartile 4 vs. 3 vs. 2 vs. 1, male 62.9% vs. 64.9% vs. 54.1% vs. 63.9%, *p* > 0.05  Iliac calcification quartile 4 vs. 3 vs. 2 vs. 4, male 58.3% vs. 65.8% vs. 68.6% vs. 52.8%, *p* > 0.05 | Coronary artery calcification (Agatston score) and common iliac artery calcification by computed tomography | (62) |
| Morena *et al* | France | 2009 | 1-5 | 133 | Male common | Severe vs. minor, 73.6% vs. 36.1%, *p* < 0.0001 | Coronary artery calcification (Agatston score) | (63) |
| Munguia *et al.* | Spain | 2015 | 5T | 119 | Neutral | With vs. without, 70% vs. 62.3%, *p* = 0.384 | Lateral lumbar radiography (Kauppila score) | (64) |
| Nitta *et al* | Japan | 2018 | 5D (HD) | 216 | Female more severe | Group 3 (severe) vs. 2 vs. no calcification, female 47.5% vs. 40.9% vs. 23.1%, *p* < 0.0001 | Aortic arch calcification on chest radiography | (65) |
| Niu *et al.* | China | 2019 | 5D (PD) | 150 | Neutral | With vs. without, male 51.65% vs. 49.15%, *p* = 0.765 | Plain films of lateral abdomen, frontal pelvic, and both hands for abdominal aorta, iliac, femoral, radial, and digital arteries | (66) |
| Niu *et al.* | China | 2019 | 5D (HD) | 56 | Neutral | Progression score >500 vs. 100–500 vs. <100, male 70.7% vs. 73.7% vs. 59.3%, *p* = 0.572 | Coronary artery calcification (Agatston score) | (67) |
| Okamoto *et al* | Japan | 2018 | 5D (HD) | 184 | Male more likely to worsen | Annual progression rapid vs. slow, male 53% vs. 27%, *p* = 0.008 | Abdominal aorta calcification on computed tomography | (68) |
| Petrovic *et al.* | Serbia | 2020 | 5D (HD) | 80 | Neutral | PWV >8.8 vs. ≤8.8 m/s, male 20% vs. 14%, *p* = 0.119 | Pulse wave velocity | (69) |
| Qureshi *et al* | Sweden | 2015 | 5T | 89 | Male more severe | Moderate-severe vs. non-minimal, male 76% vs. 54%, *p* = 0.04 | Biopsy-verified calcification in epigastric arteries | (70) |
| Raggi *et al.* | United States | 2011 | 5D (HD) | 144 | Neutral | Number of calcified valves 2 vs. 1 vs. 0, male 61.1% vs. 44.7% vs. 45.9%, *p* = 0.19 | Calcified cardiac valves on computed tomography | (71) |
| Renaud *et al.* | France | 1988 | 5D (HD) | 24 | Male more likely to worsen | Correlation coefficient for male vs. annual calcification increase = 1.97, *p* < 0.01 | Lumbosacral radiography for linear calcifications involving the abdominal aorta, iliac and femoral arteries | (72) |
| Ribeiro *et al.* | Portugal | 1998 | 5D (HD) | 92 | Neutral | No difference between genders | Calcified cardiac valves on computed tomography | (73) |
| Roca-Tey *et al.* | Spain | 2009 | 5D (HD) | 45 | Neutral | With vs. without, male 81.5% vs. 55.6%, *p* = 0.09 | Arteriovenous fistula calcification on computed tomography | (74) |
| Schlieper *et al* | Serbia | 2008 | 5D (HD) | 212 | Male common | With vs. without, male 78% vs. 47%, *p* < 0.0001 | Vascular access calcification on plain radiography | (75) |
| Shu *et al* | Taiwan | 2012 | 5T | 99 | Male more severe | Group 5 (severe) vs. 4 vs. 3 vs. 2 vs. 1, male 66.7% vs. 53.3% vs. 63.6% vs. 65.0 vs. 29.3%, *p* = 0.027 | Coronary artery calcification (Agatston score) | (76) |
| Sigrist *et al.* | United Kingdom | 2006 | 4-5D | 134 | Male more severe | Tertiles 3 vs. 2 vs. 1, male 81% vs. 71% vs. 46%, *p* < 0.001 | Superficial femoral artery calcification by computed tomography | (77) |
| Strózecki *et al.* | Poland | 2005 | 5D (HD) | 65 | Neutral | With vs. without, male 43.8% vs. 48.5%, *p* > 0.05 | Calcified cardiac valves on ultrasound | (78) |
| Tangvoraphonkchai *et al.* | United States | 2019 | 5D (PD) | 24 | Male gender (%) | Stable PWV vs. increased PWV, male 33% vs. 75% | Pulse wave velocity | (79) |
| Tomiyama *et al.* | Brazil | 2010 | 2-4 | 50 | Male more common | With vs. without, male 79% vs. 47%, *p* = 0.02 | Coronary artery calcification (Agatston score) | (80) |
| Turan *et al* | Turkey | 2016 | 5D (HD) | 224 | Male more severe | Group 4 (severe) vs. 3. vs. 2 vs. no calcification, male 56% vs. 59% vs. 38% vs. 41%, *p* = 0.003 | Coronary artery calcification (Agatston score) | (81) |
| Wang *et al.* | Hong Kong | 2014 | 3-5 | 300 | Male more severe | Scores ≥400 vs. 100–399 vs. 1–99 vs. 0, male 77.3% vs. 56.9% vs. 57.5% vs. 38.7%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (82) |
| Wang *et al.* | Hong Kong | 2003 | 5D (PD) | 192 | Neutral | With vs. without, male 50.0% vs. 51.5%, *p* = 0.842 | Calcified cardiac valves on ultrasound | (83) |
| Wu *et al.* | Taiwan | 2017 | 5D (PD) | 190 | Neutral | Grade 3 vs. 2 vs. 1 vs. 0, male 37.0% vs. 58.3% vs. 40.4% vs. 43.8%, *p* = 0.293 | Aortic arch calcification on chest radiography | (84) |
| Yoshikawa *et al.* | Japan | 2013 | 5D (HD) | 134 | Male more common | β = -0.20, *p* = 0.008 | Abdominal aorta calcification on computed tomography | (85) |
| Zhou *et al.* | Sweden | 2018 | 1-5 | 151 | Male more common | Male vs. female: 76% vs. 69%, *p* < 0.05 | Lateral lumbar radiography (Kauppila score) | (86) |
| Abd Alamir *et al.* | United States | 2015 | 2-3 | 2070 | Neutral | With vs. without, male 49.6% vs. 54.5%, *p* = 0.1 | Mitral annular calcification by coronary computed tomography | (87) |
| Adragao *et al.* | Portugal | 2004 | 5D (HD) | 123 | Male more severe | Score ≥3 vs. <3, female 22% vs. 58%, *p* < 0.001 | Plain radiography of pelvis and hands (Adragao score) | (88) |
| Bundy *et al* | United States | 2019 | 2-4 | 1274 | Neutral | Quartiles 4 vs. 3 vs. 2 vs. 1, female 46% vs. 45% vs. 49% vs. 47% | T50 (propensity of calcification) | (89) |
| Chae *et al.* | Korea | 2018 | 1-5 | 1832 | Neutral | Quartile 4 vs. 3 vs. 2 vs. 1, female 38.1% vs. 37.0% vs. 41.3% vs. 44.3%, *p* = 0.101 | Pulse wave velocity | (90) |
| Claes *et al.* | Belgium | 2013 | 5T | 115 | Neutral | Prevalence male vs. female, 61% vs. 50.7%, *p* = 0.16 | Lateral lumbar radiography (Kauppila score) | (20) |
| Dai *et al* | Sweden | 2020 | 5 | 152 | Male more severe | Moderate to extensive vs. no to minimal, male 81% vs. 56%, *p* = 0.002 | Histopathology of epigastric artery calcification | (91) |
| Floege *et al.* | Multicenter | 2010 | 5D (HD) | 360 | Neutral | Score ≥ 1000 vs. 400-999 vs. 30-399, 65% vs. 55% vs. 51% | Coronary artery calcification (Agatston score) | (92) |
| Gelev *et al.* | Macedonia | 2008 | 5D (HD) | 150 | Male more common, especially intimal | VC prevalence: male vs. female, 87.9% vs. 61.0%, *p* < 0.03  Intimal VC: male vs. female, 53.8% vs. 32.2%, *p* < 0.02  Medial VC: male vs. female, 34.1% vs. 28.8%, *p* > 0.05 | Pelvic antero-posterior radiography | (93) |
| Kestenbaum *et al.* | United States | 2009 | 3-5 | 562 | Male more common | With vs. without, male 45% vs. 29%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (94) |
| Maia *et al.* | Brazil | 2018 | 5D (HD) | 309 | Female more common | With vs. without, male 44.9% vs. 60.8%, *p* = 0.039 | Carotid artery calcification on panoramic radiographs | (95) |
| Maréchal *et al.* | Belgium | 2012 | 5T | 197 | Male more likely to worsen | Rapid progressor vs. slow progressor vs. non-progressor, male 66% vs. 65% bs. 45%, *p* = 0.02 | Coronary artery calcification (Agatston score) and thoracic artery calcification by computed tomography | (96) |
| Moldovan *et al.* | Romania | 2010 | 5D (HD) | 81 | Neutral | With vs. without, male 63.2% vs. 41.7%, *p* = 0.44 | Plain radiography of pelvis and hands (Adragao score) | (97) |
| Muntner *et al.* | United States | 2006 | 5D (HD) | 148 | Neutral | Score ≥ 1000 vs. 400-999 vs. 100-399 vs. 1-99 vs. 0, female 45.5% vs. 46.4% vs. 50% vs. 61.8% vs. 50%, *p* = 0.184 | Coronary artery calcification (Agatston score) | (98) |
| Porter *et al.* | United Kingdom | 2007 | 3-4 | 112 | Male more common | In non-diabetic group, VC prevalence in male vs. female, 60% vs. 26%, *p* = 0.003 | Coronary artery calcification (Agatston score) | (99) |
| Wang *et al* | China | 2019 | 5D (HD) | 108 | Neutral | Severe vs. mild vs. none, male 30% vs. 23.1% vs. 43.8%, *p* = 0.08 | Abdominal aortic calcification (Kauppila score) | (100) |
| Wang *et al.* | China | 2014 | 5D (HD) | 77 | Male more common | Score >400 vs. 11-400 vs. <10, male 67.8% vs. 53.8% vs. 26.1%, *p* < 0.001 | Coronary artery calcification (Agatston score) | (101) |

*AAC, abdominal aortic calcification; CKD, chronic kidney disease; HD, hemodialysis; LAD, left anterior descending; PD, peritoneal dialysis; VC, vascular calcification*

Table 2. Gender-related risk of vascular calcification in existing studies

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Authors | Country | Time | CKD stages | Sample size | Findings | Results | Calcification assessment method | Ref |
| Abd Alamir *et al.* | United States | 2015 | 2-3 | 2070 | Neutral | Female OR 1.21 (0.94–1.56) | Mitral annular calcification by coronary computed tomography | (87) |
| Adragao *et al.* | Portugal | 2004 | 5D (HD) | 123 | Male at risk for severe disease | Score ≥ 3 OR 7.47 (2.9–19.1) | Plain radiography of pelvis and hands (Adragao score) | (88) |
| Bellasi *et al* | United States | 2008 | 5D | 142 | Male at risk (subgroup) | For coronary artery calcification, male β = 735.82, p = 0.0366  For thoracic aorta, gender *p* > 0.05 | Coronary artery calcification (Agatston score) and thoracic aorta calcification | (102) |
| Budoff *et al.* | United States | 2011 | 2-3A | 1908 | Male at risk | Female OR 0.43 (0.35-0.53) | Coronary artery calcification (Agatston score) | (103) |
| Cai *et al.* | China | 2015 | 5D (HD) | 129 | Neutral | Male OR 0.549 (0.113–2.661), *p* = 0.456 | Lateral lumbar radiography | (104) |
| Chen *et al.* | Sweden | 2017 | 5D, 5T | 240 | Male at risk | β = 0.35, *p* = 0.008 | Coronary artery calcification (Agatston score) | (15) |
| Chiu *et al.* | United States | 2010 | Proteinuric (1-5) | 225 | Male at risk | Male with significantly higher probability of more severe VC (*p* = 0.01) | Coronary artery calcification (Agatston score) | (17) |
| Chue *et al* | United Kingdom | 2012 | 3 | 120 | Male at risk | Female β = -0.34 (-13.45– -4.48) | Lumbar spine lateral radiography | (19) |
| Coll *et al.* | Spain | 2010 | 5D | 232 | Neutral | Male OR 1.57 (0.69–3.55), *p* = 0.27 | Vascular ultrasound for carotid, femoral, or brachial arteries | (22) |
| Craver *et al.* | Spain | 2013 | 3-4 | 178 | Male at risk | For AAC severity, male β = 1.237 (0.058-2.417), *p* = 0.04  For severe AAC, in all patients, male OR 4.218 (1.403-14.207), p = 0.014  For severe AAC, in eGFR < 30: OR 4.167 (1.050-20.178) | Abdominal aortic calcification (Kauppila score) | (23) |
| Dai *et al* | Sweden | 2020 | 5 | 152 | Male at risk | Male OR 6.67 (2.53–17.58) | Histopathology of epigastric artery calcification | (91) |
| Evenpoel *et al.* | Belgium | 2015 | 5T | 268 | Male at risk | For coronary calcification, female β = -0.64, *p* < 0.0001  For thoracic aortic calcification, female β = -0.32, *p* = 0.008 | Coronary artery calcification (Agatston score) and thoracic aortic calcification | (105) |
| Fayed *et al.* | Egypt | 2019 | 5D (HD) | 81 | Neutral | Male β = 0.088, *p* = 0.695 | Abdominal aortic calcification by computed tomography | (106) |
| Filgueira *et al.* | Brazil | 2011 | 2-4 | 72 | Neutral | Female OR 0.149, *p* = 0.82 | Coronary artery calcification (Agatston score) | (107) |
| Floege *et al.* | Multicenter | 2010 | 5D (HD) | 360 | Male at risk for severe disease | Male β = 0.426, *p* = 0.0011 | Coronary artery calcification (Agatston score) | (92) |
| Fusaro *et al.* | Italy | 2015 | 5D (HD) | 314 | Neutral | Male OR 1.52 (0.87–2.66), *p* = 0.1 | Lateral lumbar radiography | (108) |
| Golembiewska *et al.* | Sweden | 2020 | 5, 5D | 149 | Male at risk | Male OR 4.4 (1.6–11.1), *p* = 0.003 | Inferior epigastric artery histopathology calcification grading | (109) |
| Gruppen *et al.* | Dutch | 2003 | 5D | 140 | Neutral | Male *p* > 0.05 | Aortic valve calcification on ultrasound | (110) |
| Harada *et al.* | Brazil | 2014 | 2-5 | 117 | Male at risk | Male OR 4.92 (2.07–11.70), *p* < 0.01 | Coronary artery calcification (Agatston score) | (33) |
| Ho et al. | Taiwan | 2019 | 5D | 61 | Male at risk | Male β= 1688.01, *p* = 0.02 | Coronary artery calcification (Agatston score) | (111) |
| Ishimura *et al.* | Japan | 2004 | 5D (HD) | 594 | Male at risk | For aortic calcification, male OR 2.339 (1.466–3.732), *p* = 0.0004  For hand artery calcification, male OR 1.857 (1.043–3.306), *p* = 0.0355 | Plain radiography of lateral abdomen and hand | (112) |
| Ishimura *et al.* | Japan | 2002 | 5D (HD) | 421 | Male at risk (subgroup) | In diabetics, male OR 3.38 (1.289-8.860), *p* = 0.0019  In non-diabetics, male OR 1.328 (0.252-6.997), *p* = 0.7376 | Digital artery calcification by hand radiography | (113) |
| Jankovic *et al.* | Serbia | 2017 | 5D (HD) | 90 | Male at risk and for severe disease | For VC presence, female OR 0.134 (0.04–0.45), *p* = 0.001  For VC severity, female β = –0.432 (-4.41– -1.86), *p* < 0.001 | Forearm AVF plain radiography | (38) |
| Jankovic *et al.* | Serbia | 2015 | 5D (HD) | 90 | Male at risk for severe disease | Composite calcification score, female β = -0.432, *p* < 0.001 | Plain radiography of pelvis and hands (Adragao score) + forearm AVF plain radiography | (39) |
| Jansson *et al.* | Sweden | 2019 | 3-4 | 84 | Neutral for overall risk but  male at risk for severe disease | Among total cohort, male not associated with AAC  Among those with AAC, male β = 0.413, *p* = 0.03 | Abdominal aortic calcification by computed tomography | (40) |
| Jean *et al* | France | 2009 | 5D (HD) | 161 | Neutral | Female OR 0.79 (0.3 – 1.8), *p* = 0.5 | Multi-site plain radiography involving pelvis, lumbar, knee, right hand, right arm, chest, skull, and orthopantomogram | (42) |
| Jean *et al.* | France | 2012 | 5D (HD) | 85 | Neutral | For calcification progression, female OR 0.51 (0.185–1.426), *p* = 0.2 | Multi-site plain radiography involving pelvis, lumbar, knee, right hand, right arm, chest, skull, and orthopantomogram | (43) |
| Jung *et al.* | South Korea | 2006 | 5D (HD) | 40 | Male at risk for progression | For calcification progression, male β = 1.365, *p* = 0.04 | Coronary artery calcification (Agatston score) | (114) |
| Kestenbaum *et al.* | United States | 2009 | 3-5 | 562 | Male at risk but not for progression | For VC presence, incidence rate ratio (IRR) 2.27 (1.26–4.09), *p* = 0.006  For VC progression, incidence rate ratio 1.10 (0.84-1.42), *p* = 0.5 | Coronary artery calcification (Agatston score) | (94) |
| Maia *et al.* | Brazil | 2018 | 5D (HD) | 309 | Female at risk | Female prevalence ratio 2.004 (1.012 –3.966) | Carotid artery calcification on panoramic radiographs | (95) |
| Manghat *et al.* | United Kingdom | 2011 | 1-4 | 145 | Neutral, but male at risk (in subgroup) | Overall, male β = 0.06, *p* =0.54  In those with CKD stage 4, male β = 0.29, t =2.04, *p* =0.049 | Pulse wave velocity based on a stiffness index | (115) |
| Maréchal *et al.* | Belgium | 2012 | 5T | 197 | Differential effect depending on calcification site | For coronary calcification, female progression, *p* > 0.05  For thoracic aortic calcification, female progression β = -0.09 (-0.17~-0.01), *p* = 0.03 | Coronary artery calcification (Agatston score) and thoracic artery calcification by computed tomography | (96) |
| Mazzaferro *et al.* | Italy | 2007 | 5D, 5T | 100 | Male at risk | Male OR 10.5 (3.2–34.4), *p* < 0.0001 | Coronary artery calcification (Agatston score) | (59) |
| Miyatake *et al.* | Japan | 2020 | 5T | 50 | Neutral | Female β = -0.051, p = 0.741 | Abdominal aortic calcification by computed tomography | (61) |
| Moldovan *et al.* | Romania | 2010 | 5D (HD) | 81 | Male at risk | Male OR 7.226 (1.138–45.882), *p* = 0.036 | Plain radiography of pelvis and hands (Adragao score) | (97) |
| Morena *et al.* | France | 2009 | 1-5 | 133 | Male at risk | Male OR 4.95 (2.36–10.37), *p* < 0.0001 | Coronary artery calcification (Agatston score) | (63) |
| Muntner *et al.* | United States | 2006 | 5D (HD) | 148 | Neutral | Prevalence rate ratio 1.37 (0.72–2.62) | Coronary artery calcification (Agatston score) | (98) |
| Nakayama *et al.* | Japan | 2013 | 5D (HD) | 47 | Male at risk | Female β = -0.407, *p* = 0.014 | Abdominal aortic calcification by computed tomography | (116) |
| Nishizawa *et al.* | Japan | 2015 | 5D (HD) | 207 | Neutral | Male β = -0.095, p = 0.174 | Coronary artery calcification (Agatston score) | (117) |
| Nishizawa *et al.* | Japan | 2004 | 5D (HD) | 332 | Male at risk | Male OR 3.380 (1.289-8.860), *p* = 0.0019 | Digital artery calcification by hand radiography | (118) |
| Nitta *et al.* | Japan | 2018 | 5D (HD) | 216 | Female at risk | Female β = 0.137 (0.021–0.254), *p* = 0.0206 | Aortic arch calcification on chest radiography | (65) |
| Okamoto *et al.* | Japan | 2018 | 5D (HD) | 184 | Male at risk for progression | Male OR 3.29 (1.27–8.53), *p* = 0.014 | Abdominal aorta calcification by computed tomography | (68) |
| Tamashiro *et al.* | Japan | 2002 | 5D (HD) | 24 | Male at risk progression | Male gender significant correlation with calcification progression | Pelvic and lumbar lateral radiography | (119) |
| Pateinakis *et al.* | Greece | 2013 | 5D (HD) | 81 | Neutral | β = -0.128, *p* = 0.15 | Pulse wave velocity | (120) |
| Porter *et al.* | United Kingdom | 2007 | 3-4 | 112 | Male at risk | Male OR 43.713 (2.92–654.0), *p* = 0.006 | Coronary artery calcification (Agatston score) | (99) |
| Qureshi *et al.* | Sweden | 2015 | 5T | 89 | Differential effect depending on calcification site | For epigastric artery, male RR 1.82 (1.03–1.16), *p* = 0.03  For coronary artery, male RR 0.83 (0.38-1.81), *p* = 0.63 | Biopsy-verified calcification in epigastric arteries and coronary artery calcification (Agatston score) | (70) |
| Raggi *et al.* | United States and Europe | 2002 | 5D (HD) | 205 | Differential effect depending on calcification site | For coronary artery calcification, female β = -0.587547, *p* = 0.0167  For aortic calcification, female β = -0.044508, *p* = 0.9036 | Coronary artery calcification (Agatston score) and aortic calcification by computed tomography | (121) |
| Schlieper *et al* | Serbia | 2008 | 5D (HD) | 212 | Male at risk | Male OR 3.95 (1.89–8.27), *p* = 0.0001 | Vascular access calcification by plain radiography | (75) |
| Schlieper *et al.* | Serbia | 2009 | 5D (HD) | 194 | Male at risk | For composite score, male OR 2.32 (1.19–4.52), *p* = 0.014  For Adragao score, male OR 2.75 (1.41–5.38), *p* = 0.003 | Plain radiography of pelvis and hands (Adragao score) + forearm AVF plain radiography + Cardiac ultrasound + Carotid ultrasound | (122) |
| Schlieper *et al.* | Serbia | 2008 | 5D (HD) | 212 | Male at risk | Male OR 5.08 (2.18–11.86), *p* = 0.0001 | Vascular access calcification on plain radiography | (75) |
| Sharma *et al.* | United Kingdom | 2007 | 5D | 140 | Neutral | Female OR 0.45 (0.16–0.81), *p* = 0.53 | Mitral annular calcification by cardiac ultrasound | (123) |
| Shu *et al.* | Taiwan | 2012 | 5T | 99 | Male at risk | Female β = -1.61, *p* = 0.0021 | Coronary artery calcification (Agatston score) | (76) |
| Sigrist *et al* | United Kingdom | 2007 | 4-5D | 134 | Male at risk for progression | For calcification progression at 2-yr, male OR 8.82 (1.82 to 42.65), *p* = 0.007 | Superficial femoral artery calcification by computed tomography | (77) |
| Sigrist et al. | United Kingdom | 2006 | 4-5D | 134 | Male at risk | Female β = -2.108, *p* < 0.001 | Superficial femoral artery calcification by computed tomography | (124) |
| Stavroulopoulos *et al.* | United Kingdom | 2011 | 3-4 | 112 | Male at risk for progression | Progression at 2-yr, male OR 27.808 (1.625–475.97), *p* = 0.022 | Coronary artery calcification (Agatston score) | (125) |
| Sumida *et al.* | Japan | 2010 | 5D | 135 | Neutral | Gender not associated with calcification | Carotid artery calcification by computed tomography | (126) |
| Tamei *et al.* | Japan | 2011 | 5D (HD) | 127 | Male at risk for progression | Progression at 5-yr, male β = 0.969, *p* = 0.0192 | Aortic arch calcification by chest radiography | (127) |
| Turan *et al.* | Turkey | 2016 | 5D (HD) | 224 | Male at risk | Male RR 4.14 (2.01–8.51), *p* < 0.001 | Coronary artery calcification (Agatston score) | (81) |
| Turan *et al.* | Turkey | 2013 | 5D (HD) | 191 | Male at risk | Male RR 2.79 (1.30–5.98), *p* = 0.008 | Coronary artery calcification (Agatston score) | (128) |
| Vipattawat *et al.* | Thailand | 2014 | 5, 5D,5T | 261 | Neutral | For 5T patients, OR 2.49 (0.87–7.14), *p* = 0.09  For 5 and 5D patients, OR 2.02 (0.71-5.78), *p* = 0.19 | Pelvic and lumbar spine lateral radiography | (129) |
| Wang *et al* | China | 2019 | 5D (HD) | 108 | Neutral | Female OR 0.56 (0.15–2.06), *p* = 0.38 | Abdominal aortic calcification (Kauppila score) | (100) |
| Wang *et al.* | China | 2014 | 5D (HD) | 77 | Male at risk | female OR 0.21 (0.07–0.58), *p* = 0.003 | Coronary artery calcification (Agatston score) | (101) |
| Yamada *et al.* | Japan | 2008 | 5D (HD) | 49 | Male at risk | Female β = -0.178, *p* = 0.0345 | Digital artery calcification by hand radiography | (130) |

*AAC, abdominal aortic calcification; AVF, arteriovenous fistula; CKD, chronic kidney disease; HD, hemodialysis; OR, odds ratio; RR, relative risk; VC, vascular calcification*

Table 3. Potential gender-related modifiers of vascular calcification in existing studies

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Authors | Country | Time | CKD stages | Sample size | Gender Effect | Data | Potential modifiers | Ref |
| Aoun *et al.* | Lebanon | 2017 | 5D (HD) | 50 | Male lower | <5000 vs. >5000 pmol/L, male 68.3% vs. 22.2%, *p* = 0.02 | Dp-ucMGP | (131) |
| Axelsson *et al.* | Sweden | 2008 | 5 | 198 | Male lower | Male β = –1.68, *p* < 0.001 | Total fat mass | (132) |
| Block et al. | United States | 1998 | 5D (HD) | 6407 | Female higher | Male OR 0.774, *p* = 0.0001 | Serum phosphorus > 6.5 mg/dL | (133) |
| Buiten MS | Netherlands | 2014 | 5D | 127 | Female higher | <460 vs. >460 pg/mL, female 16% vs 31%, *p* < 0.05 | Soluble Klotho | (134) |
| Cai *et al.* | China | 2015 | 5D (HD) | 129 | Neutral | ≤379 vs. 379-613 vs. 613-817 vs. >817 pg/mL, male 59.4% vs. 54.5% vs. 56.3% vs. 53.1%, *p* > 0.05 | Soluble Klotho | (104) |
| Chae *et al.* | Korea | 2018 | 1-5 | 1832 | Neutral | Quartile 1 (lowest) vs. 2 vs. 3 vs. 4, female 36.2% vs. 43.4% vs. 42.5% vs. 38.6%, *p* = 0.517 (mean, 6.76 pmol/L) | OPG | (90) |
| Chang et al. | Republic of Korea | 2012 | 5D (HD) | 289 | Female lower levels | Female OR 3.892 (1.678–9.025), *p* = 0.002 | Vitamin D (25-OH-D) deficiency (<15 ng/mL) | (11) |
| Chao *et al.* | Taiwan | 2019 | 5D | 223 | Neutral | High vs. low levels, female 63% vs. 51%, *p* = 0.14 | microRNA-125b | (135) |
| Chen *et al* | Sweden | 2017 | 5D, 5T | 240 | Neutral | Users vs. non-users, male 65% vs. 62%, *p* = 0.678 | Statin use | (15) |
| Chen *et al.* | Taiwan | 2013 | 5D (HD) | 238 | Neutral | Tertile 1 (lowest) vs. 2 vs. 3, female 55% vs. 48% vs. 57%, *p* = 0.5 | Fetuin-A | (136) |
| Choi *et al.* | Korea | 2019 | 5D (HD) | 97 | Neutral | Marker count 2 vs. 1 vs. 0, male 61.5% vs. 41.9% vs 34.1%, *p* = 0.216 | Nutritioon (albumin) and inflammation (CRP) markers | (18) |
| Claes *et al.* | Belgium | 2013 | 1-5 | 154 | Male higher | Male gender significantly associated with higher levels (*p* = 0.006) | Sclerostin | (137) |
| Evenpoel *et al.* | Belgium | 2015 | 5T | 268 | Male higher | Male gender significantly associated with higher levels (*p* = 0.002) | Sclerostin | (105) |
| Flávia Letícia et al. | Brazil | 2014 | 5D (HD) | 91 | Neutral | High vs low levels, male 68.9% vs. 52.2%, *p* = 0.103  Regression model, male OR 0.82 (0.39-1.75), *p* = 0.62 | Sclerostin | (138) |
| Golembiewska *et al.* | Sweden | 2020 | 5 | 149 | Neutral | High vs. middle vs. low levels, male 71% vs. 67% vs. 65%, *p* = 0.84  Regression model, male β -0.08, *p* = 0.31 | Copeptin | (109) |
| González-Parra E *et al.* | Spain | 2015 | 1-5 | 704 | Female higher in both | For PTH, male r = −0.084 (-0.155~-0.012), *p* = 0.0215  For FGF-23, male r = −0.191 (-0.301~-0.080), *p* = 0.0007 | Parathyroid hormone and FGF-23 | (139) |
| Gupta *et al* | Hungary | 2021 | 5D (HD) | 982 | Female higher | <3.2 vs. 3.2–4.39 vs. >4.39 pmol/L, male 63% vs. 57% vs. 52%, *p* = 0.015 | OPG | (140) |
| Harada *et al* | Brazil | 2014 | 2-5 | 117 | Male more severe | Area in males vs. females, 220.4 ± 110.5 vs. 135.4 ± 76.0, *p* < 0.001 | Pericardial fat | (33) |
| He *et al.* | China | 2018 | 5D (HD) | 150 | Neutral | Male correlation coefficient 0.106, *p* = 0.114 | Serum irisin | (34) |
| Holden *et al.* | Canada | 2014 | 3-5 | 167 | Neutral | CC vs. CG/GG, male 68% vs. 55%, *p* = 0.11 | VKORC1 (vitamin K epoxide reductase complex 1) polymorphism | (141) |
| Hou *et al.* | Taiwan | 2019 | 5D (HD) | 120 | Female lower | 72.97-237.13 vs. 237.36-323.54 vs. 329.61-835.78 pg/L, female 62.5% vs. 55.0% vs. 32.5%, *p* = 0.008 | OPG | (36) |
| Ikee *et al.* | Japan | 2016 | 5D (HD) | 86 | Neutral | Male vs. female, 2.51 ± 0.38 vs. 2.42 ± 0.33, *p* = 0.52 | Serum magnesium | (142) |
| Jean *et al.* | France | 2008 | 5D (HD) | 253 | Female lower levels | Deficient vs. sufficient, female 53% vs. 28%, *p* < 0.05 | Vitamin D (25-OH-D) deficiency | (143) |
| Jean *et al.* | France | 2011 | 5D (HD) | 1138 | Neutral | <50 vs. ≥50 pg/mL, female 43% vs. 40%, *p* > 0.05 | Parathyroid hormone | (144) |
| Jean *et al.* | France | 2016 | 5D (HD) | 227 | Female lower | Female OR 0.16 (0.075−0.362) | Sclerostin | (41) |
| Karsli Ceppioğlu *et al.* | Turkey | 2011 | 3-5 | 84 | Female higher | Female vs. male, higher in the former, *p* = 0.002 | Serum copper | (145) |
| Kato *et al.* | Japan | 2009 | 5D (HD) | 68 | Neutral | No correlation with gender | Serum pre-B cell colony-enhancing factor/visfatin | (146) |
| Kuo et al. | Taiwan | 2019 | 5D (PD) | 89 | Male higher | <80.2 vs. ≥80.2 pmol/L, male 36.4% vs. 62.2%, *p* = 0.015  Male OR 2.882 (1.219–6.815), p = 0.016 | Sclerostin | (147) |
| Liabeuf *et al.* | France | 2013 | 2-5, 5D | 139 | Neutral | ≤0.041 vs. >0.041 mg/dL, male 63% vs. 57%, *p* = 0.5 | Free p-cresylglucuronide | (148) |
| Metry *et al.* | Sweden | 2008 | 5D (HD) | 222 | Neutral | High Fetuin-A/Low CRP vs. High Fetuin-A/High CRP vs. Low Fetuin-A/Low CRP vs. Low Fetuin-A/High CRP, 60.9% vs. 52.5% vs. 44.4% vs. 58.8%, *p* > 0.05 | Fetuin-A and CRP | (149) |
| Miyatake *et al.* | Japan | 2020 | 5T | 50 | Female higher HDL, adiponectin but lower LDL | For LDL-C, male vs. female 113.0 (97.0–132.5) vs. 90.0 (76.5–98.3), *p* < 0.01  For HDL-C, male vs. female 57.0 (51.0–67.0) vs. 78.0 (66.8–96.5), *p* < 0.01  For HMW-ADPN, male vs. female 2.48 (1.62–3.33) vs. 4.52 (3.02–6.79), *p* < 0.01  For LMW-ADPN, male vs. female 1.67 (1.14–1.89) vs. 2.26 (1.85–2.83), *p* < 0.01  For CTRP9, male vs. female 2.08 (2.01–2.13) vs. 2.03 (2.00–2.07), *p* > 0.05 | Lipid profile, circulating C1q/TNF-a related protein-9 (CTRP9), and adiponectin | (61) |
| Nakashima *et al.* | Japan | 2010 | 5D (HD) | 151 | Neutral | Male β = 0.531, *p* = 0.51 | Osteoprotegerin | (150) |
| Nemeth *et al*. | Hungary | 2015 | 5T | 993 | Male lower | <3.2 vs. 3.2–4.39 vs. >4.39 pmol/L, male 63% vs. 58% vs. 52%, *p* = 0.02 | Osteoprotegerin | (151) |
| Nishiura *et al.* | Japan | 2009 | 5D (HD) | 99 | Male higher | Low vs. high, male 56% vs. 75.5%, *p* = 0.057  Male HR 3.034 (1.028–8.948), *p* = 0.044 | Osteoprotegerin | (152) |
| Okamoto *et al.* | Japan | 2018 | 5D (HD) | 230 | Neutral | <0.213 vs. ≥0.213 g/L, male 61% vs. 68%, *p* = 0.400  Male OR 0.48 (0.22-1.02), *p* = 0.056 | Fetuin-A | (153) |
| Park *et al.* | Korean | 2018 | 1-5 | 1741 | Neutral | Quartile 1 (lowest) vs. 2 vs. 3 vs. 4, male 80.6% vs. 59.0% vs. 39.7% vs. 39.6, *p* < 0.001  Male β = 0.095 (-0.421~0.231), *p* = 0.566 | ECF excess | (154) |
| Ramalho *et al* | Brazil | 2019 | 3-4 | 356 | Neutral | Tertile 1 (lowest) vs. 2 vs. 3, 59% vs. 64% vs.66%, *p* = 0.5  Male β = 0.22 (-0.02~0.45), *p* = 0.07 | Urinary calcium excretion | (155) |
| Scialla *et al.* | United States | 2011 | 1-5 | 351 | Female higher | 1.21-5.03 vs. 5.05-7.45 vs. 7.46-22.31 pmol/L, female 24.8% vs. 26.5% vs. 40.2%, *p* = 0.02  Female related OPG % difference 10.2%, *p* = 0.05 | Osteoprotegerin | (156) |
| Schlieper *et al.* | Serbia | 2011 | 5 | 188 | Neutral | <6139 vs. >6139 pmol/L, female OR 0.62 (0.35–1.11), *p* = 0.11 | dp-cMGP | (157) |
| Sigrist *et al.* | United Kingdom | 2009 | 3-4 | 134 | Neutral | ≤25 vs. >25 pmol/L, male 63% vs. 70%, *p* = 0.47 | Osteoprotegerin | (158) |
| Stenvinkel *et al.* | Sweden | 2005 | 5 | 258 | Neutral | Male vs. female, median 0.225 vs. 0.223 g/L, *p* > 0.05 | Fetuin-A | (159) |
| Stolic *et al.* | Serbia | 2016 | 5D (HD) | 88 | Neutral | Male vs. female, mean 1.2 (0.7–1.6) vs. 1.2 (0.8–1.5) mmol/L, *p* = 0.896 | Magnesium | (160) |
| Thambiah *et al.* | United Kingdom | 2012 | 3B-4 | 77 | Male higher | Male vs. female, mean 50.5 vs. 34 pmol/L, *p* = 0.015  Male β = 0.23, p = 0.024 | Sclerostin | (161) |
| Turan *et al.* | Turkey | 2016 | 5D (HD) | 224 | Neutral | <35.5 vs. 35.5-123.4 vs. >123.4 pg/mL, male 56.6% vs. 46.5% vs. 50.0%, *p* = 0.38 | FGF-23 | (81) |
| Turan *et al.* | Turkey | 2013 | 5D (HD) | 191 | Neutral | Low vs. middle vs. high, female 46% vs. 39% vs. 58%, *p* = 0.1 | Epicardial fat | (128) |
| Ulusoy *et al.* | Turkey | 2012 | 5D (HD) | 103 | Male higher | Pre-dialysis male vs. female levels, 314.7 ± 157.1 vs. 210.4 ± 115.4 ng/mL, *p* < 0.001 | Signal peptide-CUB-EGF domain-containing protein 1 (SCUBE1) | (162) |
| Viaene *et al.* | Belgium | 2013 | 5D (HD) | 100 | Neutral | Low vs. high, female 47% vs. 35%, *p* = 0.2 | Sclerostin | (163) |
| Wang *et al.* | Hong Kong | 2014 | 3-5 | 300 | Male lower | Male correlation coefficient -0.14, *p* = 0.02 | Tissue AGEs (surrogated by skin autofluorescence) | (82) |
| Yoshikawa *et al.* | Japan | 2013 | 5D (HD) | 134 | Neutral | CC vs. CT vs. TT genotype, male 14% vs. 48% vs. 33%, *p* = 0.53 | MGP Genotype T-138C | (85) |
| Zhang *et al* | China | 2019 | 5D (HD) | 105 | Neutral | Quartile 1 (lowest) vs. 2 vs. 3 vs. 4, male 57.7% vs.48.1% vs. 46.2% vs. 65.4%, *p* = 0.473 | Soluble Klotho | (164) |
| Zhang *et al.* | China | 2015 | 5D (HD) | 90 | Male higher | ≤30 vs. 30-60 vs. ≥ 60 U/L, male 29.4% vs. 46.1% vs. 85.7%, *p* < 0.001  Male correlation coefficient 0.362, *p* < 0.001 | Serum ACE2 | (165) |
| Zou *et al.* | China | 2020 | 5D | 165 | Male higher | Among PD patients, male β = 0.259 (0.052–0.416), *p* = 0.012 | Sclerostin | (166) |
| Zou *et al.* | China | 2016 | 1-5 | 296 | Neutral | Tertile 1 (lowest) vs. 2 vs. 3, male 60.2% vs. 50.0% vs. 61.2%, *p* = 0.21 | Serum phosphorus | (167) |

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