Article:
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Supplementary Data

1. Search strategy in databases

I.Cochrane data search for clinimetrics of ultrasound on 1/9/2016

1. [mh osteoarthritis]
2. osteoarthritis .ti.ab.kw
3. osteoarthrosis.ti.ab.kw
4. osteoarthropathy.ti.ab.kw
5. degenerative joint disease*.ti.ab.kw.
6. [mh osteophyte]
7. osteophyte.ti.ab.kw
8. joint space narrowing.ti.ab.kw
9. {or #1-#8}
10. [mh ultrasonography]
11. ultrasonography.ti.ab.kw
12. ultrasonog*.ti.ab.kw
13. sonograph*.ti.ab.kw
14. ultrasound.ti.ab.kw
15. [mh“ultrasonography, doppler”]
16. doppler ultrasonography.ti.ab.kw
17. musculoskeletal ultrasound.ti.ab.kw
18. ultrasonic*.ti.ab.kw
19. {or #10-#18}
20. #9 and #15
21. [mh “sensitivity and specificity”]
22. sensitivity and specificity.ti.ab.kw
23. [mh diagnosis]
24. diagnos*.ti.ab.kw

25. predictive value.ti.ab.kw
26. likelihood ratio.ti.ab.kw
27. performance.ti.ab.kw
28 [mh“validity and reliability”]
29. validity and reliability.ti.ab.kw
30. reproducibility.ti.ab.kw
31. responsiveness.ti.ab.kw
32. [mh“feasibility study”]
33. feasibility.ti.ab.kw
34. {or#21-#32}
35. #20 and #33

II.EMBASE data search for clinimetrics of ultrasound on 1/9/2016

1. exp osteoarthritis/ or osteoarthritis.mp.
2. osteoarthrosis.mp.
3. exposteoarthropathy/ or osteoarthropathy.mp.
4. degenerative joint disease$.mp.
5. osteophyte.mp. orexp osteophyte/
6. joint space narrowing.mp.
7. 1 or 2 or 3 or 4 or 5 or 6
8. ultrasonography.mp. orexp echography/
9. ultrasonog$.mp.
10. sonograph$.mp.
11. ultrasound.mp. orexp ultrasound/
12. doppler.mp. orexp tissue Doppler imaging/
13. musculoskeletal ultrasound.mp.
14. ultrasonic$.mp.
15. 8 or 9 or 10 or 11 or 12 or 13 or 14
16. 7 and 15
17. exp "sensitivity and specificity"/ or sensitivity.mp.
18. specificity.mp. orexp "sensitivity and specificity"/
19. exp diagnosis/ or diagnosis.mp.
20. diagnos$.mp.
21. predictive value.mp. orexp predictive value/
22. likelihood ratio.mp.
23. performance.mp. orexp performance/
24. exp validity/ or validity.mp.
25. reproducibility.mp. orexp reproducibility/
26. reliability.mp. orexp reliability/
27. responsiveness.mp.

28. exp feasibility study/ or feasibility.mp.

29. 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28

30. 16 and 29

31. limit 30 to English language

32. limit 31 to human

33. limit 32 to adult <18 to 64 years>

III.Medline data search for clinimetrics of ultrasound on 1/9/2016

1. osteoarthritis.mp. orexp Osteoarthritis/
2. osteoarthrosis.mp.
3. expOsteoarthropathy, Secondary Hypertrophic/ or expOsteoarthropathy, Primary Hypertrophic/ or osteoarthropathy.mp.
4. degenerative joint disease$.mp.
5. osteophyte.mp. orexp Osteophyte/
6. joint space narrowing.mp.
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp Ultrasonography/ or ultrasonography.mp.
9. ultrasonog$.mp.
10. sonograph$.mp.
11. ultrasound.mp.
12. exp Ultrasonography, Doppler, Color/ or doppler.mp. orexp Ultrasonography, Doppler/
13. musculoskeletal ultrasound.mp.
14. ultrasonic$.mp. orUltrasonics/
15. 8 or 9 or 10 or 11 or 12 or 13 or 14
16. 7 and 15
17. sensitivity.mp. orexp "Sensitivity and Specificity"/
18. specificity.mp. orexp "Sensitivity and Specificity"/
19. diagnosis.mp. orexp Diagnosis/
20. diagnos$.mp.
21. exp "Predictive Value of Tests"/ or predictive value.mp.
22. likelihood ratio.mp.
23. performance.mp.
24. validity.mp.
25. exp "Reproducibility of Results"/ or reproducibility.mp.
26. reliability.mp.
27. responsiveness.mp.

28. exp Feasibility Studies/ or feasibility.mp.

29. 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28

30. 16 and 29

31. limit 30 to English language

32. limit 31 to humans

33. limit 32 to "all adult (19 plus years)"

2. Quality Assessment Tool modified from derived from Downs and Black score system

Domain/Item	Questions
Patients/selection bias	1) Is the hypothesis/aim/objective of the study clearly described? 2) Are the characteristics of the patients included in the study clearly described? 3) Is the patient sample representative of patients treated in routine clinical practice? 4) Is there information on possibility of selection bias present in study?
Interventions	5) Are the interventions of interest clearly described? Treatments should be clearly described. In non-treatment related observational studies the characteristics under study should be clearly described.
Comparison	6) Was a comparison group identified and clearly defined?
Blinding	7) Blinding of the main outcome measured was reported?
Outcomes	8) Are the main outcomes to be measured clearly described in the Introduction or Methods section? If the main outcomes are first mentioned in the Results section, the question should be answered no. 9) Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes. 10) Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided).
Reported findings/statistical analysis	11) Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests which are considered below) 12) Does the study provide estimates of the random variability in the data for the main outcomes? In non normally distributed data the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes. 13) Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no

	evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.
Confounding	14) Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided. 15) Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?
Losses to follow-up	16) Were losses of patients to follow-up reported? 17) Were losses of patients to follow-up taken into account? If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.
Power	18) Was a sample size calculation reported? 19) Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%? Sample sizes have been calculated to detect a difference of x% and y%.

3. List of studies included in systematic review

1. Abraham, A.M., et al., Reliability and validity of ultrasound imaging of features of knee osteoarthritis in the community. BMC Musculoskeletal Disorders, 2011. **12**.
2. Acebes, J.C., et al., Ultrasonographic assessment of Baker's cysts after intra-articular corticosteroid injection in knee osteoarthritis. Journal of Clinical Ultrasound, 2006. **34**(3): p. 113-7.
3. Acebes, C., et al., Dynamic ultrasound assessment of medial meniscal subluxation in knee osteoarthritis. Rheumatology (United Kingdom), 2013. **52**(8): p. 1443-1447.
4. aIagnocco, A., et al., The reliability of musculoskeletal ultrasound in the detection of cartilage abnormalities at the metacarpo-phalangeal joints. Osteoarthritis & Cartilage, 2012. **20**(10): p. 1142-6.
5. aKeen, H.I., et al., Can ultrasonography improve on radiographic assessment in osteoarthritis of the hands? A comparison between radiographic and ultrasonographic detected pathology. Annals of the Rheumatic Diseases, 2008. **67**(8): p. 1116-20.
6. Arrestier, S., et al., Ultrasound features of nonstructural lesions of the proximal and distal interphalangeal joints of the hands in patients with finger osteoarthritis. Joint, Bone, Spine: Revue du Rhumatisme, 2011. **78**(1): p. 65-9.
7. Atchia, I., et al., Efficacy of a single ultrasound-guided injection for the treatment of hip osteoarthritis. Annals of the Rheumatic Diseases, 2011. **70**(1): p. 110-6.
8. Bagnato, G.L., et al., Far infrared emitting plaster in knee osteoarthritis: a single blinded, randomised clinical trial. Reumatismo, 2012. **64**(6): p. 388-94.
9. Bandinelli, F., et al., Longitudinal ultrasound and clinical follow-up of Baker's cysts injection with steroids in knee osteoarthritis. Clinical Rheumatology, 2012. **31**(4): p. 727-31.
10. Bansal, H., et al., Chondroprotection using naturally occurring mineral supplementation formula in degenerative Osteoarthritis of the knees. Journal of Stem Cells, 2014. **9**(1): p. 65-76.
11. Bansa, H., et al., Natural minerals used as food supplement provides early relief from osteoarthritis of knee symptoms: A randomized, placebo controlled clinical trial. Trace Elements and Electrolytes, 2015. **32**(1): p. 8-15.
12. bBevers, K., et al., Are ultrasonographic signs of inflammation predictors for response to intra-articular glucocorticoids in knee osteoarthritis? Clinical and Experimental Rheumatology, 2014. **32**(6): p. 930-934.
13. Beitinger, N., et al., The value of colour Doppler sonography of the knee joint: A useful tool to discriminate inflammatory from non-inflammatory disease? Rheumatology (United Kingdom), 2013. **52**(8): p. 1425-1428.
14. Bevers, K., et al., Ultrasonographic analysis in knee osteoarthritis: evaluation of inter-observer reliability. Clinical & Experimental Rheumatology, 2012. **30**(5): p. 673-8.
15. Bevers, K., et al., Ultrasonographic features in symptomatic osteoarthritis of the knee and relation with pain. Rheumatology, 2014. **53**(9): p. 1625-9.
16. Bevers, K., et al., Ultrasonographic predictors for clinical and radiological progression in knee osteoarthritis after 2 years of follow-up. Rheumatology (United Kingdom), 2015. **54**(11): p. 2000-2003.
17. bIagnocco, A., et al., The interobserver reliability of ultrasound in knee osteoarthritis. Rheumatology, 2012. **51**(11): p. 2013-9.
18. Birn, J., et al., Sonographic evaluation of hip joint effusion in osteoarthritis with correlation to radiographic findings. Journal of Clinical Ultrasound, 2014. **42**(4): p. 205-11.
19. bKeen, H.I., et al., An ultrasonographic study of osteoarthritis of the hand: Synovitis and its relationship to structural pathology and symptoms. Arthritis Care and Research, 2008. **59**(12):

p. 1756-1763.

20. Bruyn, G.A., et al., An OMERACT reliability exercise of inflammatory and structural abnormalities in patients with knee osteoarthritis using ultrasound assessment. Ann Rheum Dis, 2016. **75**(5): p. 842-6.
21. Calis, H.T., et al., Efficacy of intra-articular autologous platelet rich plasma application in knee osteoarthritis. Archives of Rheumatology, 2015. **30**(3): p. 198-205.
22. Chan, K.K., et al., Clinical, radiological and ultrasonographic findings related to knee pain in osteoarthritis. PLoS ONE, 2014. **9**(3): p. e92901.
23. Chatzopoulos, D., et al., Yttrium-90 radiation synovectomy in knee osteoarthritis: a prospective assessment at 6 and 12 months. Nuclear Medicine Communications, 2009. **30**(6): p. 472-9.
24. Chen, Y.J., et al., Association between the severity of femoral condylar cartilage erosion related to knee osteoarthritis by ultrasonographic evaluation and the clinical symptoms and functions. Archives of Physical Medicine & Rehabilitation, 2015. **96**(5): p. 837-44.
25. cIagnocco, A., et al., Ultrasound imaging for the rheumatologist XLI. Sonographic assessment of the hip in OA patients. Clinical & Experimental Rheumatology, 2012. **30**(5): p. 652-7.
26. Conaghan, P.G., et al., Clinical and ultrasonographic predictors of joint replacement for knee osteoarthritis: results from a large, 3-year, prospective EULAR study. Annals of the Rheumatic Diseases, 2010. **69**(4): p. 644-7.
27. D'Agostino, M.A., et al., EULAR report on the use of ultrasonography in painful knee osteoarthritis. Part 1: prevalence of inflammation in osteoarthritis. Annals of the Rheumatic Diseases, 2005. **64**(12): p. 1703-9.
28. Damman, W., et al., Sensitivity-to-change and validity of semi-automatic joint space width measurements in hand osteoarthritis: A follow-up study. Osteoarthritis and Cartilage, 2016. **24**(7): p. 1172-1179.
29. Darweesh, H., et al., Serum and synovial cartilage oligomeric matrix protein (COMP) in patients with rheumatoid arthritis and osteoarthritis. Indian Journal of Rheumatology, 2010. **5**(3): p. 112-117.
30. de Miguel Mendieta, E., et al., Clinical and ultrasonographic findings related to knee pain in osteoarthritis. Osteoarthritis and Cartilage, 2006. **14**(6): p. 540-544.
31. Di Sante, L., et al., Ultrasound-guided aspiration and corticosteroid injection of Baker's cysts in knee osteoarthritis: a prospective observational study. American Journal of Physical Medicine & Rehabilitation, 2010. **89**(12): p. 970-5.
32. Dundar, U., et al., Assessment of pulsed electromagnetic field therapy with Serum YKL-40 and ultrasonography in patients with knee osteoarthritis. International Journal of Rheumatic Diseases, 2016. **19**(3): p. 287-293.
33. Elsaman, A.M., et al., Low-dose spironolactone: Treatment for osteoarthritis-related knee effusion. A prospective clinical and sonographic-based study. Journal of Rheumatology, 2016. **43**(6): p. 1114-1120.
34. Esen, S., et al., Clinical evaluation during the acute exacerbation of knee osteoarthritis: the impact of diagnostic ultrasonography. Rheumatology International, 2013. **33**(3): p. 711-7.
35. Fam, A.G., S.R. Wilson, and S. Holmberg, Ultrasound evaluation of popliteal cysts on osteoarthritis of the knee. Journal of Rheumatology, 1982. **9**(3): p. 428-34.
36. Hall, M., et al., Synovial pathology detected on ultrasound correlates with the severity of radiographic knee osteoarthritis more than with symptoms. Osteoarthritis and Cartilage, 2014. **22**(10): p. 1627-1633.

37. Hammer, H.B., et al., Global ultrasound assessment of structural lesions in osteoarthritis: a reliability study by the OMERACT ultrasonography group on scoring cartilage and osteophytes in finger joints. Annals of the Rheumatic Diseases, 2016. **75**(2): p. 402-7.
38. Hassan, A.S., et al., Effectiveness of the intra-articular injection of platelet rich plasma in the treatment of patients with primary knee osteoarthritis. Egyptian Rheumatologist, 2015. **37**(3): p. 119-124.
39. Henricsdotter, C., et al., Changes in ultrasound assessed markers of inflammation following intra-articular steroid injection combined with exercise in knee osteoarthritis: Exploratory outcome from a randomized trial. Osteoarthritis and Cartilage, 2016. **24**(5): p. 814-821.
40. Henrotin, Y., et al., Intra-articular use of a medical device composed of hyaluronic acid and chondroitin sulfate (Structovial CS): effects on clinical, ultrasonographic and biological parameters. BMC Research Notes, 2012. **5**: p. 407.
41. Iagnocco, A., et al., High resolution ultrasonography in detection of bone erosions in patients with hand osteoarthritis. Journal of Rheumatology, 2005. **32**(12): p. 2381-3.
42. Iagnocco, A., et al., Ultrasound imaging for the rheumatologist XXIX. Sonographic assessment of the knee in patients with osteoarthritis. Clinical & Experimental Rheumatology, 2010. **28**(5): p. 643-6.
43. Jan, M.H., et al., Effects of repetitive shortwave diathermy for reducing synovitis in patients with knee osteoarthritis: an ultrasonographic study. Physical Therapy, 2006. **86**(2): p. 236-44.
44. Jung, Y.O., et al., Correlation of sonographic severity with biochemical markers of synovium and cartilage in knee osteoarthritis patients. Clin Exp Rheumatol, 2006. **24**(3): p. 253-9.
45. Keen, H.I., et al., Response of symptoms and synovitis to intra-muscular methylprednisolone in osteoarthritis of the hand: An ultrasonographic study. Rheumatology, 2010. **49**(6): p. 1093-1100.
46. Keen, H.I., et al., Ultrasound assessment of response to intra-articular therapy in osteoarthritis of the knee. Rheumatology (United Kingdom), 2015. **54**(8): p. 1385-1391.
47. Kim, H.R., et al., Clinical value of ^{99m}Tc-methylene diphosphonate (MDP) bone single photon emission computed tomography (SPECT) in patients with knee osteoarthritis. Osteoarthritis and Cartilage, 2008. **16**(2): p. 212-218.
48. Kim, H.R., et al., The relationship between synovial fluid VEGF and serum leptin with ultrasonographic findings in knee osteoarthritis. International Journal of Rheumatic Diseases, 2016. **19**(3): p. 233-240.
49. Klauser, A.S., et al., Sonographic criteria for therapy follow-up in the course of ultrasound-guided intra-articular injections of hyaluronic acid in hand osteoarthritis. European Journal of Radiology, 2012. **81**(7): p. 1607-11.
50. Koroglu, M., et al., Ultrasound guided percutaneous treatment and follow-up of Baker's cyst in knee osteoarthritis. European Journal of Radiology, 2012. **81**(11): p. 3466-71.
51. Kortekaas, M.C., et al., Pain in hand osteoarthritis is associated with inflammation: The value of ultrasound. Annals of the Rheumatic Diseases, 2010. **69**(7): p. 1367-1369.
52. Kortekaas, M.C., et al., Osteophytes and joint space narrowing are independently associated with pain in finger joints in hand osteoarthritis. Annals of the Rheumatic Diseases, 2011. **70**(10): p. 1835-7.
53. Kortekaas, M.C., et al., In erosive hand osteoarthritis more inflammatory signs on ultrasound are found than in the rest of hand osteoarthritis. Annals of the Rheumatic Diseases, 2013. **72**(6): p. 930-4.

54. Kortekaas, M.C., et al., Follow-up study of inflammatory ultrasound features in hand osteoarthritis over a period of 3 months: Variable as well as constant. Osteoarthritis and Cartilage, 2014. **22**(1): p. 40-43.
55. Kortekaas, M.C., et al., Inflammatory ultrasound features show independent associations with progression of structural damage after over 2 years of follow-up in patients with hand osteoarthritis. Annals of the Rheumatic Diseases, 2015. **74**(9): p. 1720-4.
56. Kortekaas, M.C., et al., Brief Report: Association of Inflammation with Development of Erosions in Patients with Hand Osteoarthritis: A Prospective Ultrasonography Study. Arthritis and Rheumatology, 2016. **68**(2): p. 392-397.
57. Koski, J.M., et al., Atlas-based knee osteophyte assessment with ultrasonography and radiography: Relationship to arthroscopic degeneration of articular cartilage. Scandinavian Journal of Rheumatology, 2016. **45**(2): p. 158-164.
58. Koutroumpas, A.C., et al., Comparison between clinical and ultrasonographic assessment in patients with erosive osteoarthritis of the hands. Clinical Rheumatology, 2010. **29**(5): p. 511-6.
59. Kristoffersen, H., et al., Indications of inflammation visualized by ultrasound in osteoarthritis of the knee. Acta Radiologica, 2006. **47**(3): p. 281-6.
60. Lee, C.L., et al., The validity of in vivo ultrasonographic grading of osteoarthritic femoral condylar cartilage: a comparison with in vitro ultrasonographic and histologic gradings. Osteoarthritis & Cartilage, 2008. **16**(3): p. 352-8.
61. Malas, F.T., et al., Effects of different strength training on muscle architecture: Clinical and ultrasonographic evaluation in knee osteoarthritis. PM and R, 2013. **5**(8): p. 655-662.
62. Malas, F.U., et al., Ultrasonographic evaluation in symptomatic knee osteoarthritis: clinical and radiological correlation. International Journal of Rheumatic Diseases, 2014. **17**(5): p. 536-40.
63. Mallinson, P.I., et al., Osteoarthritis of the thumb carpometacarpal joint: correlation of ultrasound appearances to disability and treatment response. Clinical Radiology, 2013. **68**(5): p. 461-5.
64. Mancarella, L., et al., Ultrasound-detected synovitis with power Doppler signal is associated with severe radiographic damage and reduced cartilage thickness in hand osteoarthritis. Osteoarthritis and Cartilage, 2010. **18**(10): p. 1263-1268.
65. Mancarella, L., et al., Ultrasound detected inflammation is associated with the development of new bone erosions in hand osteoarthritis: A longitudinal study over 3.9 years. Osteoarthritis and Cartilage, 2015. **23**(11): p. 1925-1932.
66. Martino, F., et al., Validity of echographic evaluation of cartilage in gonarthrosis. Preliminary report. Clinical Rheumatology, 1993. **12**(2): p. 178-83.
67. Mathiessen, A., et al., Ultrasonographic assessment of osteophytes in 127 patients with hand osteoarthritis: exploring reliability and associations with MRI, radiographs and clinical joint findings. Annals of the Rheumatic Diseases, 2013. **72**(1): p. 51-6.
68. Mathiessen, A., et al., Ultrasound-detected inflammation predicts radiographic progression in hand osteoarthritis after 5 years. Annals of the Rheumatic Diseases, 2016. **75**(5): p. 825-830.
69. Mermerci, B.B., et al., Clinic and ultrasound findings related to pain in patients with knee osteoarthritis. Clinical Rheumatology, 2011. **30**(8): p. 1055-62.

70. Micu, M.C., G.D. Bogdan, and D. Fodor, Steroid injection for hip osteoarthritis: efficacy under ultrasound guidance. Rheumatology, 2010. **49**(8): p. 1490-4.
71. Mortada, M., et al., Reliability of a Proposed Ultrasonographic Grading Scale for Severity of Primary Knee Osteoarthritis. Clin Med Insights Arthritis Musculoskelet Disord, 2016. **9**: p. 161-6.
72. Naguib, A., et al., Hand osteoarthritis: Clinical and imaging study. Alexandria Journal of Medicine, 2011. **47**(3): p. 237-242.
73. Naredo, E., et al., Ultrasonographic findings in knee osteoarthritis: A comparative study with clinical and radiographic assessment. Osteoarthritis and Cartilage, 2005. **13**(7): p. 568-574.
74. Nogueira-Barbosa, M.H., et al., Ultrasound assessment of medial meniscal extrusion: A validation study using MRI as reference standard. American Journal of Roentgenology, 2015. **204**(3): p. 584-588.
75. Pendleton, A., et al., Can sonography be used to predict the response to intra-articular corticosteroid injection in primary osteoarthritis of the knee? Scandinavian Journal of Rheumatology, 2008. **37**(5): p. 395-7.
76. Podlipska, J., et al., In vivo quantitative ultrasound image analysis of femoral subchondral bone in knee osteoarthritis. Thescientificworldjournal, 2013. **2013**: p. 182562.
77. Podlipská, J., et al., Comparison of Diagnostic Performance of Semi-Quantitative Knee Ultrasound and Knee Radiography with MRI: Oulu Knee Osteoarthritis Study. Scientific Reports, 2016. **6**: p. 22365.
78. Qvistgaard, E., et al., Reproducibility and inter-reader agreement of a scoring system for ultrasound evaluation of hip osteoarthritis. Annals of the Rheumatic Diseases, 2006. **65**(12): p. 1613-9.
79. Razek, A.A.K.A. and S.R. El-Basyouni, Ultrasound of knee osteoarthritis: interobserver agreement and correlation with Western Ontario and McMaster Universities Osteoarthritis. Clinical Rheumatology, 2015.
80. Rennesson-Rey, B., et al., Does joint effusion influence the clinical response to a single Hylan GF-20 injection for hip osteoarthritis? Joint Bone Spine, 2008. **75**(2): p. 182-188.
81. Riecke, B.F., et al., An ultrasound score for knee osteoarthritis: A cross-sectional validation study. Osteoarthritis and Cartilage, 2014. **22**(10): p. 1675-1691.
82. Robinson, P., A.M. Keenan, and P.G. Conaghan, Clinical effectiveness and dose response of image-guided intra-articular corticosteroid injection for hip osteoarthritis. Rheumatology, 2007. **46**(2): p. 285-91.
83. Saarakkala, S., et al., Diagnostic performance of knee ultrasonography for detecting degenerative changes of articular cartilage. Osteoarthritis Cartilage, 2012. **20**(5): p. 376-81.
84. Sampson, S., et al., Injection of platelet-rich plasma in patients with primary and secondary knee osteoarthritis: a pilot study. American Journal of Physical Medicine & Rehabilitation, 2010. **89**(12): p. 961-9.
85. Song, I.H., et al., Knee osteoarthritis. Efficacy of a new method of contrast-enhanced musculoskeletal ultrasonography in detection of synovitis in patients with knee osteoarthritis in comparison with magnetic resonance imaging. Annals of the Rheumatic Diseases, 2008. **67**(1): p. 19-25.
86. Tarhan, S. and Z. Unlu, Magnetic resonance imaging and ultrasonographic evaluation of the patients with knee osteoarthritis: a comparative study. Clinical Rheumatology, 2003. **22**(3): p. 181-8.
87. Toktas, H., et al., Ultrasonographic assessment of pes anserinus tendon and pes anserinus tendinitis bursitis syndrome in patients with knee osteoarthritis. Modern rheumatology / the

Japan Rheumatism Association, 2015. **25**(1): p. 128-133.

88. Tormenta, S., et al., Prevalence study of iliopsoas bursitis in a cohort of 860 patients affected by symptomatic hip osteoarthritis. Ultrasound in Medicine & Biology, 2012. **38**(8): p. 1352-6.
89. Traistaru, R., et al., A complex assessment of patients with knee osteoarthritis and Baker's cyst: observational study. Romanian Journal of Morphology & Embryology, 2013. **54**(3): p. 593-601.
90. Ulasli, A.M., et al., Accuracy in detecting knee effusion with clinical examination and the effect of effusion, the patient's body mass index, and the clinician's experience. Clinical Rheumatology, 2014. **33**(8): p. 1139-43.
91. Usón, J., et al., Symptomatic and asymptomatic interphalageal osteoarthritis: An ultrasonographic study. Reumatologia Clinica, 2014. **10**(5): p. 278-282.
92. Uysal, F., et al., Prevalence of pes anserine bursitis in symptomatic osteoarthritis patients: an ultrasonographic prospective study. Clinical Rheumatology, 2015. **34**(3): p. 529-33.
93. Vlychou, M., et al., Ultrasonographic evidence of inflammation is frequent in hands of patients with erosive osteoarthritis. Osteoarthritis and Cartilage, 2009. **17**(10): p. 1283-1287.
94. Vlychou, M., et al., High-resolution ultrasonography and 3.0 T magnetic resonance imaging in erosive and nodal hand osteoarthritis: high frequency of erosions in nodal osteoarthritis. Clinical Rheumatology, 2013. **32**(6): p. 755-62.
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96. Wittoek, R., et al., Reliability and construct validity of ultrasonography of soft tissue and destructive changes in erosive osteoarthritis of the interphalangeal finger joints: a comparison with MRI. Annals of the Rheumatic Diseases, 2011. **70**(2): p. 278-83.
97. Wu, P.T., et al., Pain in patients with equal radiographic grades of osteoarthritis in both knees: The value of gray scale ultrasound. Osteoarthritis and Cartilage, 2012. **20**(12): p. 1507-1513.
98. Yanagisawa, S., et al., Morphological evaluation and diagnosis of medial type osteoarthritis of the knee using ultrasound. Journal of Orthopaedic Science, 2014. **19**(2): p. 270-274.
99. Yoon, C.H., et al., Validity of the sonographic longitudinal sagittal image for assessment of the cartilage thickness in the knee osteoarthritis. Clinical Rheumatology, 2008. **27**(12): p. 1507-16.
100. Kortekaas MC, et al, Magnetic Resonance Imaging in Hand Osteoarthritis: Intraobserver Reliability and Criterion Validity for Clinical and Structural Characteristics. J Rheumatol. 2015;42(7):1224-30.

4. Characteristics of included studies in knee, hand and hip OA

Serial No.	Authors	Year	Country	Study Design	Setting	Selection Method	Dx Criteria	Pt (N)	Joint (N)	Site	Quality	Quality %
1	Abraham	2011	UK	cross-sectional study	General Practice	random	NR	18	36	knee	11	79
2	Acebes	2006	Spain	cohort study	outpatient rheumatology clinic	consecutive	ACR	30	30	knee	12	60
3	Acebes	2013	Spain	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	33	46	knee	15	88
4	aIagnocco	2012	Italy	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	8	32	hand	13	68
5	aKeen	2008	UK	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	37	1106	hand	11	69
6	Arrestier	2011	France	case-control observational study	outpatient rheumatology clinic	not reported	ACR	101	1616	hand	15	79
7	Atchia	2011	UK	RCT	outpatient rheumatology clinic	not reported	ACR	77	77	hip	19	95
8	Bagnato	2012	Italy	RCT	outpatient rheumatology clinic	not reported	ACR	60	60	knee	18	90
9	Bandinelli	2012	Italy	cohort study	outpatient rheumatology clinic	consecutive	ACR	40	40	knee	15	79
10	Bansal	2014	India	RCT	not reported	not reported	ACR	93	93	knee	11	55
11	Bansal	2015	India	cohort study	not reported	not reported	Brandt Grading	43	43	knee	8	40
12	bBevers	2014	Netherlands	cohort study	specialized hip and knee outpatient clinic	not reported	ACR	62	62	knee	16	80
13	Beitinger	2014	Germany	cross-sectional study	not reported	not reported	ACR	106	111	knee	10	63
14	Bevers	2012	Netherlands	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	60	60	knee	13	87
15	Bevers	2014	Netherlands	cross-sectional study	specialized hip and knee outpatient clinic	consecutive	ACR	180	180	knee	12	80
16	Bevers	2015	Netherlands	cohort study	specialized hip and knee outpatient clinic	consecutive	ACR	125	125	knee	14	78

17	bIagnocco	2012	Italy	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	9	17	knee	13	81
18	Birn	2014	USA	Retrospective case-control study	not reported	convenience	NR	89	94	hip	12	75
19	bKeen	2008	UK	case-control observational study	outpatient rheumatology clinic	not reported	ACR	55	55	hand	12	75
20	Bruyn	2016	Europe	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	13	13	knee	10	77 %
21	Çalis	2015	Turkey	cohort study	outpatient rheumatology clinic	consecutive	Kellgren &Lawrence	82	103	knee	13	65
22	Chan	2014	Hong Kong	Retrospective case-control study	multicentre study	convenience	ACR	193	193	knee	12	80
23	Chatzopoulos	2009	Greece	cohort study	outpatient rheumatology clinic	consecutive	ACR	90	90	knee	17	85
24	Chen	2015	Taiwan	cross-sectional study	outpatient rehabilitation clinic	consecutive	knee pain	101	202	knee	16	84
25	cIagnocco	2012	Italy	cross-sectional study	multicentre study	consecutive	ACR	75	150	hip	13	81
26	Conaghan	2010	EUROPE	cohort study	multicentre study	not reported	ACR	531	531	knee	14	74
27	D'Agostino	2005	EUROPE	cross-sectional study	outpatient knee clinic	not reported	ACR	600	600	knee	17	89
28	Damman	2016	Netherlands	cohort study	outpatient rheumatology clinic	consecutive	ACR	56	56	hand	14	74
29	Darweesh	2010	Egypt	cross-sectional study	outpatient rheumatology and rehabilitation clinic	not reported	ACR	42	42	knee	11	69
30	de Miguel Mendieta	2006	Spain	case-control observational study	outpatient rheumatology clinic	not reported	ACR	101	101	knee	17	85
31	Di Sante	2010	Italy	cohort study	outpatient rheumatology clinic	consecutive	ACR	26	26	knee	13	65
32	Dundar	2016	Turkey	RCT	outpatient rehabilitation clinic	not reported	ACR	40	40	knee	16	80
33	Elsaman	2016	Germany	RCT	not reported	not reported	ACR	20	200	knee	16	80

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34	Esen	2013	Turkey	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	100	100	knee	13	81
35	Fam	1982	Canada	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	75	150	knee	11	69
36	Hall	2014	UK	case-control observational study	general practice	not reported	NR	243	243	knee	16	84
37	Hammer	2016	Norway	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	10	300	hand	11	69
38	Hassan	2015	Egypt	cohort study	outpatient rheumatology and rehabilitation clinic	not reported	ACR	20	20	knee	12	60
39	Henricsdotter	2016	Denmark	RCT	outpatient OA clinic	not reported	ACR	100	100	knee	15	75
40	Henrotin	2012	Belgium	cohort study	outpatient rheumatology clinic	not reported	ACR	30	30	knee	12	60
41	Iagnocco	2005	Italy	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	110	110	hand	12	75
42	Iagnocco	2010	Italy	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	82	164	knee	12	75
43	Jan	2006	Taiwan	cohort study	outpatient orthopedic clinic	convenience	Kellgren &Lawrence	30	44	knee	14	70
44	Jung	2006	South Korea	cross-sectional study	not reported	consecutive	ACR	51	51	knee	13	72
45	Keen	2010	UK	cohort study	outpatient rheumatology clinic	not reported	ACR	36	540	hand	10	63
46	Keen	2015	UK	cohort study	outpatient rheumatology clinic	consecutive	ACR	35	35	knee	15	75
47	Kim	2008	Korea	cross-sectional study	not reported	not reported	ACR	30	30	knee	14	70
48	Kim	2016	Korea	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	34	34	knee	15	79
49	Klauser	2012	Austria	cohort study	not reported	not reported	ACR	33	78	hand	7	35
50	Köroglu	2012	Turkey	cohort study	not reported	consecutive	ACR	32	32	knee	11	55
51	Kortekaas	2010	Netherlands	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	55	1650	hand	16	84
52	Kortekaas	2011	Netherlands	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	55	1649	hand	16	84

53	Kortekaas	2013	Netherlands	cohort study	outpatient rheumatology clinic	consecutive	ACR	55	990	hand	16	84
54	Kortekaas	2014	Netherlands	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	25	750	hand	15	79
55	Kortekaas	2015	Netherlands	cohort study	outpatient rheumatology clinic	consecutive	ACR	56	1680	hand	16	84
56	Kortekaas	2016	Netherlands	cohort study	outpatient rheumatology clinic	consecutive	ACR	56	1680	hand	16	84
57	Koski	2016	Finland	cross-sectional study	outpatient rheumatology clinic	random	ACR	40	40	knee	12	75
58	Koutroumpas	2010	Greece	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	18	540	hand	11	69
59	Kristoffersen	2006	Denmark	case-control observational study	general practice	consecutive	ACR	71	71	knee	11	69
60	Lee	2008	Taiwan	cross-sectional study	not reported	not reported	ACR	95	172	knee	11	69
61	Malas	2013	Turkey	RCT	not reported	not reported	ACR	61	122	knee	12	60
62	Malas	2014	Turkey	case-control observational study	not reported	not reported	ACR	61	122	knee	11	69
63	Mallinson	2013	UK	cohort study	outpatient rheumatology clinic and general practice	consecutive	NR	68	68	hand	13	65
64	Mancarella	2010	Italy	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	35	576	hand	19	100
65	Mancarella	2015	Italy	cohort study	outpatient rheumatology clinic	consecutive	ACR	35	576	hand	17	89
66	Martino	1993	Italy	case-control observational study	not reported	not reported	NR	18	18	knee	9	56
67	Mathiessen	2013	Norway	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	127	3810	hand	12	67
68	Mathiessen	2016	Norway	cohort study	outpatient rheumatology clinic	not reported	ACR	78	2340	hand	14	74
69	Mermerci	2011	Turkey	case-control observational study	outpatient rheumatology clinic	not reported	ACR	143	143	knee	13	81
70	Micu	2010	Romania	cohort study	outpatient rheumatology clinic	convenience	ACR	61	66	hip	13	76
71	Mortada	2016	Egypt	cross-sectional study	outpatient rheumatology and rehabilitation clinic	random	ACR	160	160	knee	15	83

72	Naguib	2011	Egypt	case-control observational study	not reported	not reported	NR	45	1350	hand	11	69
73	Naredo	2005	Spain	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	50	50	knee	14	88
74	Nogueira-Barbosa	2015	Brazil	cross-sectional study	Department of Radiology	consecutive	NR	93	93	knee	12	86
75	Pendleton	2008	UK	cohort study	not reported	not reported	ACR	86	86	knee	7	35
76	Podlipská	2013	Finland	cross-sectional study	not reported	random	NR	39	39	knee	13	76
77	Podlipská	2016	Finland	cross-sectional study	Department of Radiology	consecutive	NR	159	159	knee	14	88
78	Qvistgaard	2006	Denmark	cross-sectional study	not reported	consecutive	ACR	100	100	hip	10	67
79	Razek and El-Basyouni	2016	Egypt	cross-sectional study	outpatient rheumatology and rehabilitation clinic	not reported	ACR	80	80	knee	11	79
80	Rennesson-Rey	2008	France	cohort study	not reported	not reported	ACR	55	55	hip	14	70
81	Riecke	2014	Denmark	cross-sectional study	Department of Radiology	consecutive	NR	45	90	knee	13	93
82	Robinson	2007	UK	cohort study	not reported	not reported	NR	120	120	hip	12	60
83	Saarakkala	2012	Finland	cross-sectional study	outpatient orthopedic clinic	random	NR	40	40	knee	13	87
84	Sampson	2010	USA	cohort study	not reported	not reported	NR	14	14	knee	13	65
85	Song	2008	Germany	case-control observational study	not reported	not reported	ACR	47	47	knee	10	53
86	Tarhan	2003	Turkey	case-control observational study	not reported	not reported	knee pain	58	58	knee	11	69
87	Toktas	2015	Turkey	case-control observational study	outpatient rehabilitation clinic	not reported	ACR	187	374	knee	16	84

88	Tormenta	2012	Italy	case-control observational study	not reported	not reported	ACR	860	860	hip	12	60
89	Traistaru	2013	Craiova	cross-sectional study	outpatient rehabilitation clinic	not reported	ACR	70	140	knee	10	50
90	Ulaşli	2014	Turkey	cross-sectional study	outpatient rehabilitation clinic	not reported	ACR	86	172	knee	12	75
91	Usón	2014	Spain	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	20	100	hand	10	67
92	Uysal	2015	Turkey	cross-sectional study	outpatient rehabilitation clinic	convenience	ACR	85	170	knee	14	78
93	Vlychou	2009	Greece	cross-sectional study	outpatient rheumatology clinic	consecutive	ACR	22	660	hand	13	72
94	Vlychou	2013	Greece	case-control observational study	outpatient rheumatology clinic	consecutive	ACR	25	600	hand	15	94
95	Wittoek	2010	Belgium	cross-sectional study	not reported	consecutive	ACR	38	684	hand	12	67
96	Wittoek	2011	Belgium	case-control observational study	outpatient rheumatology clinic	not reported	ACR	14	252	hand	12	75
97	Wu	2012	Taiwan	cross-sectional study	outpatient orthopedic clinic	consecutive	ACR	156	156	knee	16	84
98	Yanagisawa	2014	Japan	cross-sectional study	outpatient Department of Orthopedic Surgery	not reported	NR	81	131	knee	10	71
99	Yoon	2008	South Korea	cross-sectional study	not reported	not reported	ACR	51	51	knee	11	69
100	Kortekaas	2015	Netherlands	cross-sectional study	outpatient rheumatology clinic	not reported	ACR	16	128	hand	15	79

ACR=American college of rheumatology Criteria; NR=Non-reported; RCT=Randomized control trial

5. Ultrasound Scanning Characteristics of Included Studies

Serial No,	Author	Year	Mode	B Freq	D setting	D. Freq	PRF	Scanning method	Definition	Grading Score	Ultrasound scanner
1	Abraham	2011	B	10-18 MHz linear				EULAR	OMERACT	binary and quantitative	ultrasonographer
2	Acebes	2006	B	7.5 MHz linear				NR	other	quantitative	not specified
3	Acebes	2013	B	8-12 MHz linear				NR	other	quantitative	rheumatologist
4	aIagnocco	2012	B	6-18 MHz linear				other	OMERACT	binary	rheumatologist
5	aKeen	2008	B	7-15 MHz hockey				other	other	binary	physician
6	Arrestier	2011	B+D	10–13MHz linear	yes	8.3	750Hz	EULAR	OMERACT	semi-quantitative	rheumatologist
7	Atchia	2011	B	NR				NR	other	binary	not specified
8	Bagnato	2012	B	8 MHz				other	NR	binary	not reported
9	Bandinelli	2012	B	7.5–12 MHz linear				other	other	quantitative	rheumatologist
10	Bansal	2014	B	NR				NR	NR	quantitative	not reported
11	Bansal	2015	B	NR				NR	NR	quantitative	not reported
12	Beitinger	2014	B+D	5-14 MHz linear	yes	6.7		NR	other	semi-quantitative	ultrasonographer
13	Bevers	2012	B	8-15 MHz				EULAR	OMERACT	Binary/quantitative	rheumatologist
14	Bevers	2014	B	8-15 MHz linear				EULAR	OMERACT	Binary/quantitative	rheumatologist
15	Bevers	2014	B	8-15 MHz linear				EULAR	OMERACT	Binary/quantitative	rheumatologist
16	Bevers	2015	B	6-18 MHz linear				EULAR	OMERACT	Binary/quantitative	rheumatologist
17	bIagnocco	2012	B+D	4-13 MHz at 13 MHz	yes	6.3	750 Hz	EULAR	OMERACT	binary	rheumatologist
18	Birn	2014	B	NR				NR	NR	semi-quantitative	fellow in training
19	bKeen	2008	B+D	7-15 MHz hockey	yes		750 Hz	other	OMERACT	Binary/semi-quantitative	physician
20	Bruyn	2016	B	6–18 MHz linear				other	OMERACT	Binary/semi-quantitative	rheumatologist
21	Çalis	2015	B	7.5 MHz linear				other	other	quantitative	radiologist
22	Chan	2014	B	12–18 MHz linear				other	OMERACT	quantitative	ultrasonographer

23	Chatzopoulos	2009	B	NR				other	other	binary	physician
24	Chen	2015	B	5-13 MHz linear				other	other	semi-quantitative	not specified
25	cIagnocco	2012	B+D	9 MHz linear	yes	7.5	750 Hz	EULAR	OMERACT	binary	rheumatologist
26	Conaghan	2010	B	NR				EULAR	other	binary	combined R and R
27	D'Agostino	2005	B	10 MHz				EULAR	other	Binary/semi-quantitative	combined R and R
28	Damman	2016	B+D	10-14 MHz linear				other	OMERACT	semi-quantitative	ultrasonographer
29	Darweesh	2010	B	13 MHZ linear				other	other	quantitative	not reported
30	de Miguel Mendieta	2006	B	7-11 MHz linear				Van Holsbeeck technique	other	binary	rheumatologist
31	Di Sante	2010	B	7.5 MHz linear				other	other	quantitative	physician
32	Dundar	2016	B	6-18 MHz linear				other	OMERACT	Binary/semi-quantitative	physician
33	Elsaman	2016	B	8–12 MHz linear				EULAR	OMERACT	quantitative	not reported
34	Esen	2013	B	5–10 MHz				EULAR	other	binary	physician
35	Fam	1982	B	5-MHz				NR	other	binary	not reported
36	Hall	2014	B+D	7-12 MHz linear				EULAR	OMERACT	Binary/semi-quantitative	not reported
37	Hammer	2016	B	8–18 MHz hockey/6-15 MHz linear				other	OMERACT	semi-quantitative	rheumatologist
38	Hassan	2015	B	5-12 MHz linear				other	OMERACT	semi-quantitative	not reported
39	Henricsdotter	2016	B+D	15 MHz linear	yes	6.3	3 Hz	EULAR	other	Binary/quantitative	not specified
40	Henrotin	2012	B	10-15 MHz				other	NR	Binary/semi-quantitative	not reported
41	Iagnocco	2005	B	8–16 MHz linear				other	other	binary	rheumatologist
42	Iagnocco	2010	B+D	12 MHz	yes	7.5	500 Hz	EULAR	OMERACT	Binary/semi-quantitative	not specified

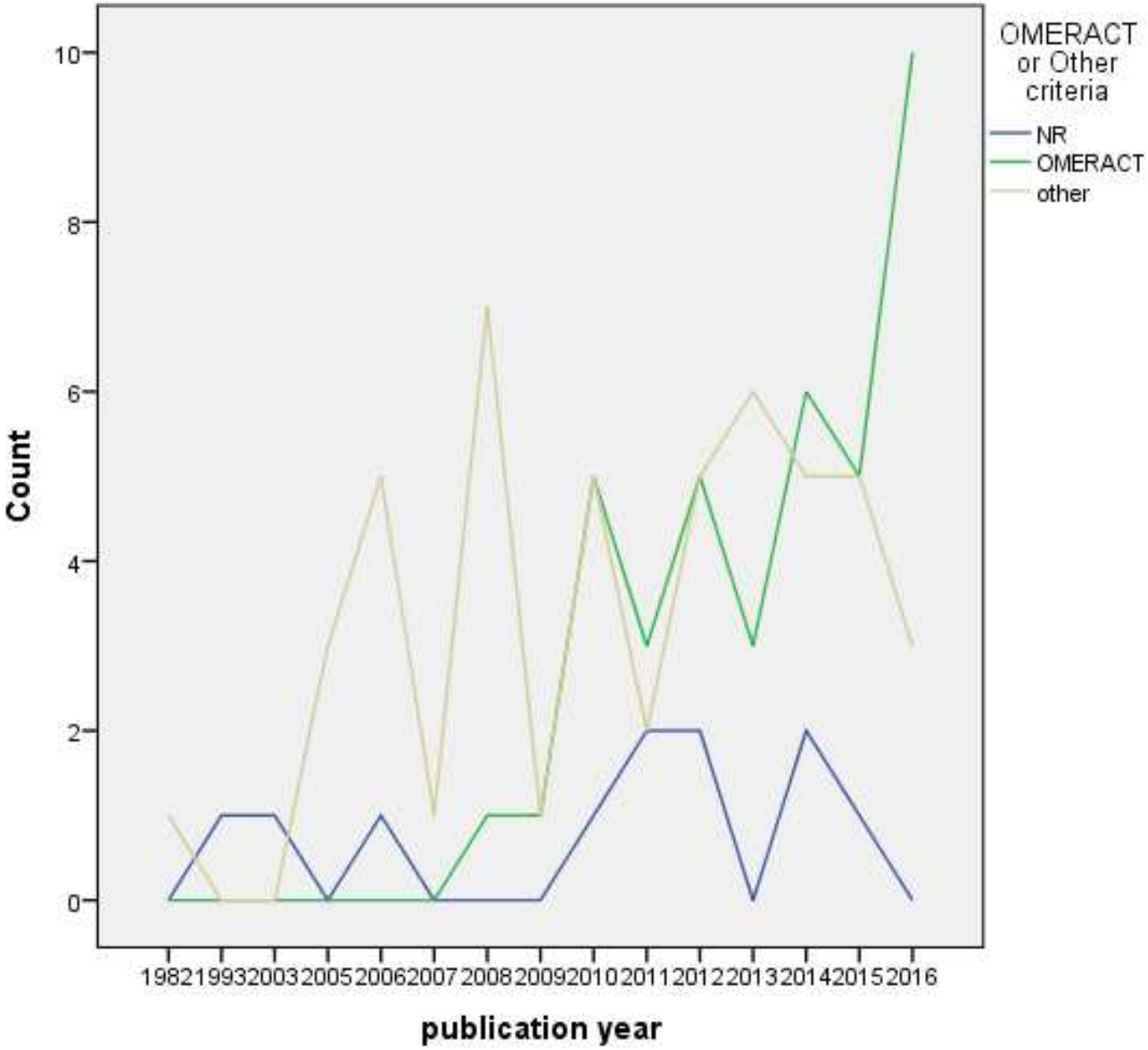
43	Jan	2006	B	5-12 MHZ linear				Van Holsbeeck technique	NR	quantitative	not reported
44	Jung	2006	B	12 MHz				other	other	quantitative	rheumatologist
45	Keen	2010	B+D	7-15 MHz hockey	yes		750 Hz	other	other	semi-quantitative	rheumatologist
46	Keen	2015	B+D	5-12 MHz linear	yes		750 Hz	EULAR	OMERACT	semi-quantitative/quantitative	not reported
47	Kim	2008	B	7-12 MHz linear				EULAR	other	quantitative	rheumatologist
48	Kim	2016	B	7–15 MHz linear				EULAR	OMERACT	quantitative	rheumatologist
49	Klauser	2012	B+D	13–16 MHz	yes	12	750-1000 Hz	other	other	semi-quantitative/quantitative	radiologist
50	Köroglu	2012	B	7.5 MHz linear				NR	other	Binary/quantitative	physician
51	Kortekaas	2010	B+D	10-14 MHz linear				other	OMERACT	semi-quantitative	ultrasonographer
52	Kortekaas	2011	B+D	10-14 MHz linear				other	NR	semi-quantitative	ultrasonographer
53	Kortekaas	2013	B+D	10-14 MHz linear				other	OMERACT	semi-quantitative	ultrasonographer
54	Kortekaas	2014	B+D	10-14 MHz linear	yes		13.2KHz	other	OMERACT	semi-quantitative	ultrasonographer
55	Kortekaas	2015	B+D	10-14 MHz linear	yes		13.2KHz	other	OMERACT	semi-quantitative	ultrasonographer
56	Kortekaas	2016	B+D	10-14 MHz linear				other	OMERACT	semi-quantitative	ultrasonographer
57	Koski	2016	B	13 MHz linear				other	other	semi-quantitative	rheumatologist
58	Koutroumpas	2010	B+D	8–13 MHz linear				other	OMERACT	binary	radiologist
59	Kristoffersen	2006	B+D	13 MHz (central)	yes	7	lowest PRF	other	other	binary	not reported
60	Lee	2008	B	5-12 MHz linear				other	other	semi-quantitative	not specified
61	Malas	2013	B	5-10 MHz linear				other	other	quantitative	physiatrist
62	Malas	2014	B	5–10 MHz linear				other	other	Binary/semi-quantitative/quantitative	physiatrist

63	Mallinson	2013	B	8-15 MHz linear				other	other	semi-quantitative/quantitative	radiologist
64	Mancarella	2010	B+D	5-13 MHz	yes	11.4		other	OMERACT	Binary/quantitative	ultrasonographer
65	Mancarella	2015	B	5-13 MHz				other	OMERACT	binary	ultrasonographer
66	Martino	1993	B	7.5 MHz linear				other	NR	quantitative	not specified
67	Mathiessen	2013	B	5–13 MHz linear				EULAR	OMERACT	semi-quantitative	ultrasonographer
68	Mathiessen	2016	B+D	5–13 MHz linear	yes	7.3	391 Hz	EULAR	OMERACT	Binary/semi-quantitative	rheumatologist
69	Mermerci	2011	B	8–10 MHz linear				other	other	Binary/quantitative	radiologist
70	Micu	2010	B+D	5–7.5 MHz linear				NR	other	quantitative	not reported
71	Mortada	2016	B	5–12 MHz linear				other	OMERACT	semi-quantitative	combined R and R
72	Naguib	2011	B	7.5–10 MHz				NR	NR	semi-quantitative	not reported
73	Naredo	2005	B	7-12 MHz				EULAR	other	binary	rheumatologist
74	Nogueira-Barbosa	2015	B	5-12 MHz linear				other	other	semi-quantitative	radiologist
75	Pendleton	2008	B+D	5–12 MHz linear	yes		1100 Hz	EULAR	other	binary	not reported
76	Podlipská	2013	B	13 MHz linear				other	other	quantitative	not reported
77	Podlipská	2016	B	15 MHz linear				other	other	semi-quantitative/quantitative	ultrasonographer
78	Qvistgaard	2006	B	8–15 MHz				other	other	semi-quantitative	combined R and R
79	Razek and El-Basyouni	2016	B	10-12 MHz linear				EULAR	OMERACT	binary	combined R and R
80	Rennesson-Rey	2008	B+D	5-12 MHz linear				other	other	binary	rheumatologist
81	Riecke	2014	B+D	14 MHz M12L linear	yes	7.5	900 Hz	other	other	semi-quantitative/quantitative	physician

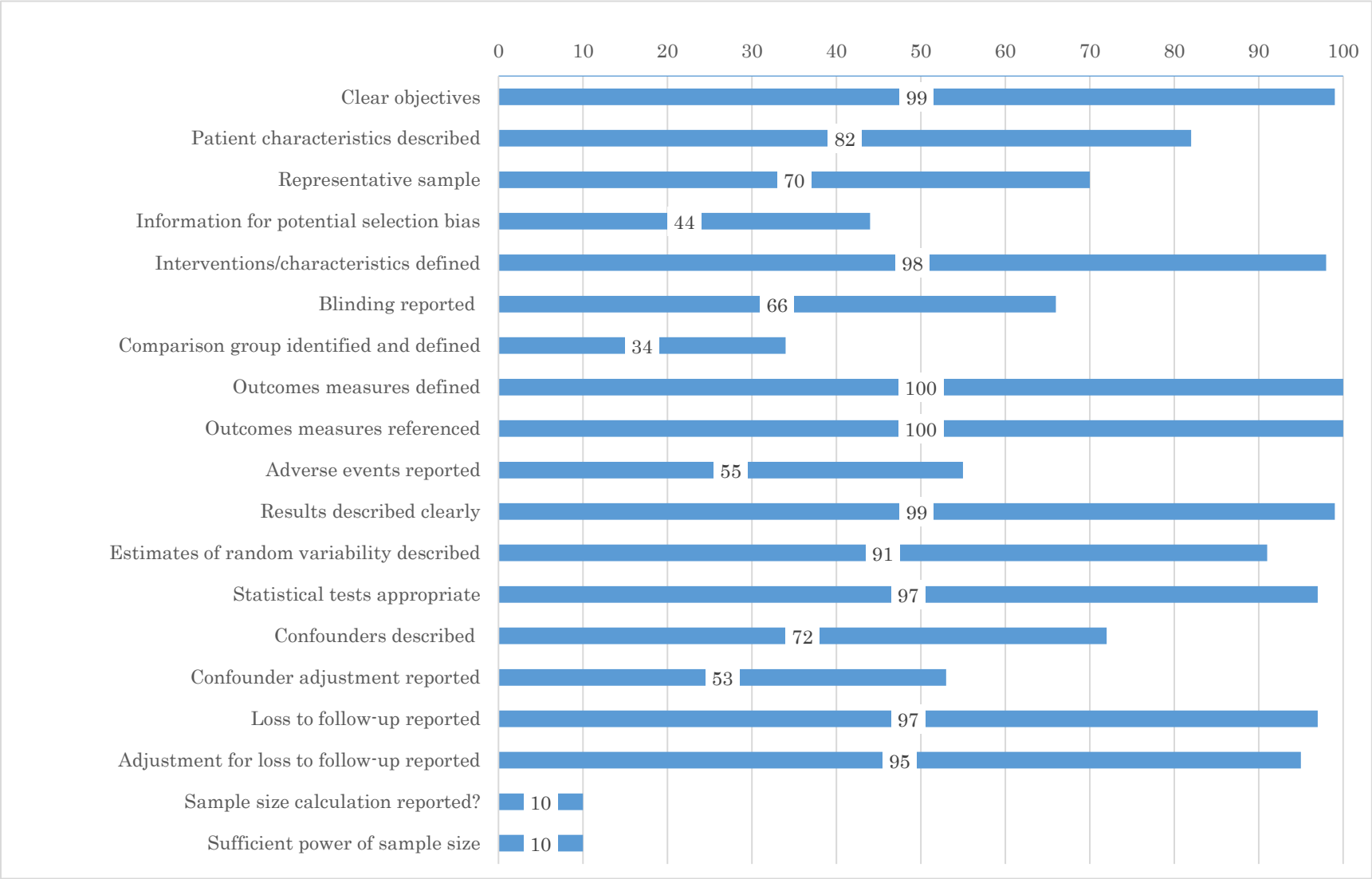
82	Robinson	2007	B+D	10–15 MHz linear				other	other	Binary/semi-quantitative/ quantitative	radiologist
83	Saarakkala	2012	B	13 MHz linear				other	other	semi-quantitative	ultrasonographer
84	Sampson	2010	B	7.5 –13.0 MHz linear				other	NR	quantitative	not reported
85	Song	2008	B+D	5-12 MHz linear for MUS, 8–4-MHz linear for CE-MUS	yes	6.3	500 Hz	EULAR	other	semi-quantitative	rheumatologist
86	Tarhan	2003	B	5-10 MHz linear				other	NR	semi-quantitative/quantitative	not reported
87	Toktas	2015	B	6-18 MHz linear				other	other	Binary/quantitative	not specified
88	Tormenta	2012	B	3.5–5 MHz convex/ 7.5–12 MHz linear				other	other	binary	radiologist
89	Traistaru	2013	B	12.5 MHz linear				NR	other	binary	not reported
90	Ulaşli	2014	B	6-18MHz linear				other	OMERACT	semi-quantitative	not reported
91	Usón	2014	B	M12 linear				other	other	binary	rheumatologist
92	Uysal	2015	B	12 MHz linear				other	other	Binary/quantitative	radiologist
93	Vlychou	2009	B+D	8-13 MHz linear				other	OMERACT	binary	radiologist
94	Vlychou	2013	B	10–14 MHz linear/ 10–15 MHz hockey				other	OMERACT	binary	radiologist
95	Wittoek	2010	B+D	10–18 MHz linear	yes	8.3	500 Hz	other	OMERACT	binary	rheumatologist
96	Wittoek	2011	B	12–18 MHz				other	OMERACT	binary	rheumatologist
97	Wu	2012	B	6-13 MHz linear				EULAR	OMERACT	Binary/semi-quantitative	ultrasonographer
98	Yanagisawa	2014	B	12 MHz linear				other	other	quantitative	surgeon
99	Yoon	2008	B	12.5 MHz linear				EULAR	other	quantitative	rheumatologist
100	Kortekaas	2015	B+D	10-14 MHz linear				NR	NR	semi-quantitative	ultrasonographer

B=bmode; D=Doppler mode; EULAR=European league against rheumatism scanning method; NR=Non-reported; OMERACT=Outcome measures in rheumatology definition

6. Utilization of OMERACT definitions in the included studies across the years



7. Methodological Quality of included studies in systematic literature review

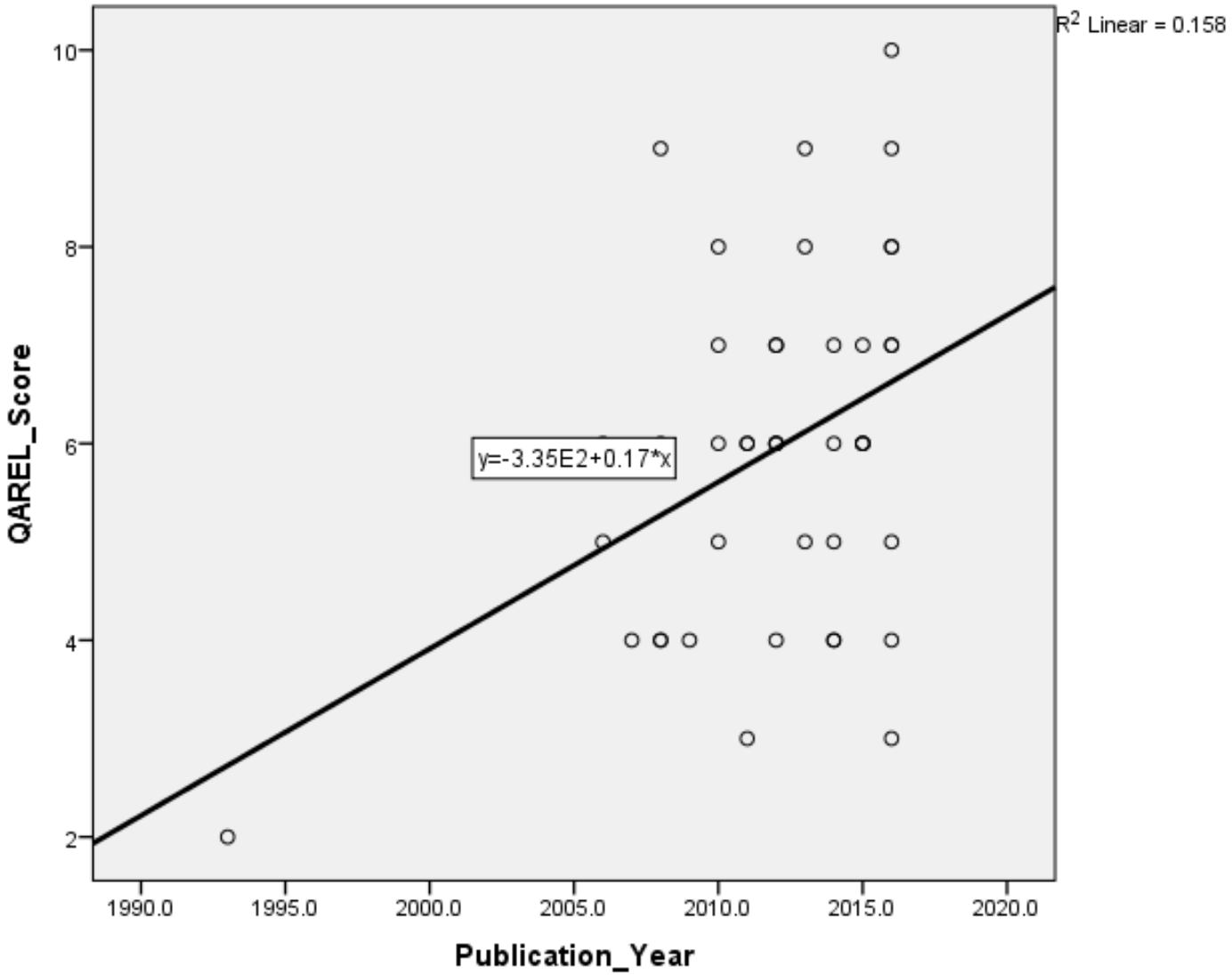


8. Quality Appraisal of Diagnostic Reliability (QAREL) score for included studies in systematic literature review

	Author	Year	Representative sample	Representative raters	Blinding (other raters)	Blinding (prior findings)	Blinding (reference)	Blinding (clinical info)	Blinding (Non-clinical data)	Order of exam	Time interval	Correct Test	Appropriate statistics
1	Abraham	2011	Unclear	Yes	Unclear	NC	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes
2	Acebes	2013	Yes	Yes	Yes	Yes	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
3	aIagnocco	2012	Yes	Yes	Yes	Yes	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes
4	aKeen	2008	Yes	Yes	NC	Unclear	NC	No	Unclear	Unclear	Unclear	Yes	Yes
5	Bandinelli	2012	Yes	Yes	Unclear	Unclear	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes
6	bBevers	2014	Yes	Yes	Yes	NC	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
7	Bevers	2012	Yes	Yes	Yes	NC	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
8	bIagnocco	2012	Yes	Yes	Yes	NC	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
9	bKeen	2008	Yes	Yes	NC	Unclear	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
10	Bruyn	2016	Yes	Yes	Yes	Yes	NC	Unclear	Unclear	Yes	Unclear	Yes	Yes
11	Damman	2016	Yes	Yes	Unclear	NC	NC	Unclear	Unclear	Unclear	Unclear	Yes	No
12	Hall	2014	Unclear	Yes	NC	Yes	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes
13	Hammer	2016	Yes	Yes	Unclear	Unclear	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes
14	Jung	2006	Yes	Yes	NC	Unclear	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
15	Keen	2015	Yes	Yes	NC	Unclear	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
16	Kortekaas	2010	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Unclear	Yes	Yes
17	Kortekaas	2011	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Unclear	Yes	Yes
18	Kortekaas	2015	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Unclear	Yes	Yes
19	Kortekaas	2016	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
20	Koski	2016	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	Yes	Yes	Yes
21	Koutroumpas	2010	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
22	Lee	2008	Yes	Yes	Unclear	NC	NC	Unclear	Unclear	Unclear	Unclear	Yes	Yes

23	Malas	2013	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
24	Mancarella	2010	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Yes	Yes	Yes
25	Mancarella	2015	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Unclear	Yes	Yes
26	Martino	1993	Unclear	Yes	Unclear	Unclear	NC	Unclear	Unclear	Unclear	Unclear	Yes	No
27	Mathiessen	2013	Yes	Yes	Yes	Yes	NC	Yes	Unclear	Yes	Yes	Yes	Yes
28	Mathiessen	2016	Yes	Yes	Yes	Yes	NC	Yes	Unclear	Yes	Yes	Yes	Yes
29	Mortada	2016	Yes	Yes	Yes	Yes	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
30	Nogueira-Barbosa	2015	Unclear	Yes	Yes	NC	NC	Yes	Unclear	Yes	Yes	Yes	Yes
31	Podlipská	2016	Unclear	Yes	NC	Yes	NC	Yes	Yes	Yes	Yes	Yes	Yes
32	Qvistgaard	2006	Yes	Yes	Yes	Yes	NC	Unclear	Unclear	Unclear	Unclear	Yes	No
33	Razek and El-Basyouni	2016	Yes	Yes	Yes	NC	NC	Yes	Unclear	Yes	Yes	Yes	Yes
34	Riecke	2014	Unclear	Yes	Unclear	Unclear	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
35	Robinson	2007	Unclear	Yes	NC	Unclear	NC	Unclear	Unclear	Yes	Yes	Yes	No
36	Tormenta	2012	Yes	Yes	Yes	NC	NC	Unclear	Unclear	Yes	Yes	Yes	Yes
37	Usón	2014	Yes	Yes	NC	Unclear	NC	Yes	Unclear	Yes	Yes	Yes	Yes
38	Vlychou	2009	Yes	Yes	NC	Unclear	NC	No	Unclear	Unclear	Unclear	Yes	Yes
39	Wittoek	2010	Yes	Yes	Yes	NC	NC	Yes	Unclear	Yes	Yes	Yes	Yes
40	Wittoek	2011	Yes	Yes	Yes	NC	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
41	Wu	2012	Yes	Yes	Unclear	Yes	NC	Yes	Unclear	Yes	Unclear	Yes	Yes
42	Yanagisawa	2014	Unclear	Yes	NC	Unclear	NC	Yes	Unclear	Unclear	Unclear	Yes	Yes
43	Yoon	2008	Yes	Yes	Yes	Yes	NC	Yes	Unclear	Yes	Yes	Yes	Yes

9. Scatter plot for improvement of QAREL Scores in reliability studies across the years



10.Tables

Table 1. Stratified Meta-analysis for Construct Validity (function)

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Effusion	3	171	257	**0.25(0.13,0.36)**	**0.23(0.08,0.37)**	**0.29**	**20**	**0.06**
Power Doppler	1	71	71	**0.23(-0.01,0.44)**				
Osteophyte	2	205	205	**0.18(0.04,0.31)**	**0.18(0.04,0.31)**	**0.43**	**0**	**0**
Meniscal protrusion	1	61	122	**0.22(-0.04,0.45)**				
Cartilage thickness	2	101	162	**0.14(-0.06,0.33)**	**0.15(-0.11,0.39)**	**0.20**	**38**	**0.12**
Baker cyst	1	70	140	**0.35(0.12,0.54)**				
Pes Anserine bursitis	1	157	314	**0.18(0.07,0.29)**				

Table 2. Stratified Meta-analysis for Construct Validity (MRI)

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Synovitis	1	41	41	**0.63(0.41,0.79)**				
Effusion	1	138	212	**0.63(0.54,0.70)**				
Synovial hypertrophy	1	138	212	**0.62(0.53,0.70)**				
Osteophyte								
Meniscal protrusion								
Cartilage thickness	2	189	265	**0.60(0.52,0.67)**	**0.60(0.52,0.67)**	**0.67**	**0**	**0**
Baker cyst	1	138	212	**0.66(0.58,0.73)**				

Table 3. Construct validity of ultrasound features with blood biomarkers (Serum COMP)

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Effusion	3	95	95	**0.003(-0.206,0.211)**	**0.003(-0.206,0.211)**	**0.085**	**0**	**0**
Capsular distension	3	95	95	**0.21(0.01,0.40)**	**0.21(0.01,0.40)**	**0.81**	**0**	**0**
Osteophyte	3	95	95	**0.19(-0.01,0.39)**	**0.19(-0.01,0.39)**	**0.50**	**0**	**0**
Cartilage thickness	3	95	95	**0.13(-0.08,0.33)**	**0.13(-0.08,0.33)**	**0.91**	**0**	**0**

Table 4. Stratified meta-analysis for Criteria validity of cartilage thickness with histology

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Cartilage thickness	2	113	190	**0.44(0.32,0.55)**	**0.66(-0.05,0.93)**	**0.001**	**90**	**0.59**

Table 5. Stratified Meta-analysis for Internal Responsiveness(independent sample)

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Effusion	2	240	240	**0.64(0.42,0.85)**	**0.64(0.42,0.85)**	**0.38**	**0**	**0**
Synovial hypertrophy	1	20	20	**0.37(0.05,0.69)**				
Power Doppler	1	20	20	**0.28(-0.04,0.61)**				
Cartilage thickness	3	240	240	**0.29(0.04,0.55)**	**0.29(0.04,0.55)**	**0.80**	**0**	**0**

Table 6. Stratified Meta-analysis for External Responsiveness

Stratified meta-analysis	No. of studies	No. of patients	No. of joints	Correlation coefficient (95% CI)		Heterogeneity		
Knee				**Fixed**	**Random**	**P value**	**I^2**	**Tau**
Effusion	1	33	33	**0.05(-0.30,0.39)**				
Synovial hypertrophy	2	63	77	**0.45(0.25,0.62)**	**0.43(-0.02,0.73)**	**0.05**	**74**	**0.30**
Power Doppler	1	33	33	**0.36(0.02,0.63)**				
Baker's cyst	2	58	58	**0.37(0.12,0.58)**	**0.35(-0.11,0.69)**	**0.08**	**68**	**0.29**

Table 7. Feasibility studies

	Author/Year	OA site	Pathologies	Grading Score	Scanning method	Scanning time
1.	Bevers, 2012	knee	Effusion, synovial hypertrophy, meniscal lesion, cartilage thickness, Baker's cyst, bursitis	Binary/quantitative	EULAR	5 min
2.	Bevers, 2014	knee	Effusion, synovial hypertrophy, meniscal lesion, cartilage thickness, Baker's cyst, bursitis	Binary/quantitative	EULAR	10 min
3.	Bruyn, 2016	knee	Synovitis, Effusion, Synovial hypertrophy, Global synovitis, Meniscal damage, Cartilage damage, Osteophytes	Binary/semi-quantitative	EULAR	8 min
4.	Riecke, 2014	Knee	Synovitis, Effusion, Synovial hypertrophy, Global synovitis, Meniscal damage, Cartilage damage, Osteophytes (61 items)	Binary/semi-quantitative	other	5 min (scanning) 10-15min (subsequent analysis)
5.	Saarakkala, 2012	knee	cartilage thickness, grading	semi-quantitative	other	10 min

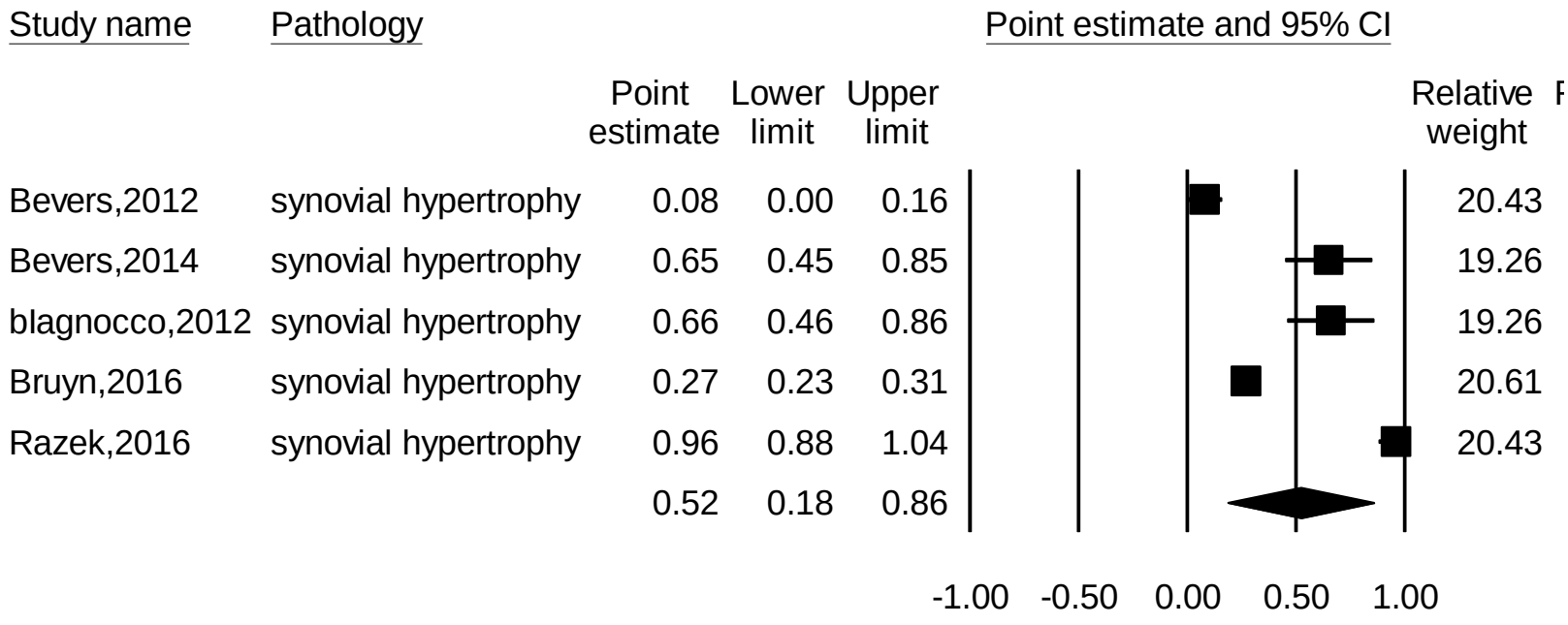
EULAR=European league against rheumatism scanning method

11.Forest plots

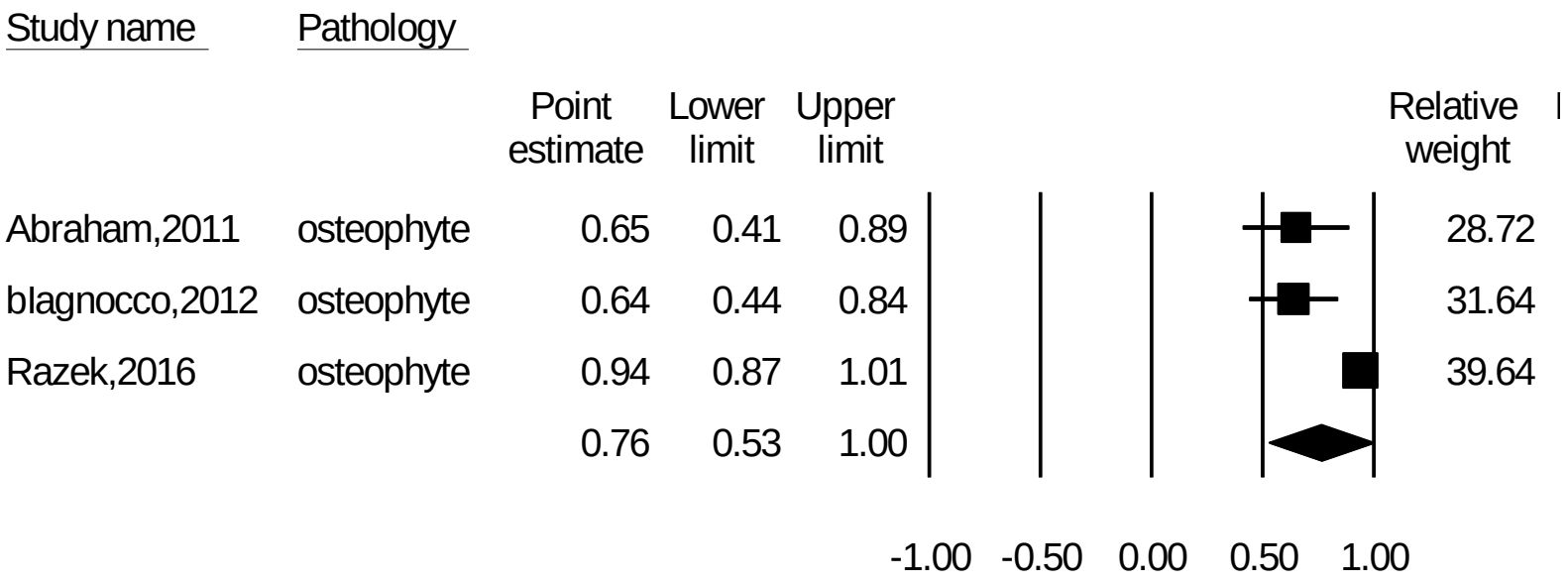
A. Reliability

I. Inter-rater reliability of ultrasound features for knee OA (binary score)

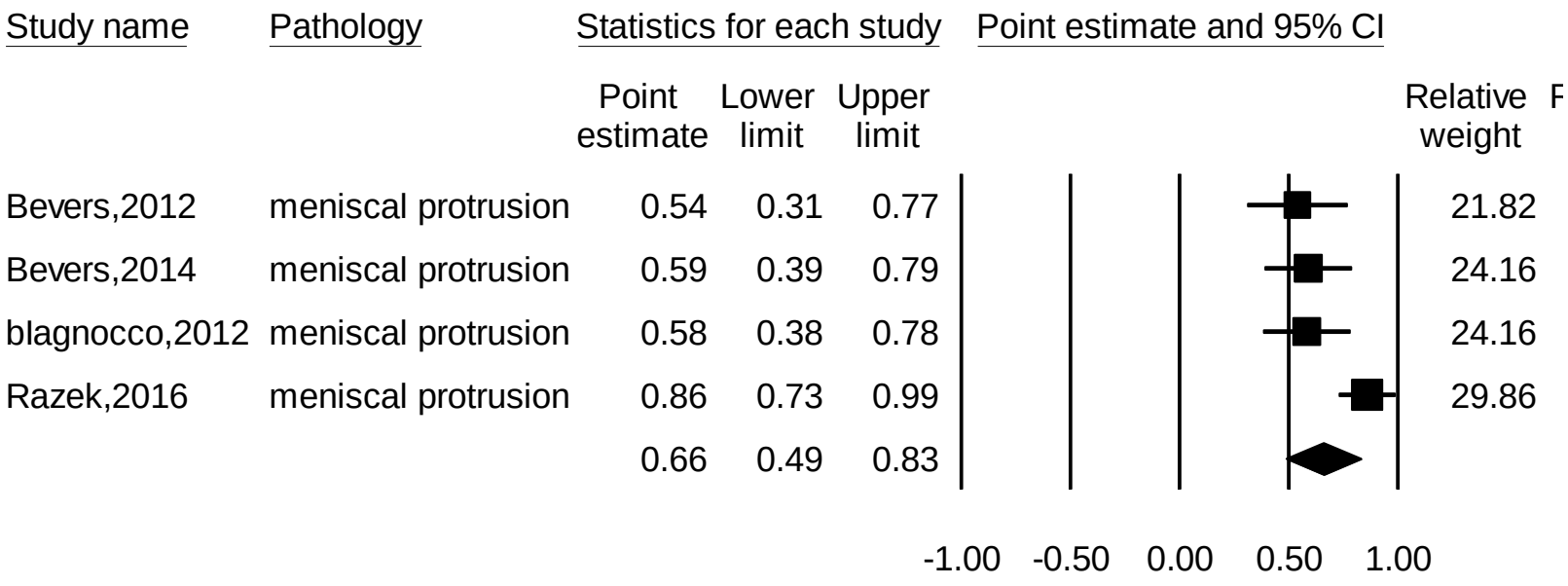
a. Forest plot for meta-analysis of synovial hypertrophy in knee OA



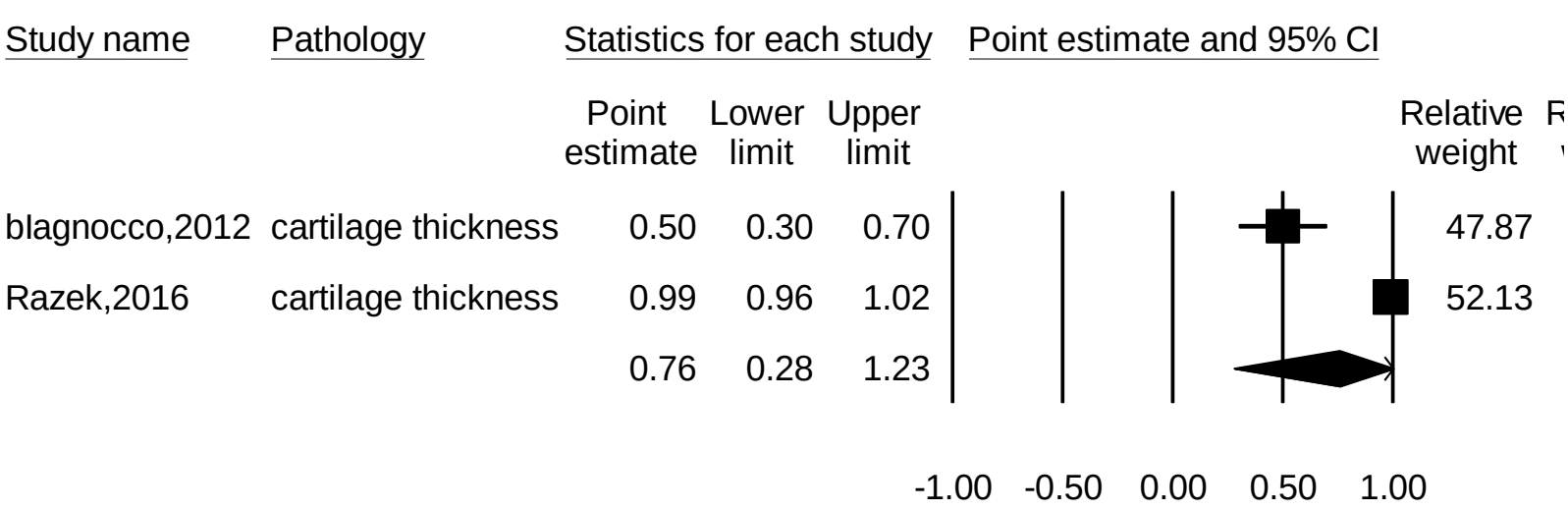
b. Forest plot for meta-analysis of osteophyte in knee OA



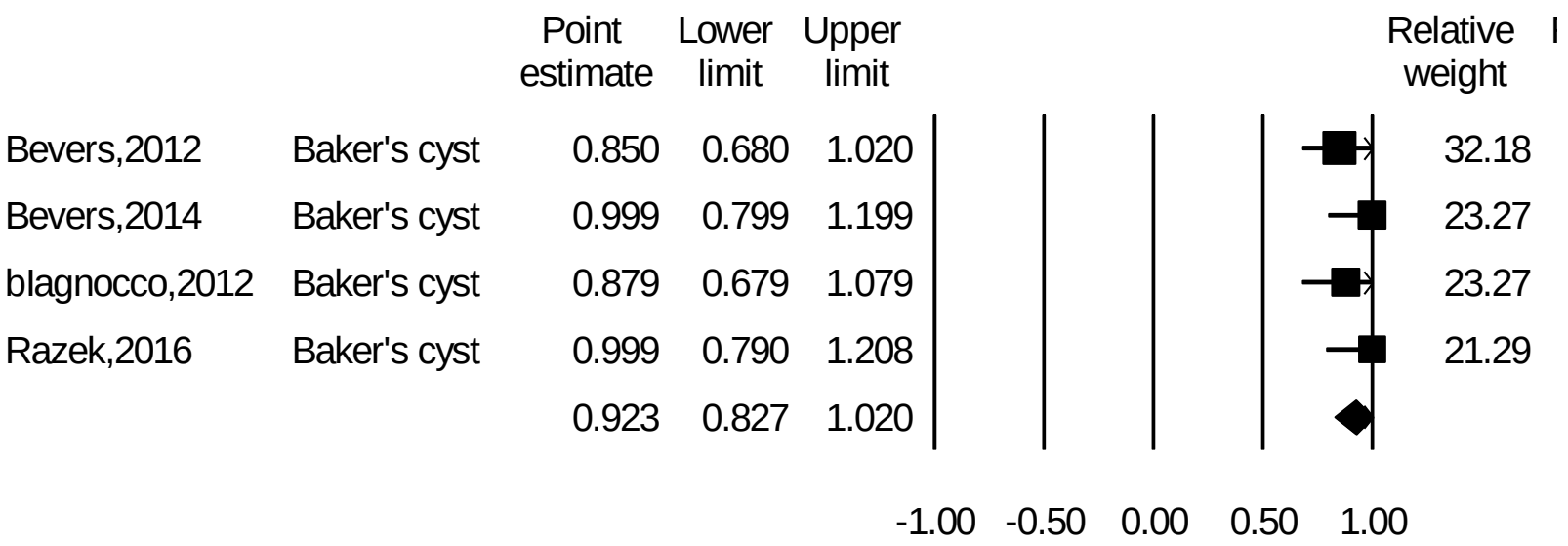
c. Forest plot for meta-analysis of meniscal extrusion in knee OA



d. Forest plot for meta-analysis of cartilage thickness in knee OA

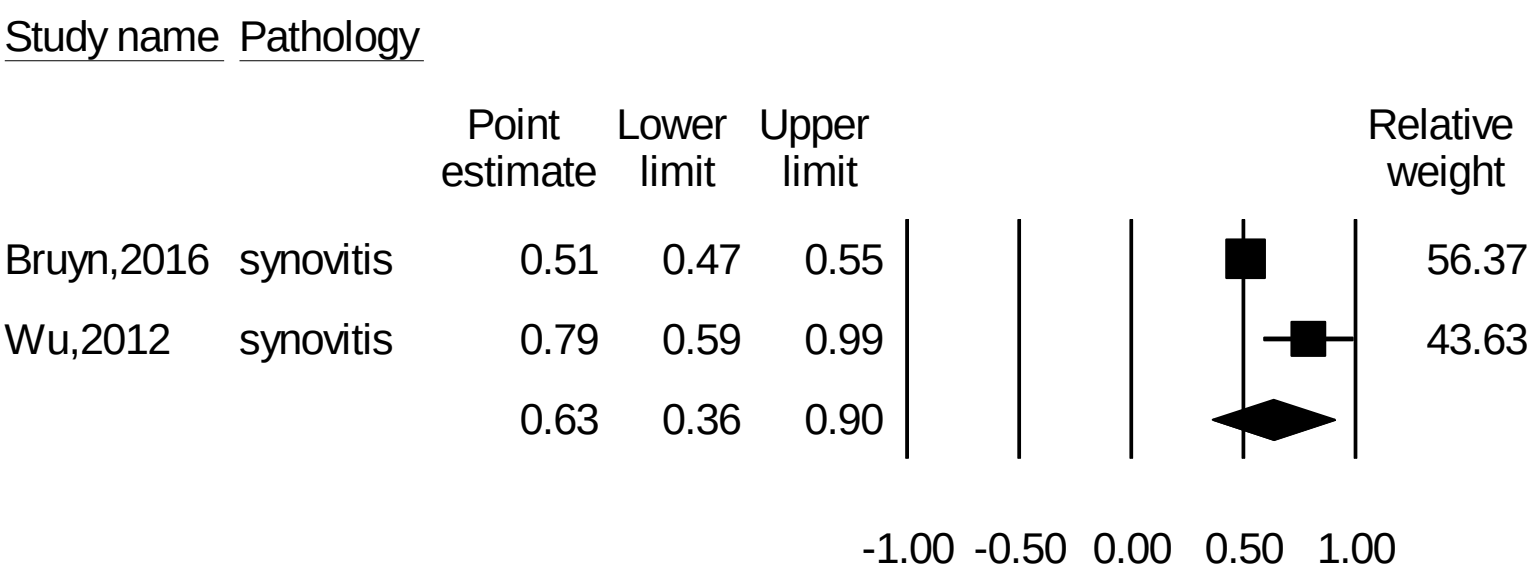


e. Forest plot for meta-analysis of Baker's cyst in knee OA

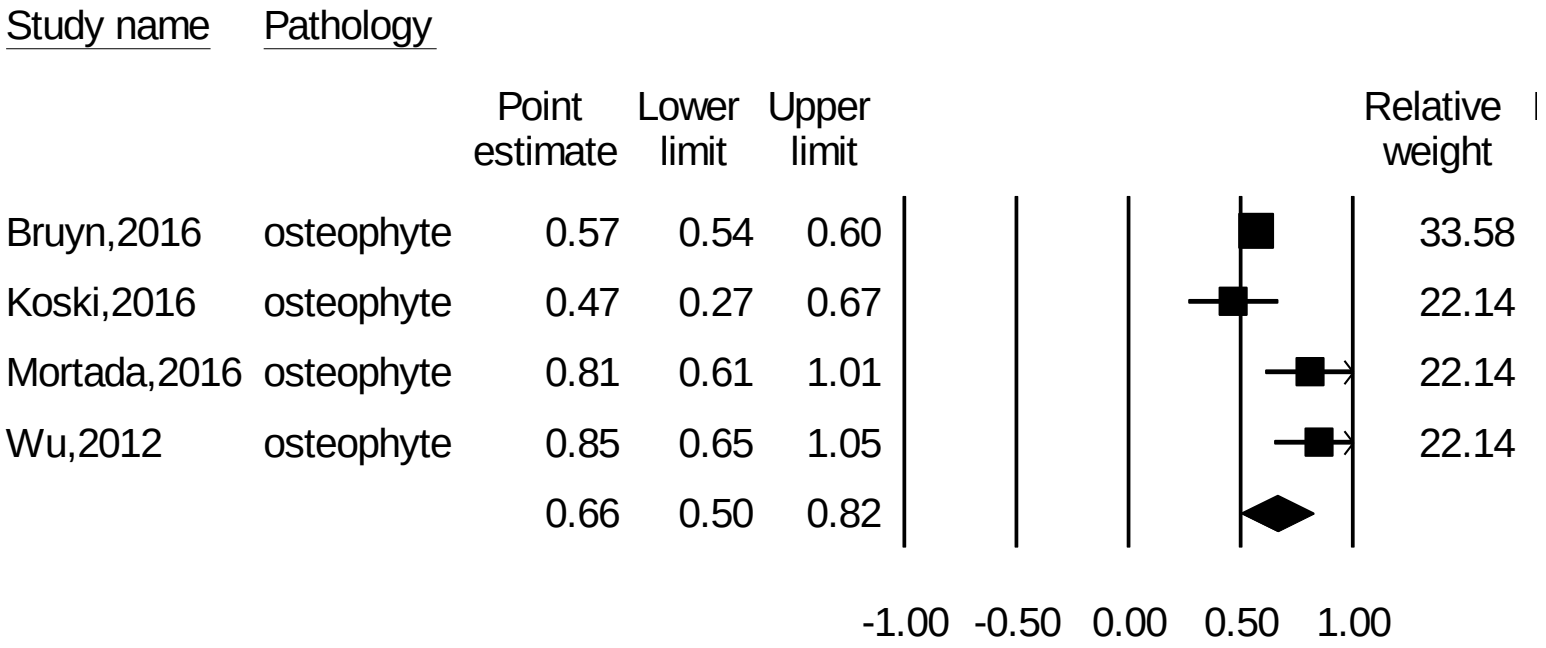


II. Inter-rater reliability for ultrasound features in knee OA (semi-quantitative score)

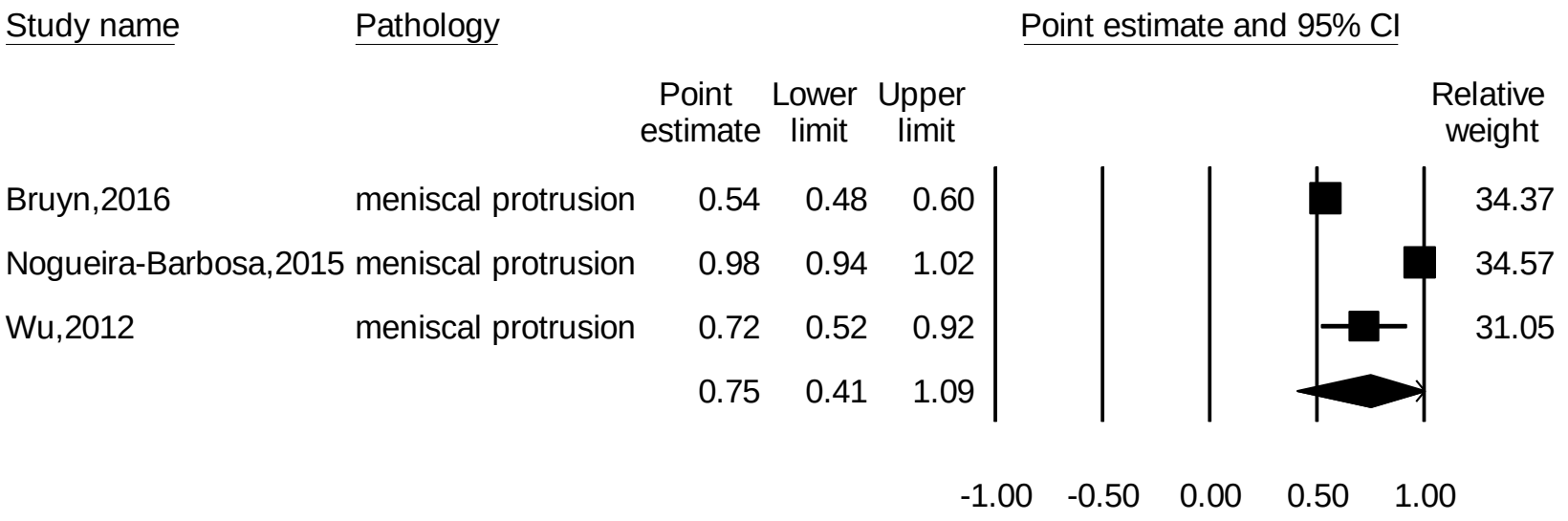
a. Forest plot for meta-analysis of synovitis in knee OA



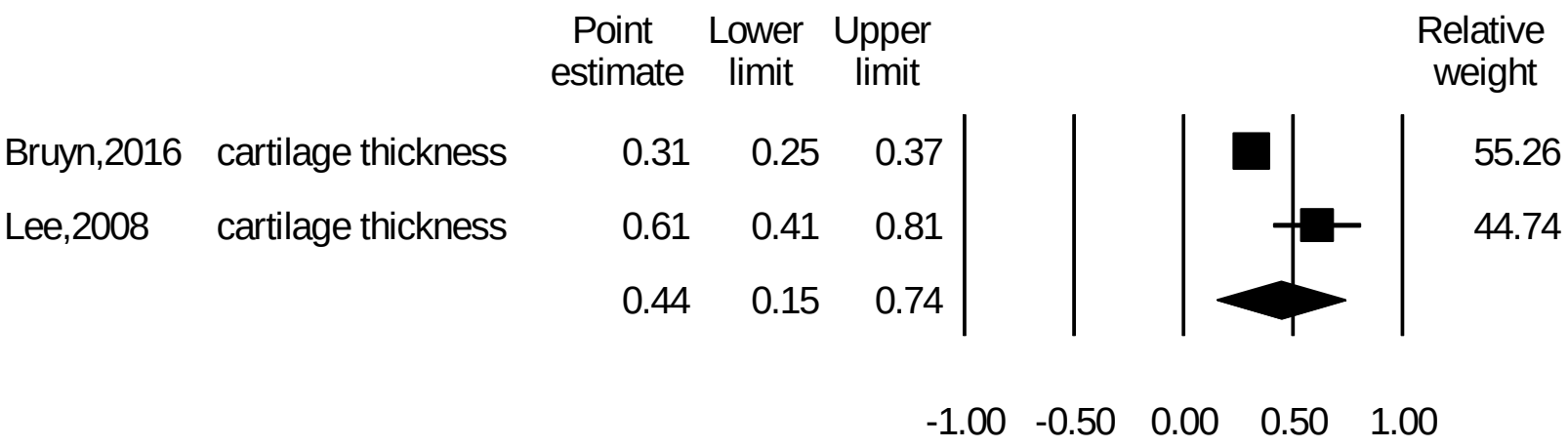
b. Forest plot for meta-analysis of osteohyte in knee OA



c. Forest plot for meta-analysis of meniscal extrusion in knee OA

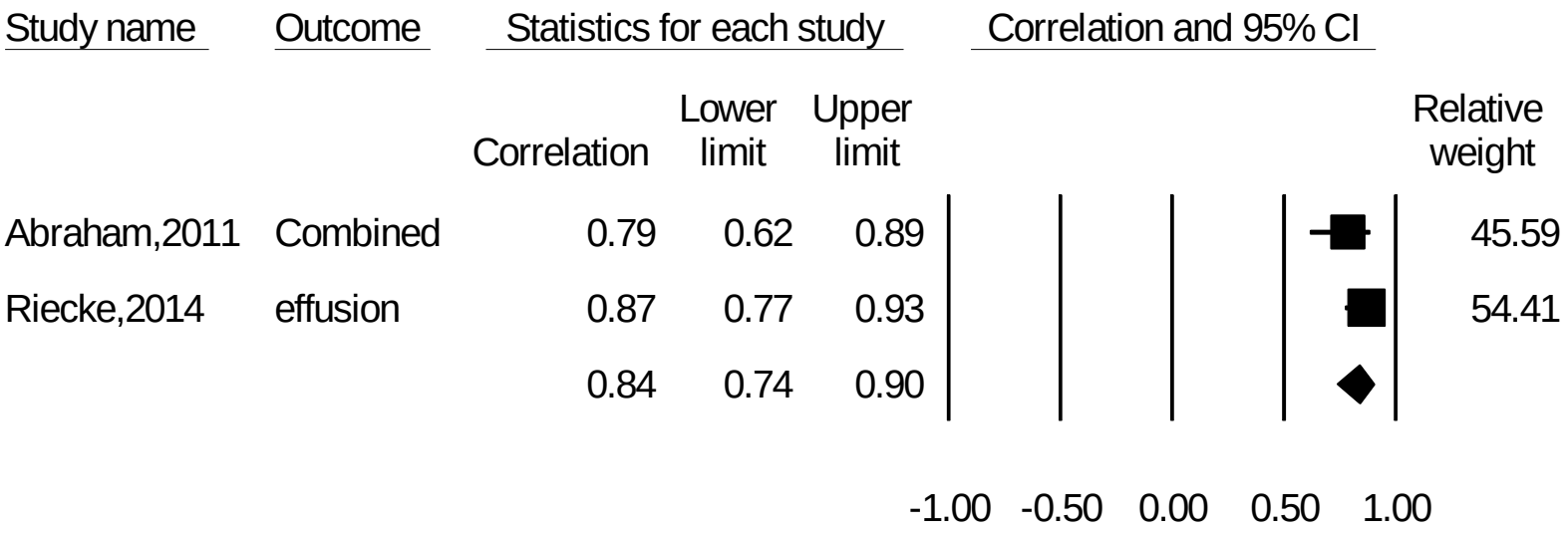


d. Forest plot for meta-analysis of cartilage thickness in knee OA

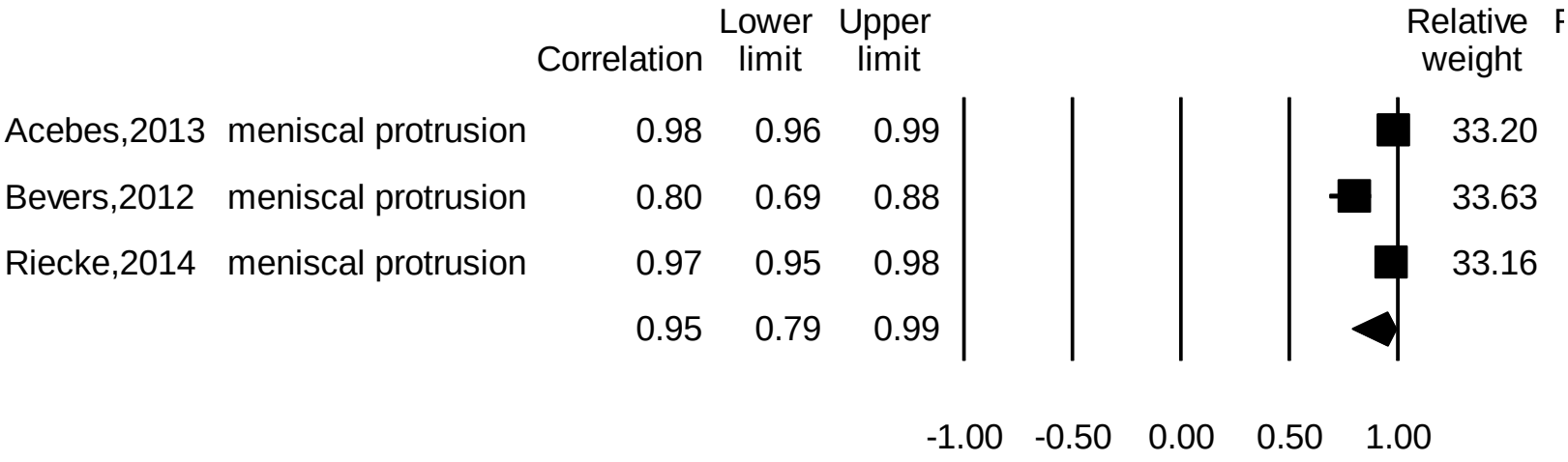


III. Inter-rater reliability for knee OA (Quantitative score)

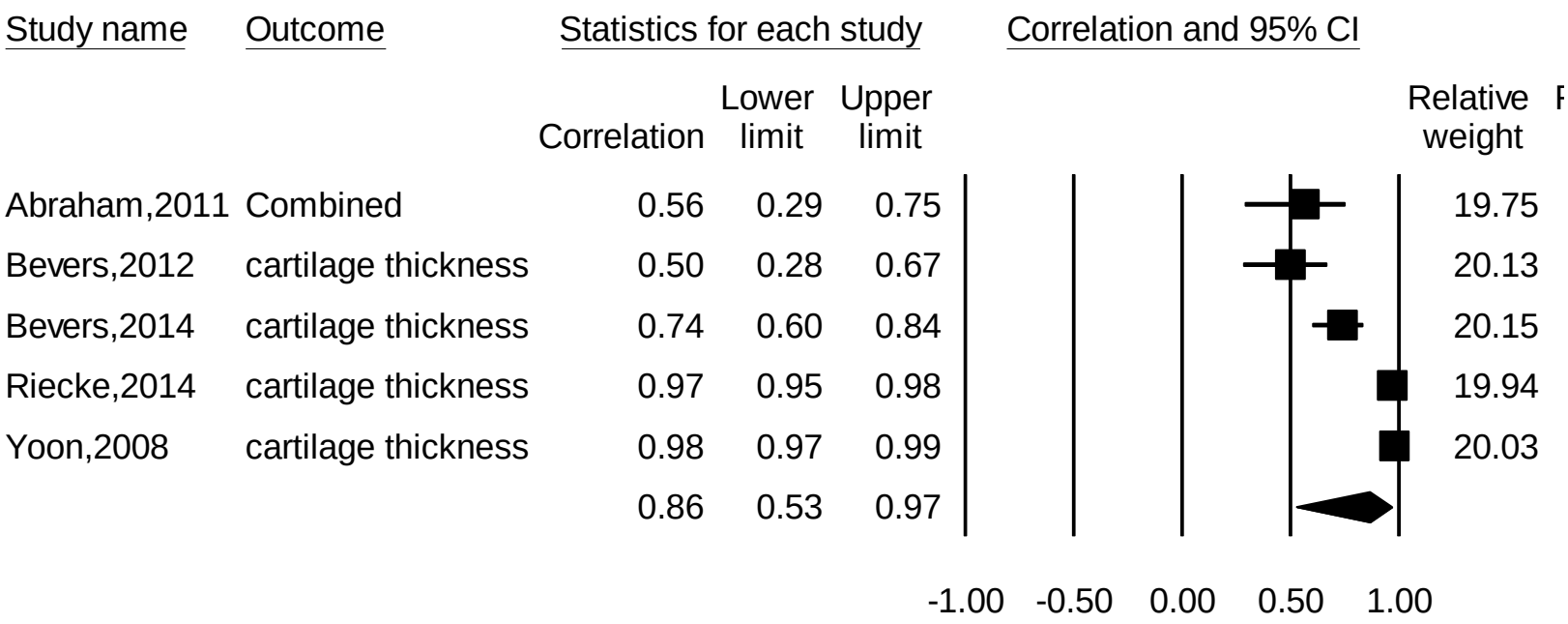
a. Forest plot for meta-analysis of effusion in knee OA



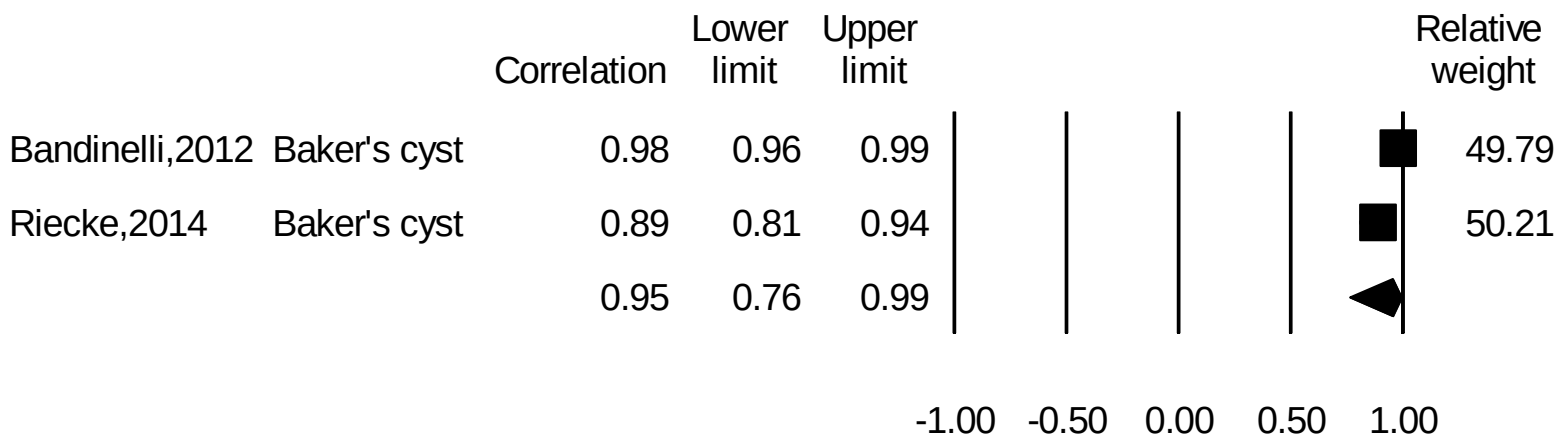
b. Forest plot for meta-analysis of meniscal protrusion in knee OA



c. Forest plot for meta-analysis of cartilage thickness in knee OA

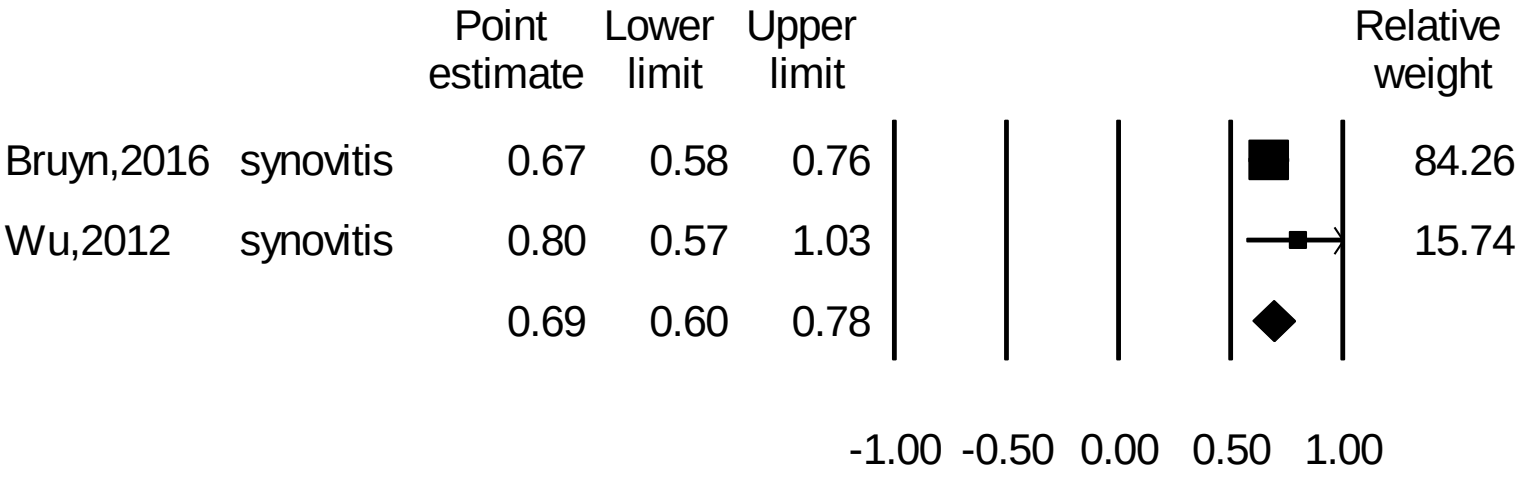


d. Forest plot for meta-analysis of Baker's cyst in knee OA

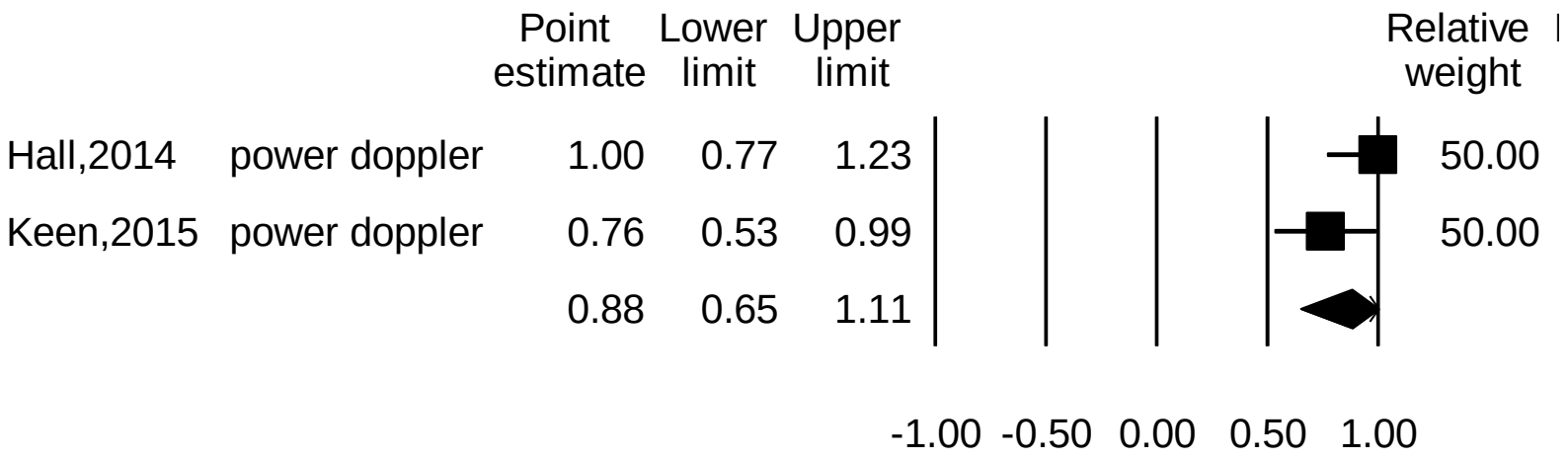


IV. Intra-rater reliability for knee OA (semi-quantitative score)

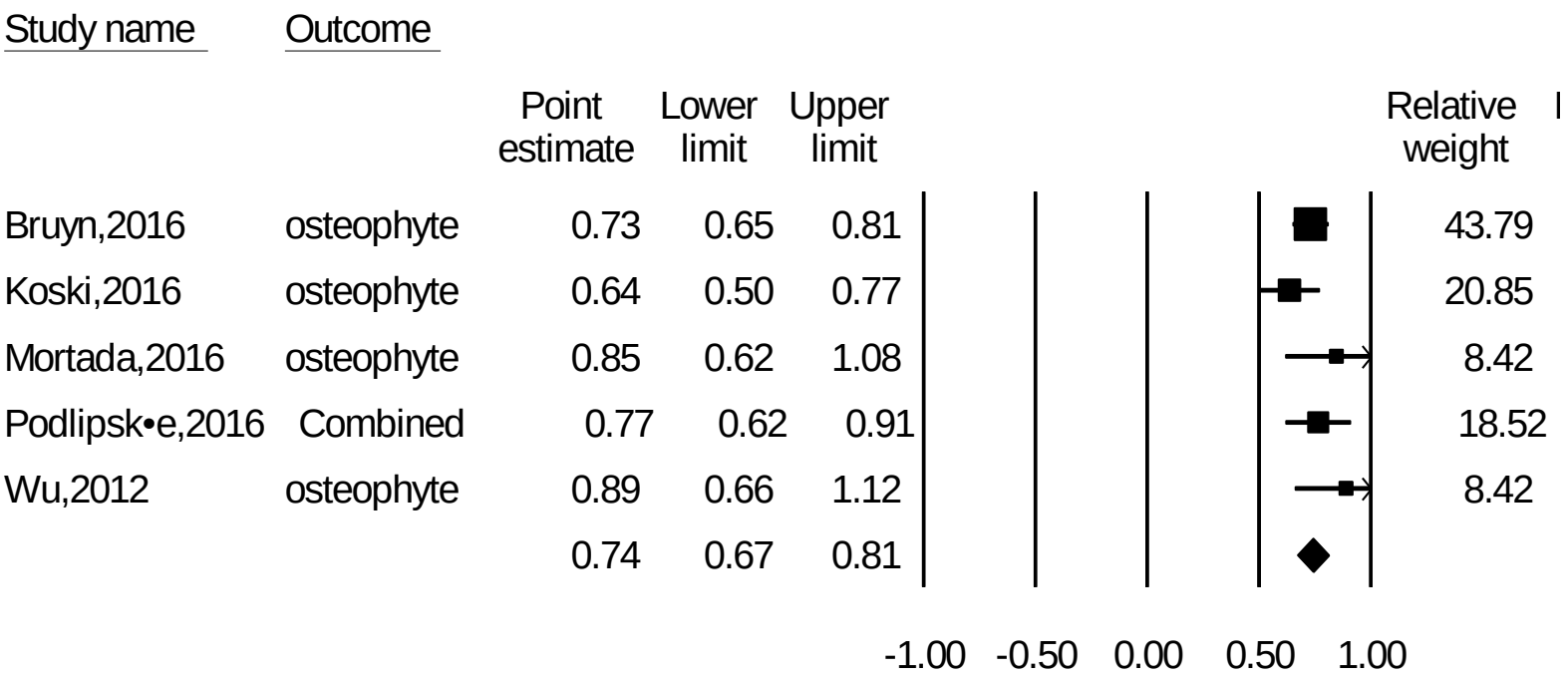
a. Forest plot for meta-analysis of synovitis in knee OA



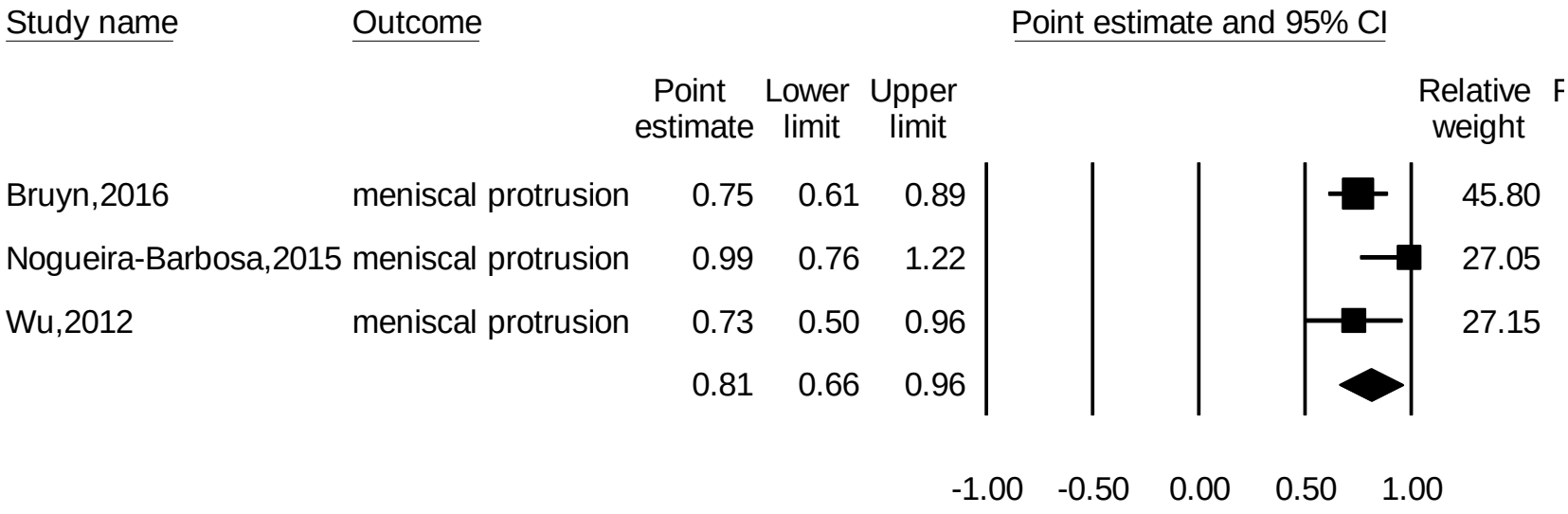
b. Forest plot for meta-analysis of power Doppler in knee OA



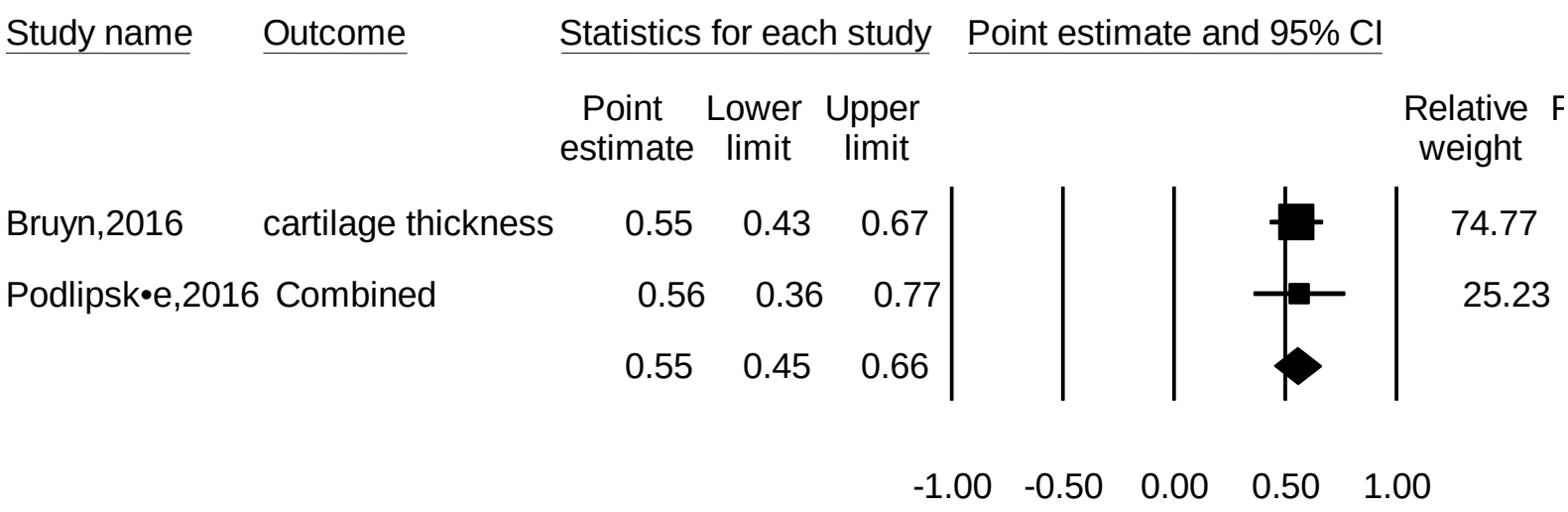
c. Forest plot for meta-analysis of osteophyte in knee OA



d. Forest plot for meta-analysis of meniscal protrusion in knee OA

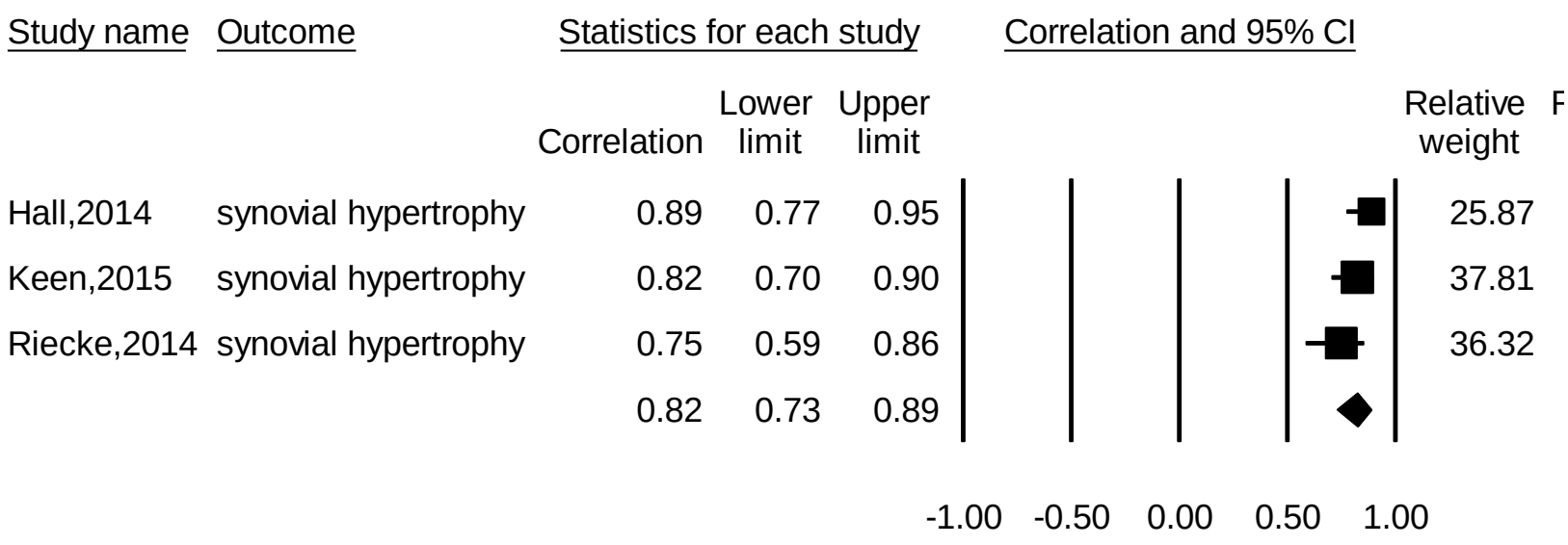


e. Forest plot for meta-analysis of cartilage thickness in knee OA

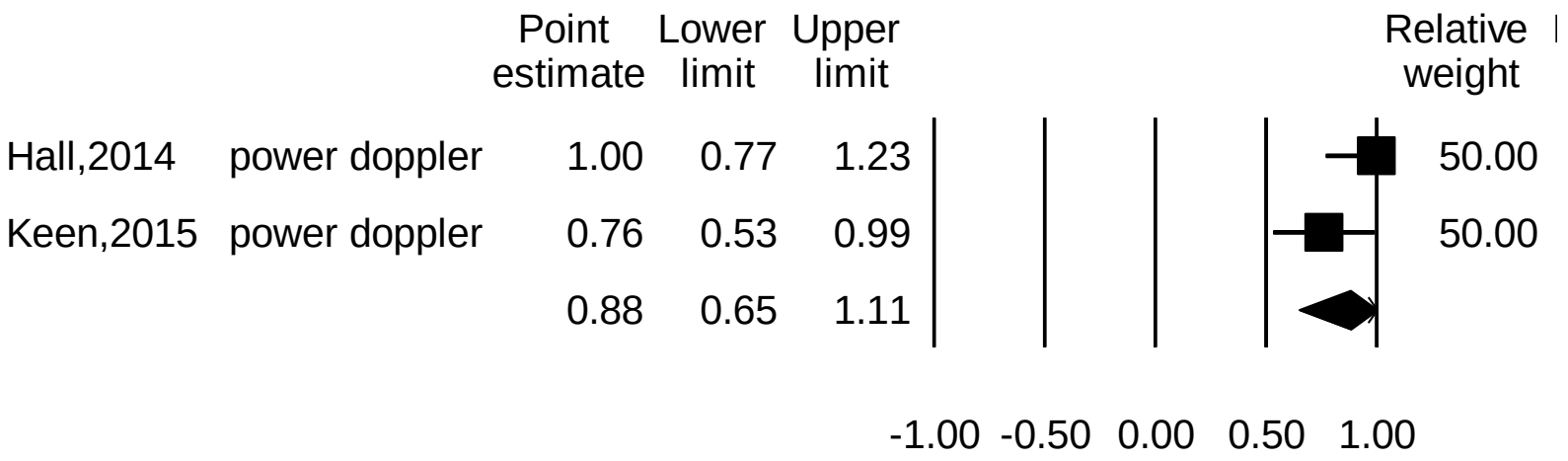


V. Intra-rater reliability for knee OA (Quantitative score)

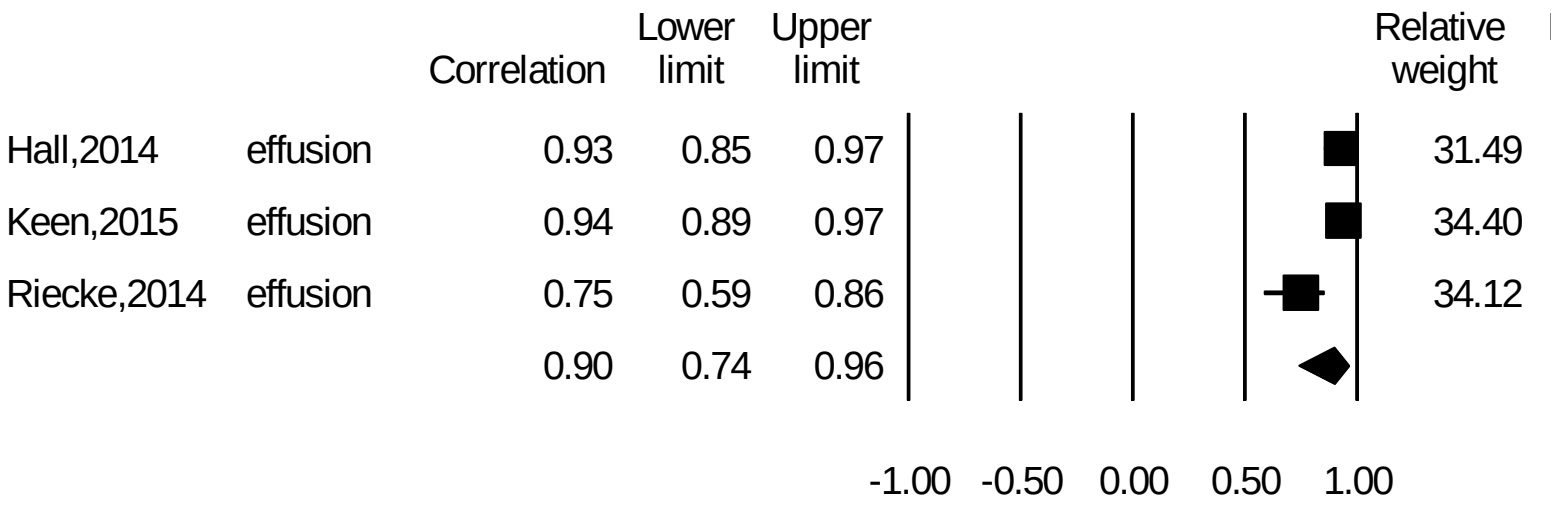
a. Forest plot for meta-analysis of synovial hypertrophy in knee OA



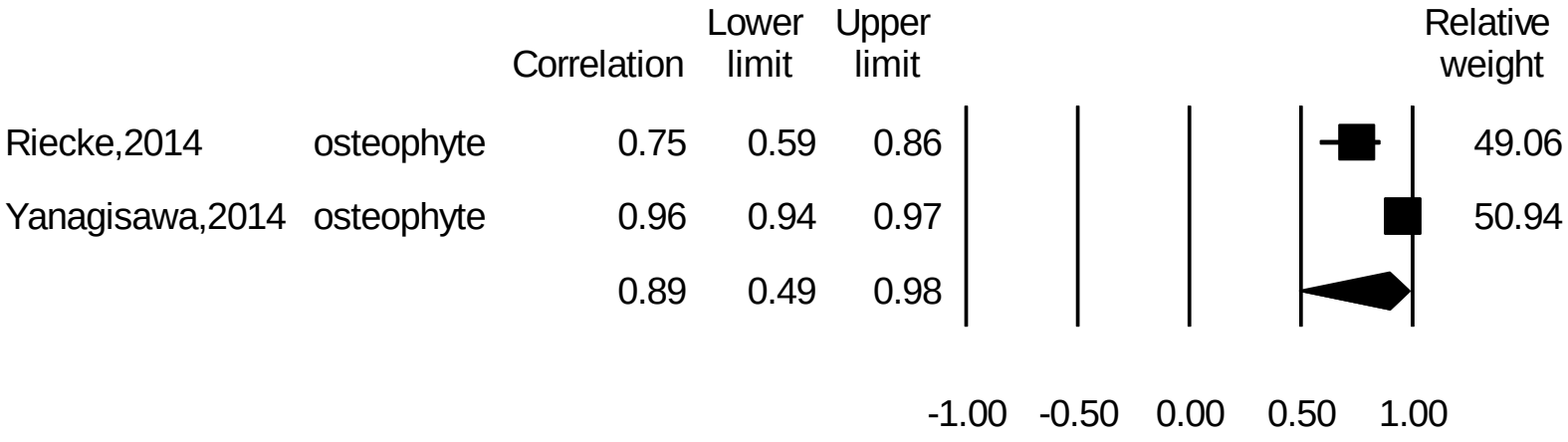
b. Forest plot for meta-analysis of power Doppler in knee OA



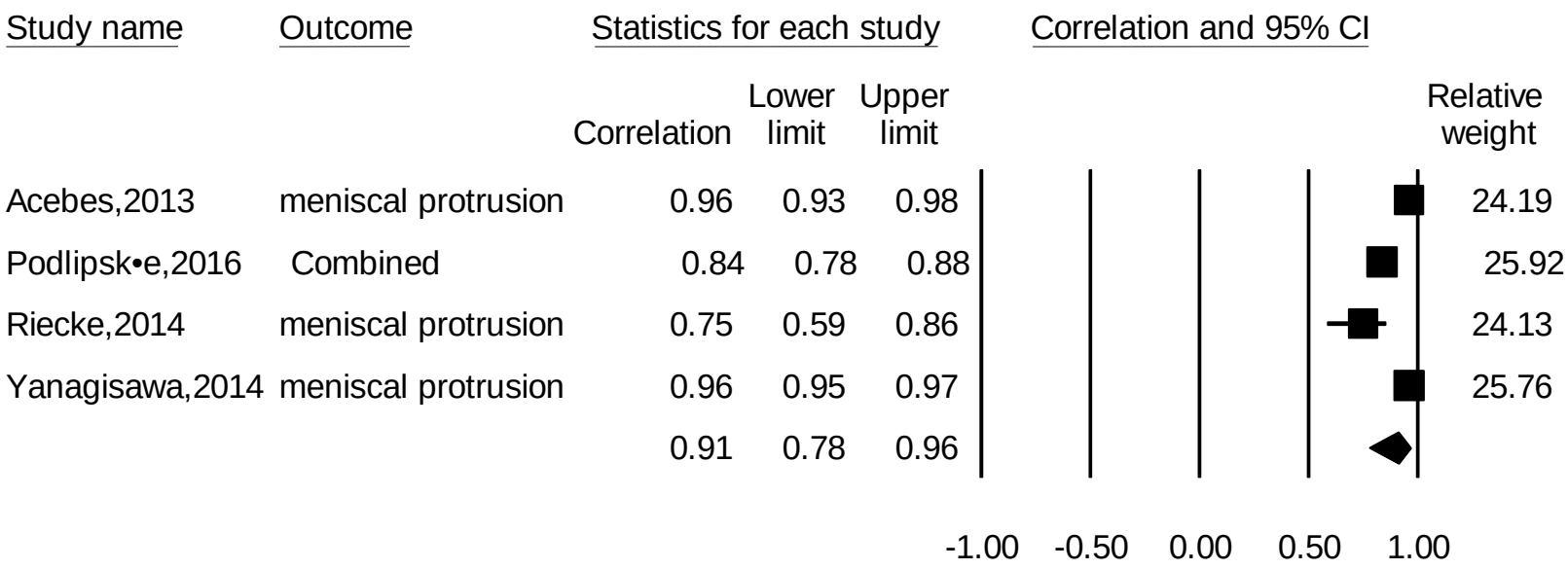
c. Forest plot for meta-analysis of effusion in knee OA



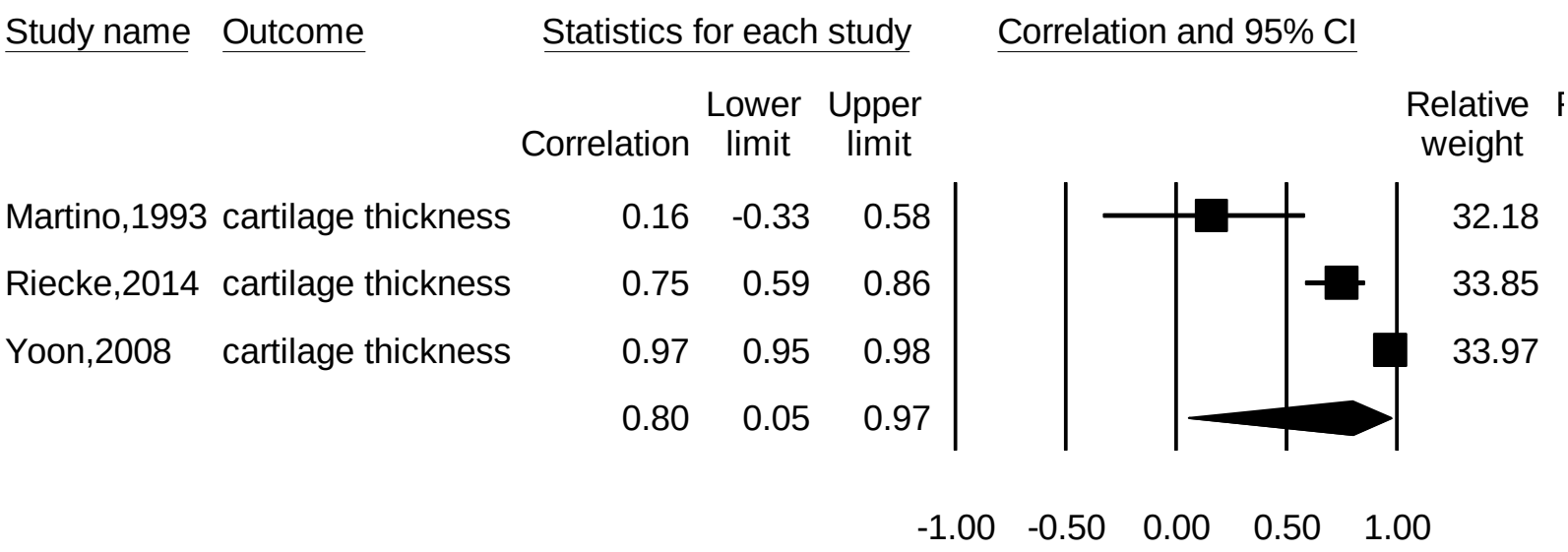
d. Forest plot for meta-analysis of osteophyte in knee OA



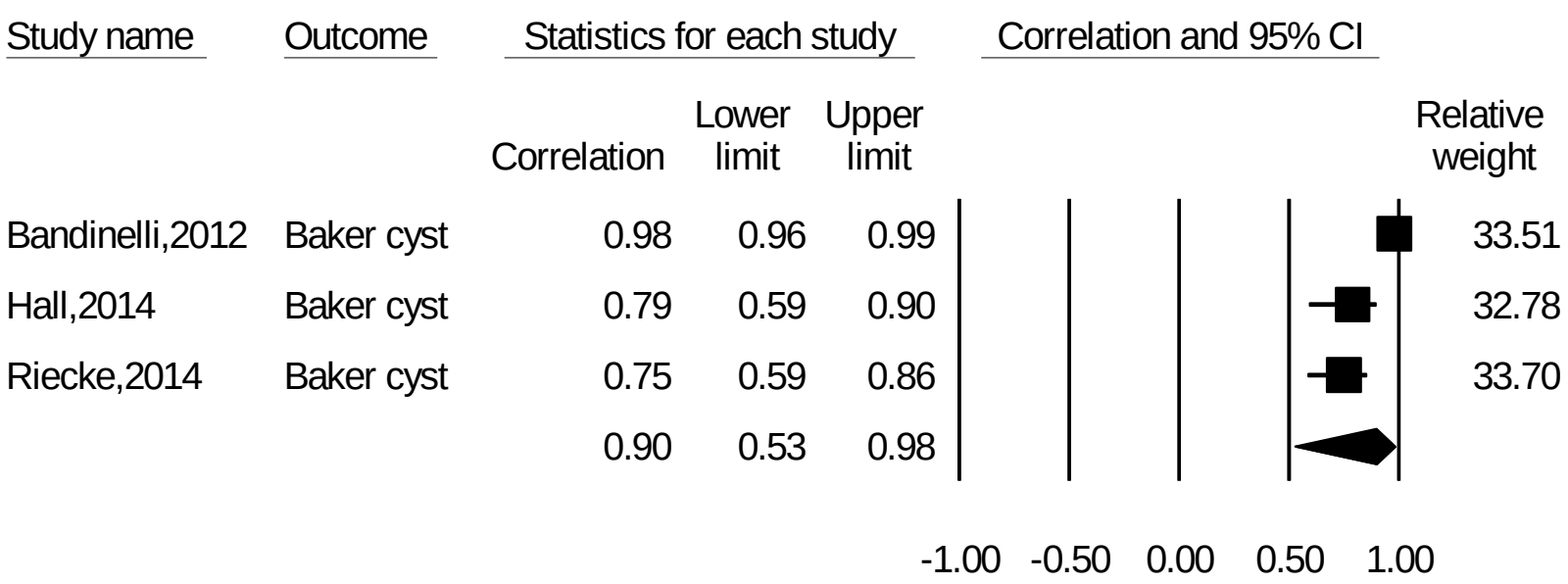
e. Forest plot for meta-analysis of meniscal protrusion in knee OA



f. Forest plot for meta-analysis of cartilage thickness in knee OA



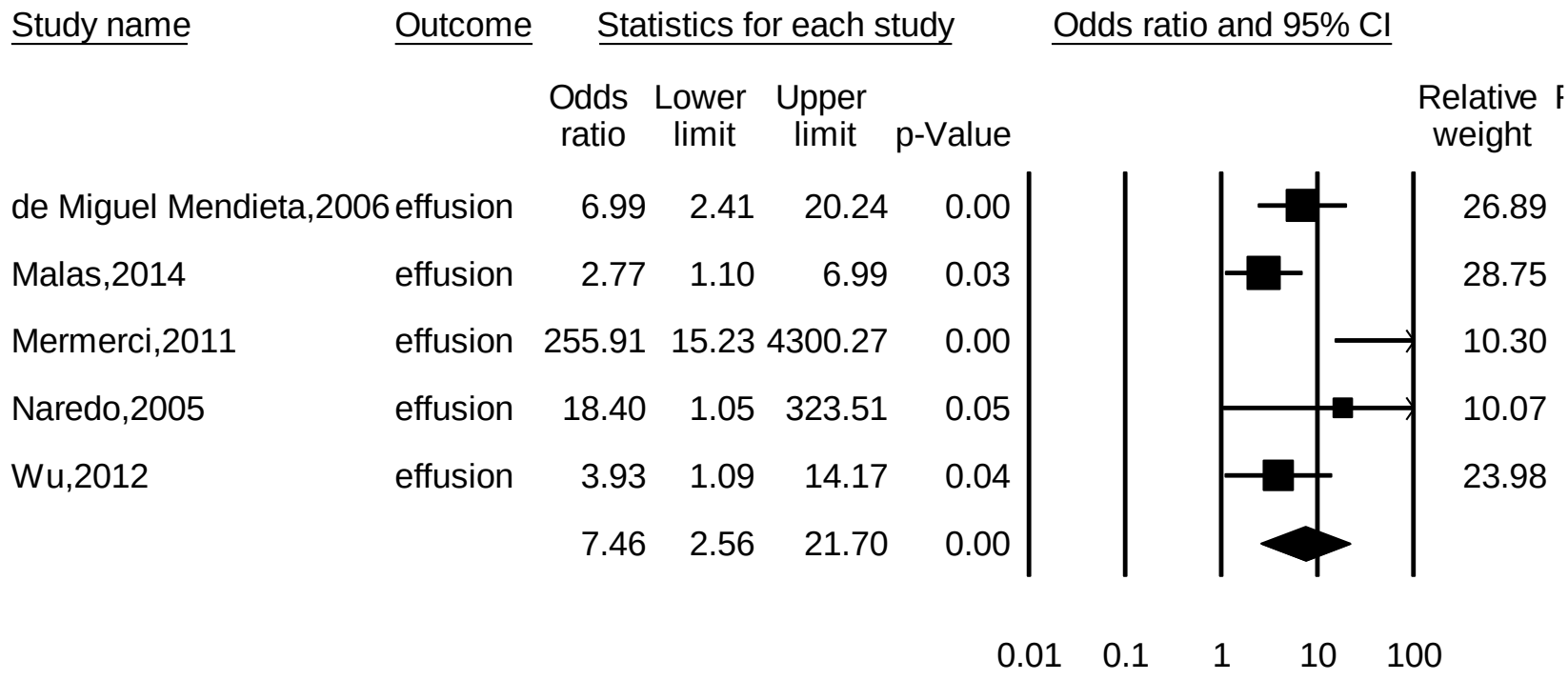
g. Forest plot for meta-analysis of Baker's cyst in knee OA



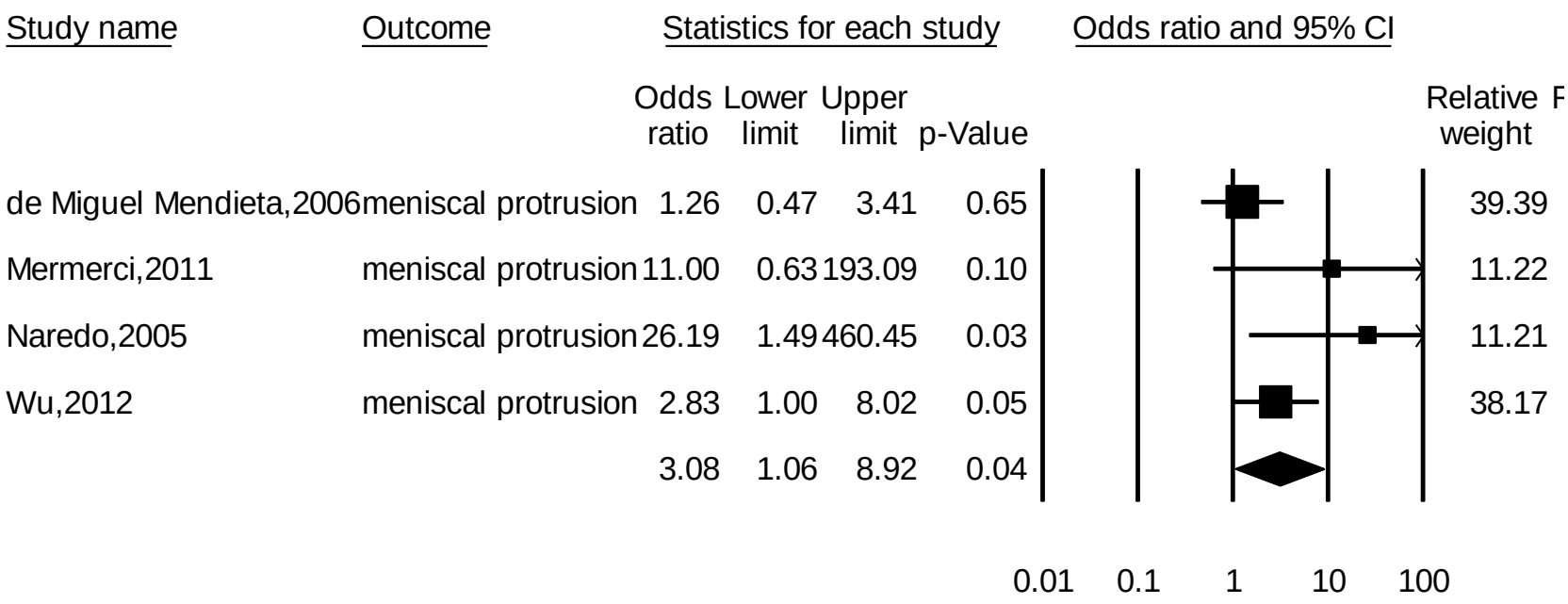
B. Construct validity

I. Construct validity of ultrasound features with symptomatic patients against healthy control

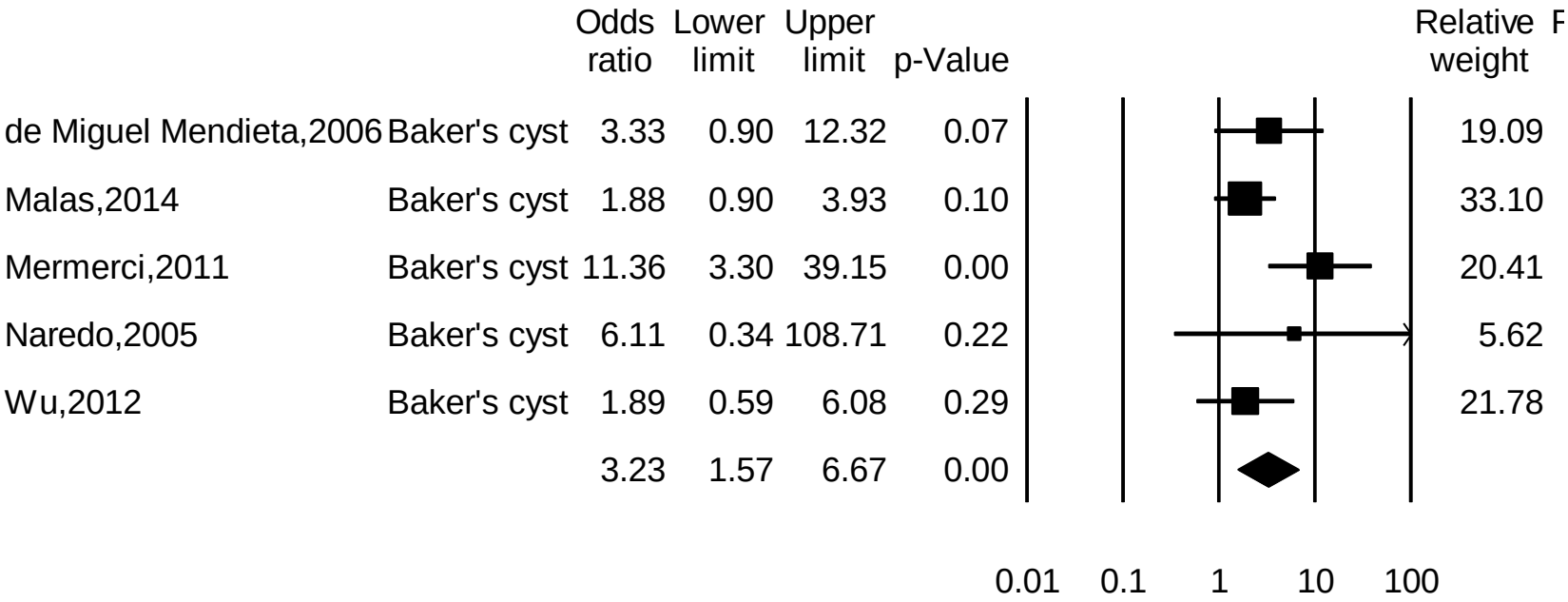
a. Forest plot for meta-analysis of effusion in knee OA



b. Forest plot for meta-analysis of meniscal protrusion in knee OA

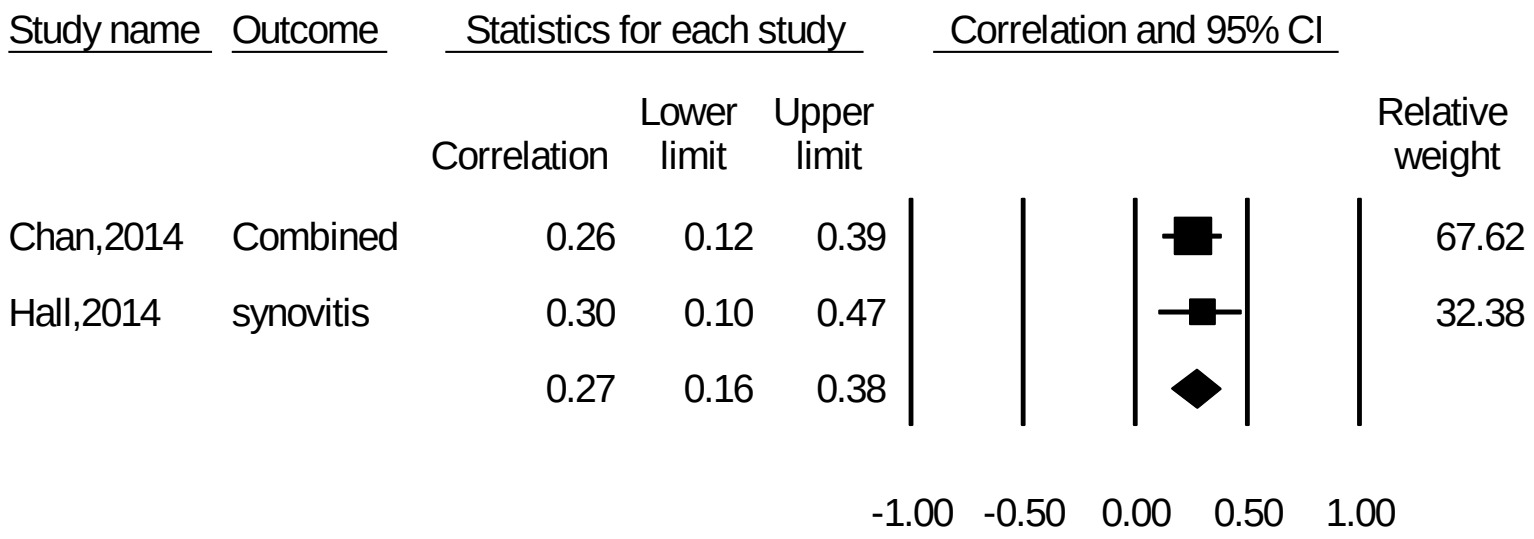


c. Forest plot for meta-analysis of Baker's cyst in knee OA

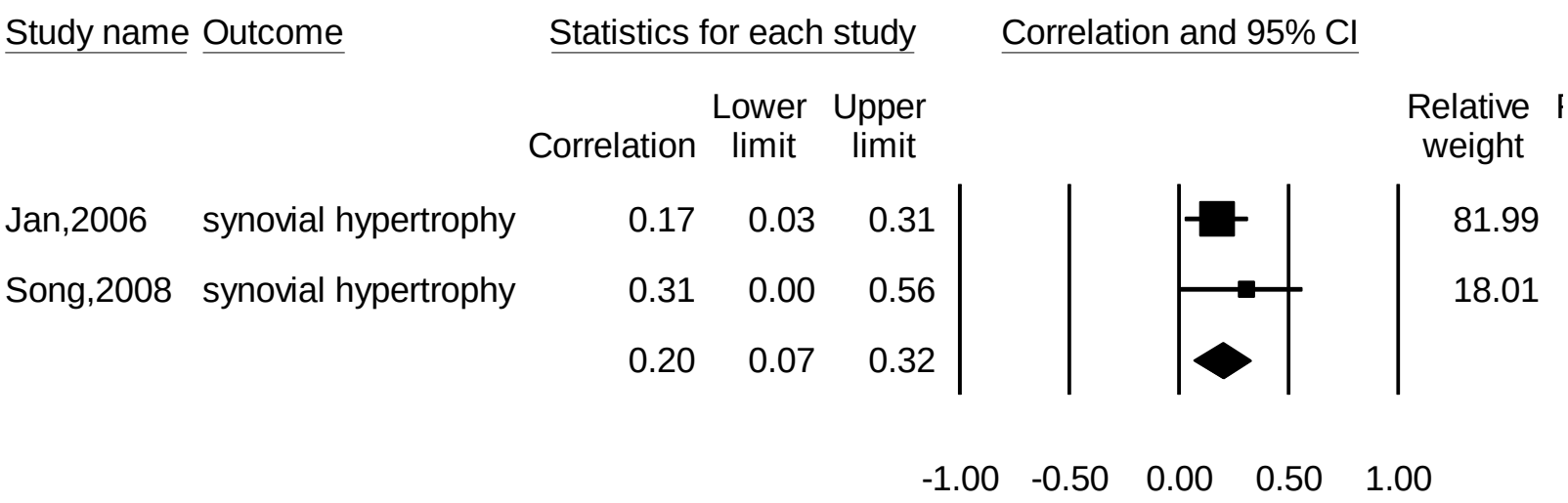


II. Construct validity of ultrasound features with pain

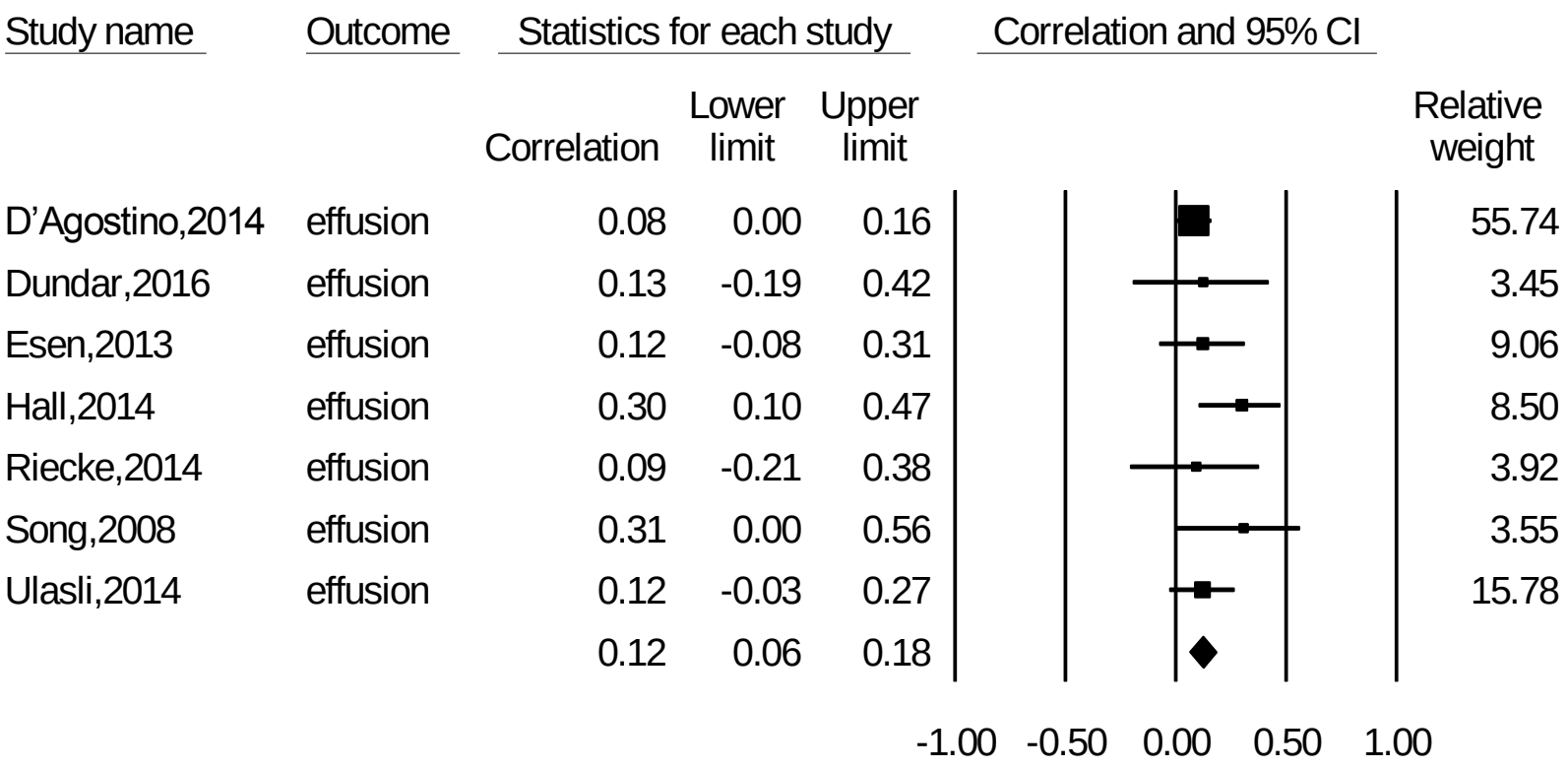
a. Forest plot for meta-analysis of synovitis in knee OA



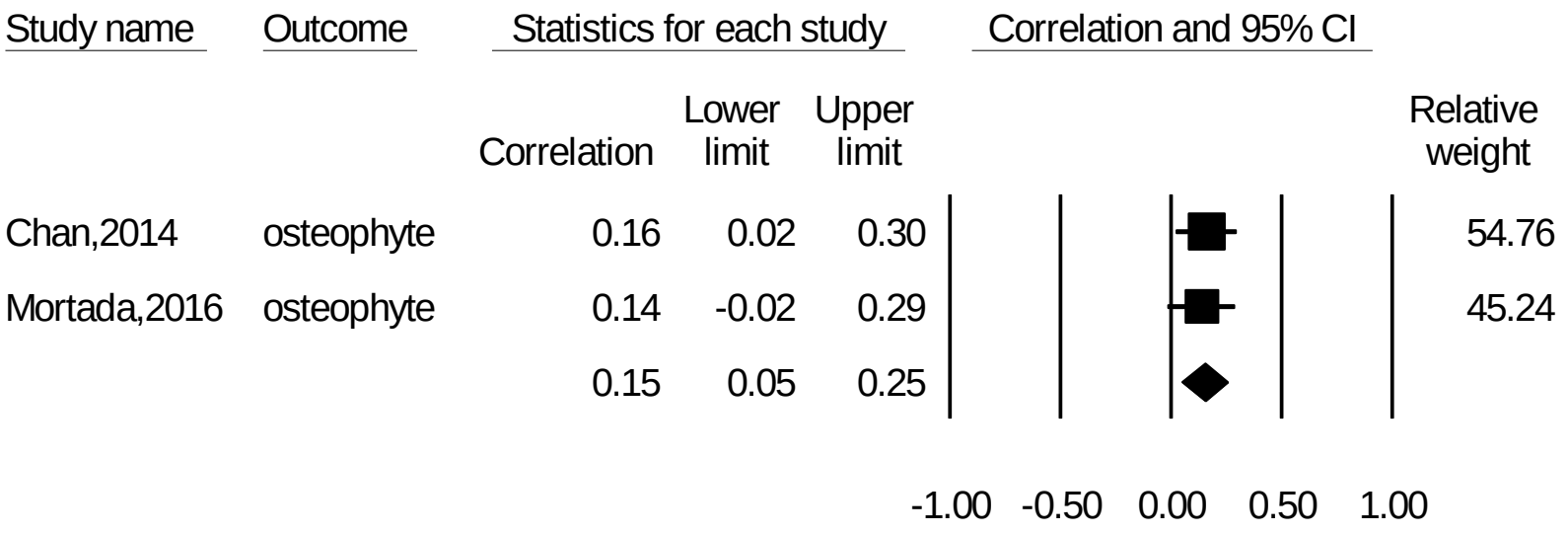
b. Forest plot for meta-analysis of synovial hypertrophy in knee OA



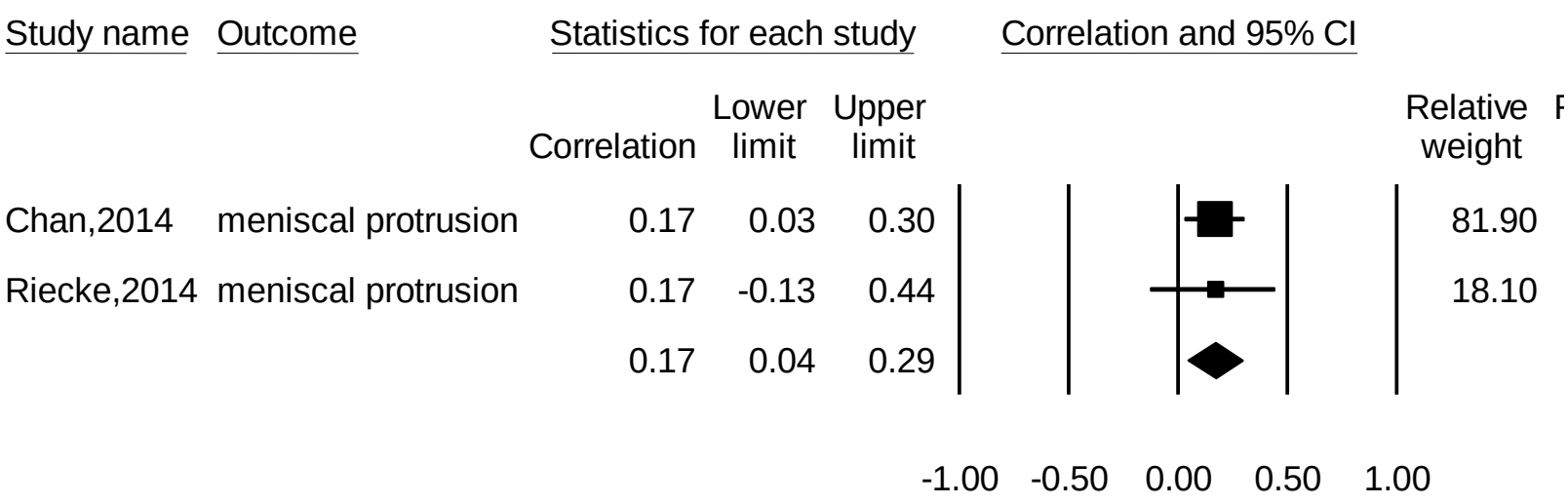
c. Forest plot for meta-analysis of effusion in knee OA



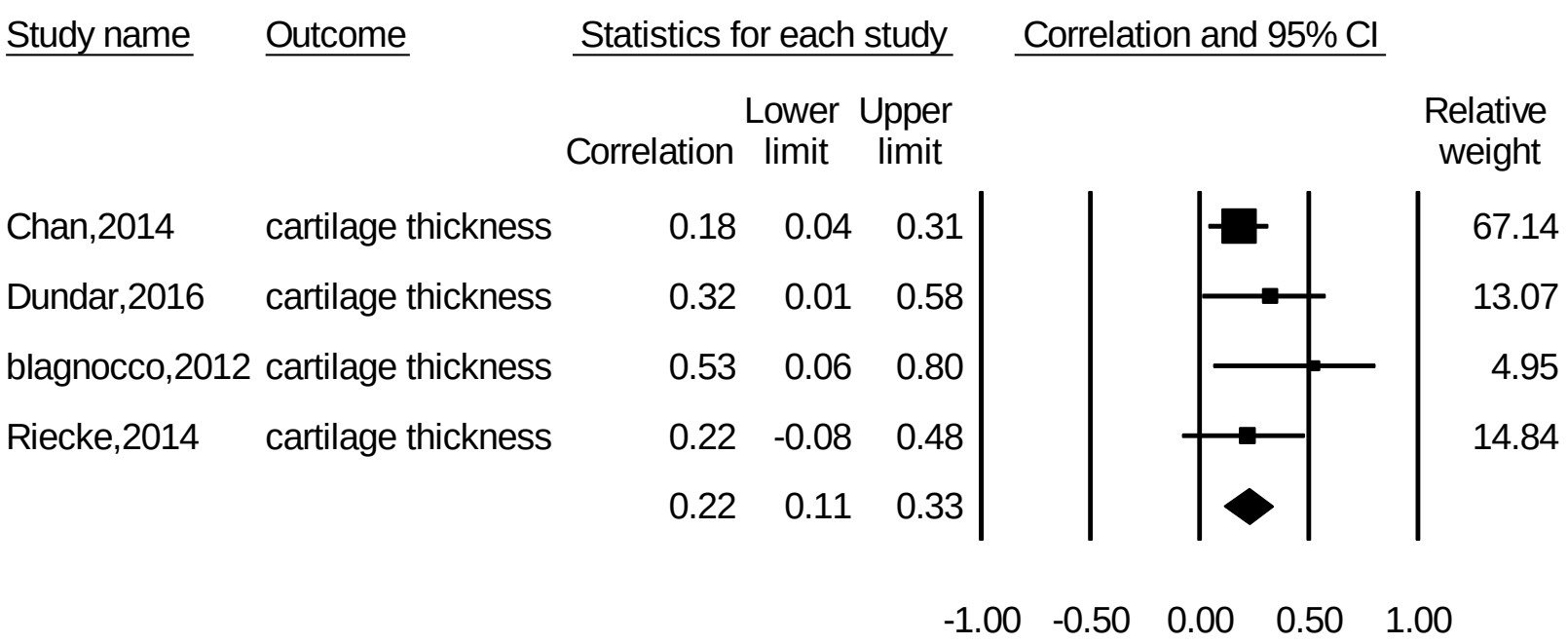
d. Forest plot for meta-analysis of osteophyte in knee OA



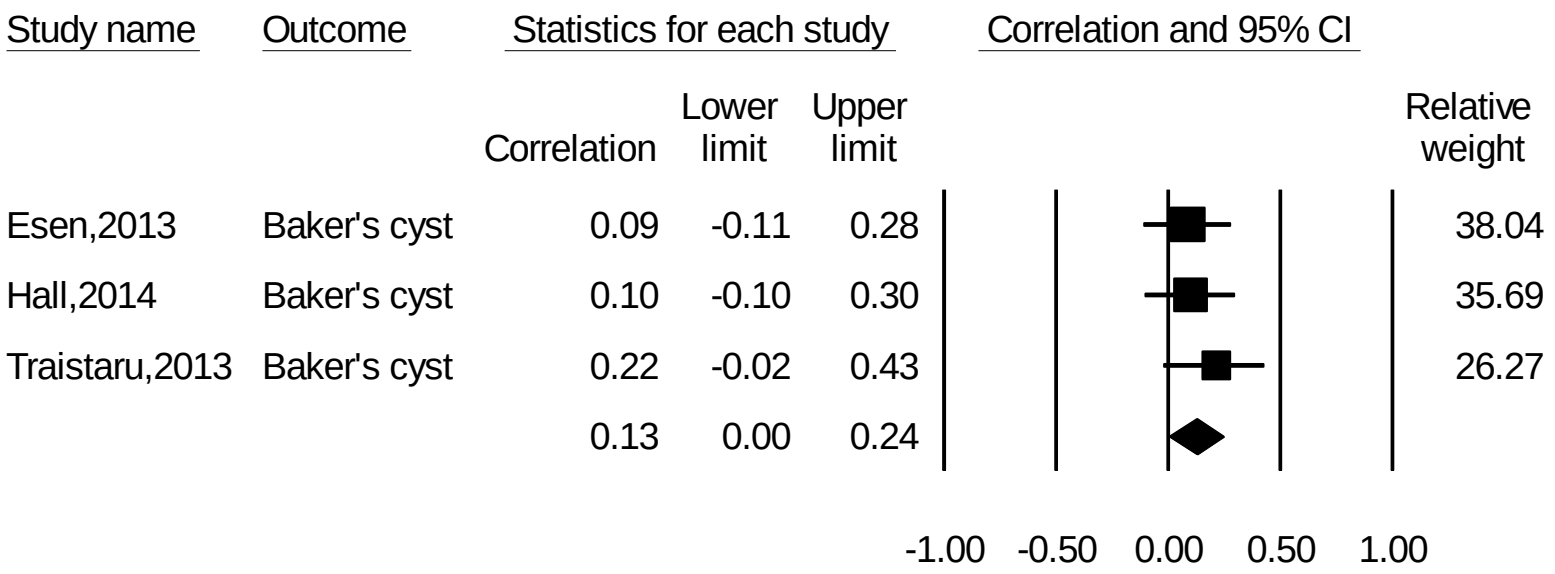
e. Forest plot for meta-analysis of meniscal protrusion in knee OA



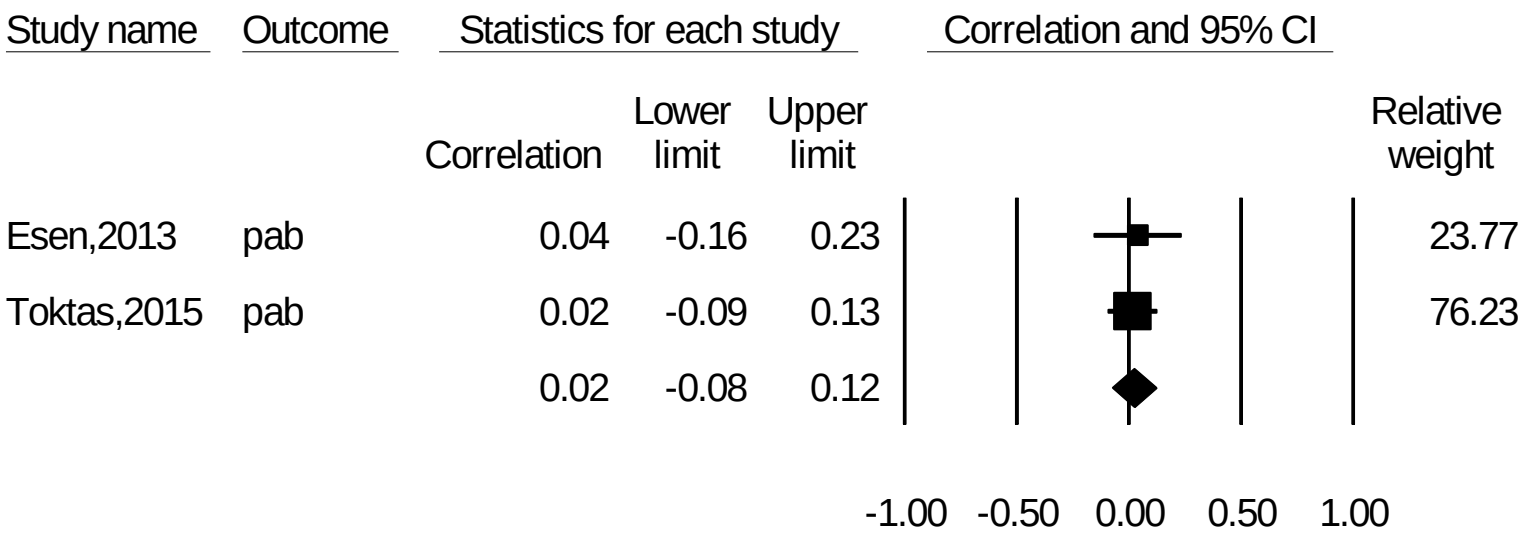
f. Forest plot for meta-analysis of cartilage thickness in knee OA



g. Forest plot for meta-analysis of Baker's cyst in knee OA



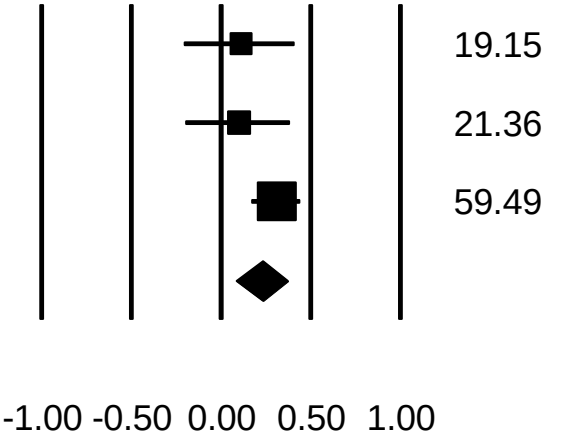
h. Forest plot for meta-analysis of pes anserine bursitis (pab) in knee OA



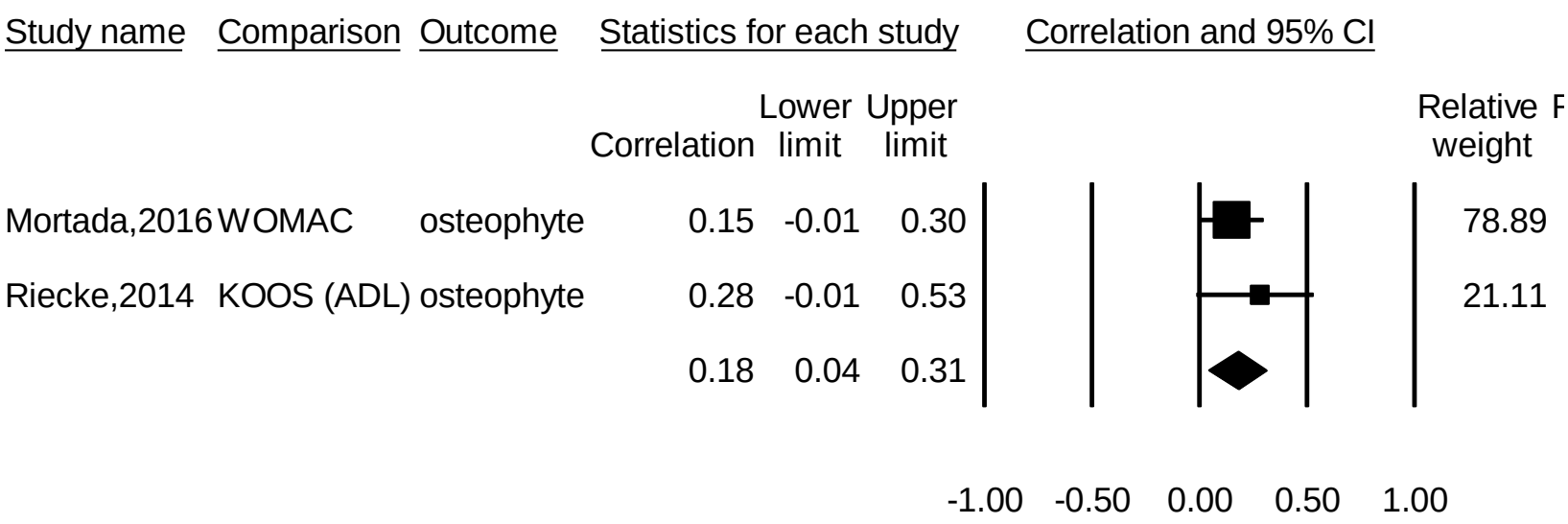
III. Construct validity of ultrasound features with function

a. Forest plot for meta-analysis of effusion in knee OA

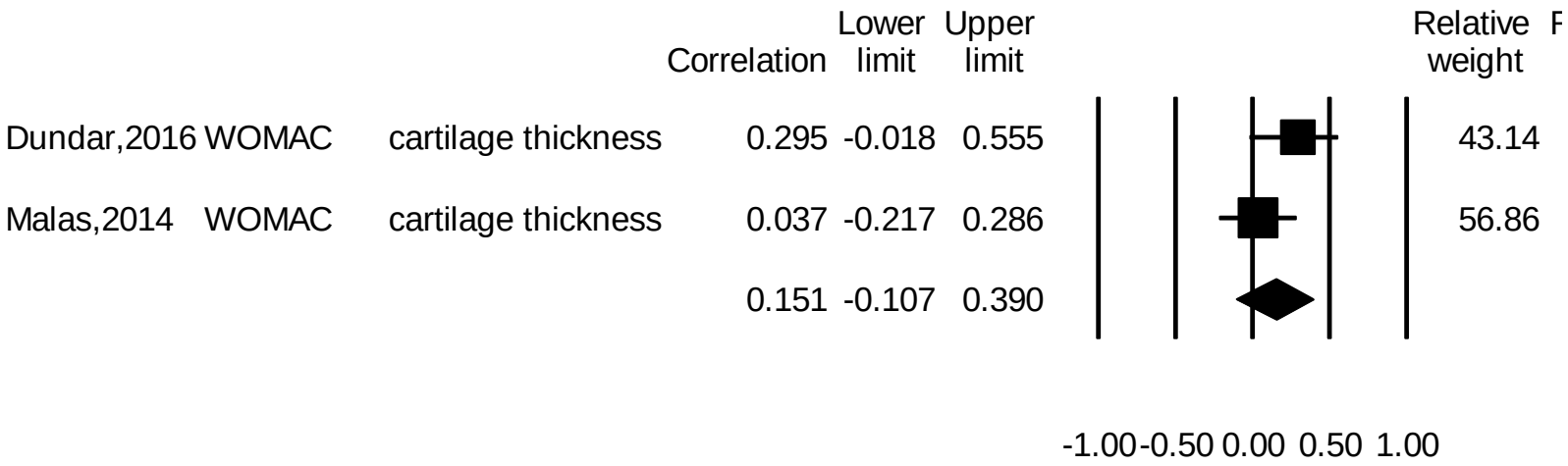
Study name	Comparison	Outcome	Correlation	Lower limit	Upper limit	Relative weight
Dundar,2016	WOMAC	effusion	0.11	-0.21	0.41	19.15
Riecke,2014	KOOS (ADL)	effusion	0.10	-0.20	0.38	21.36
Ulasli,2014	WOMAC	effusion	0.31	0.17	0.44	59.49
			0.23	0.08	0.37	



b. Forest plot for meta-analysis of osteophyte in knee OA

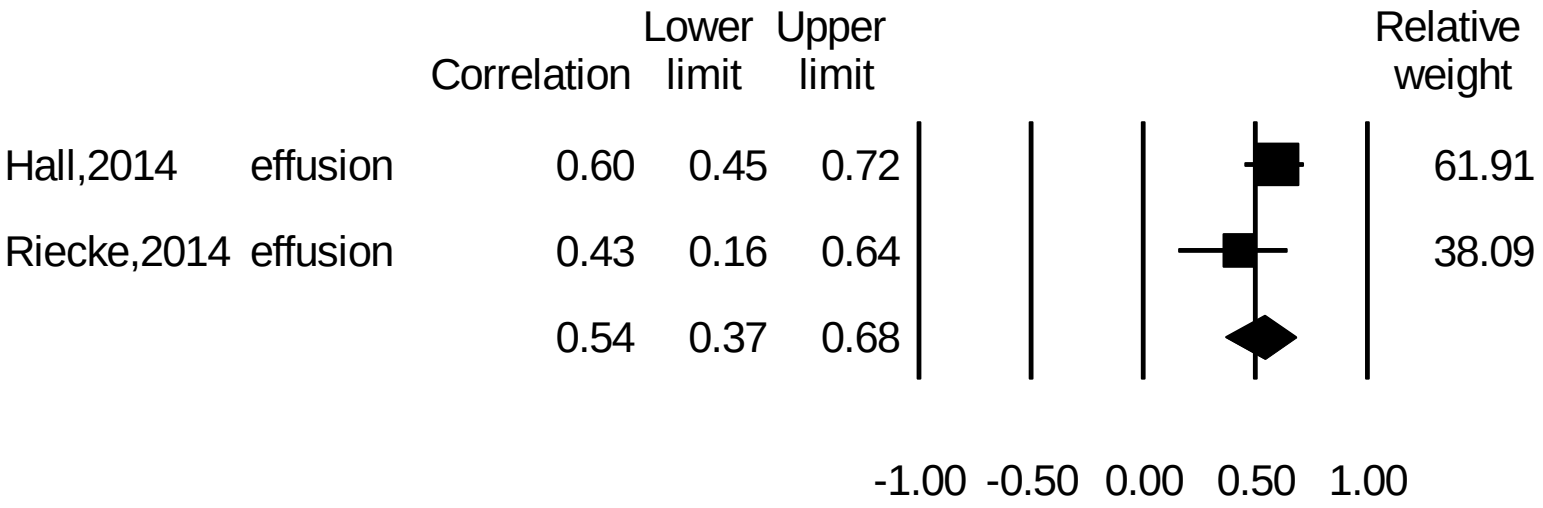


c. Forest plot for meta-analysis of cartilage thickness in knee OA

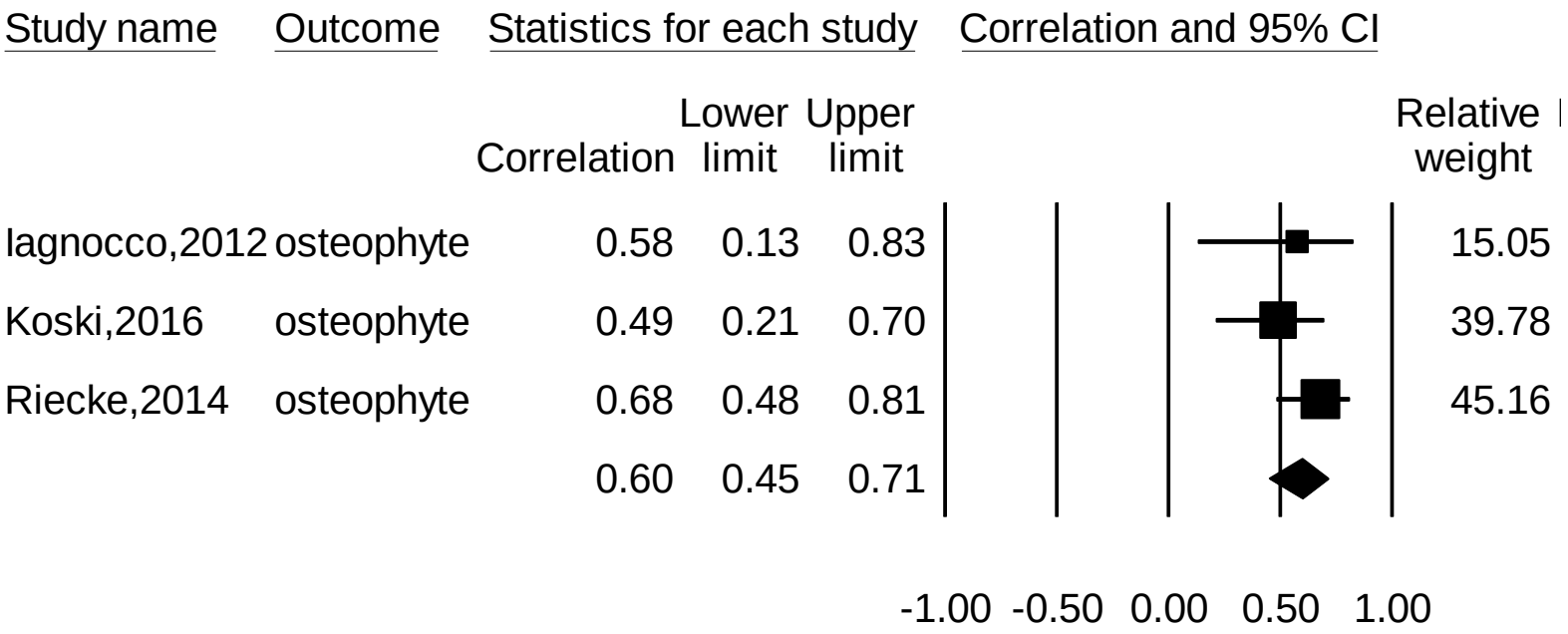


IV. Construct validity of ultrasound features with X rays

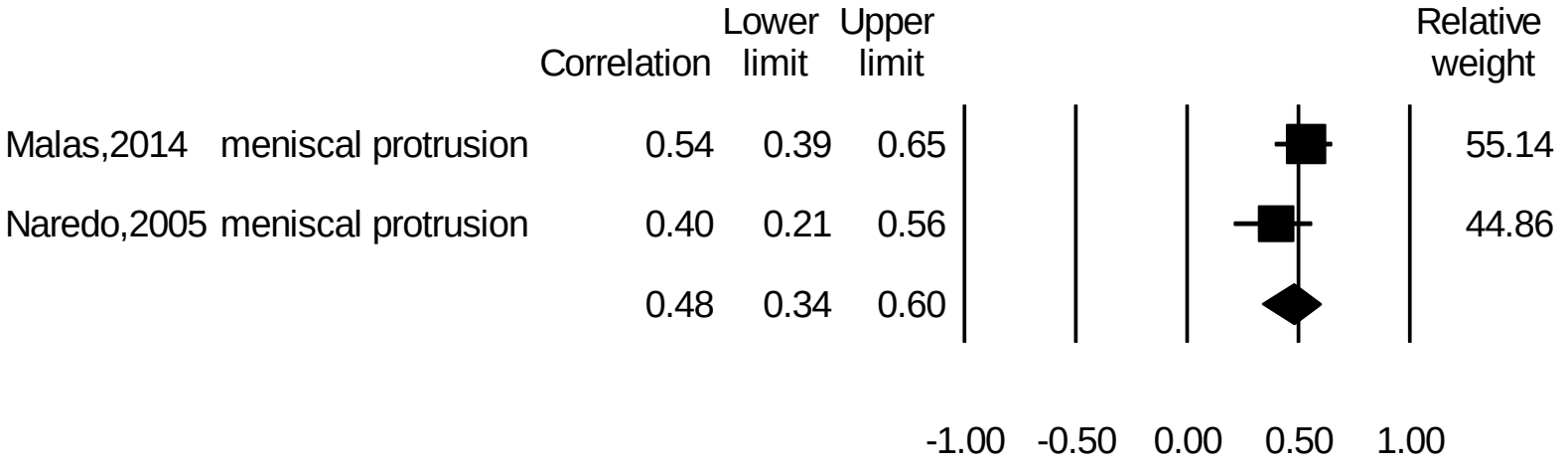
a. Forest plot for meta-analysis of effusion in knee OA



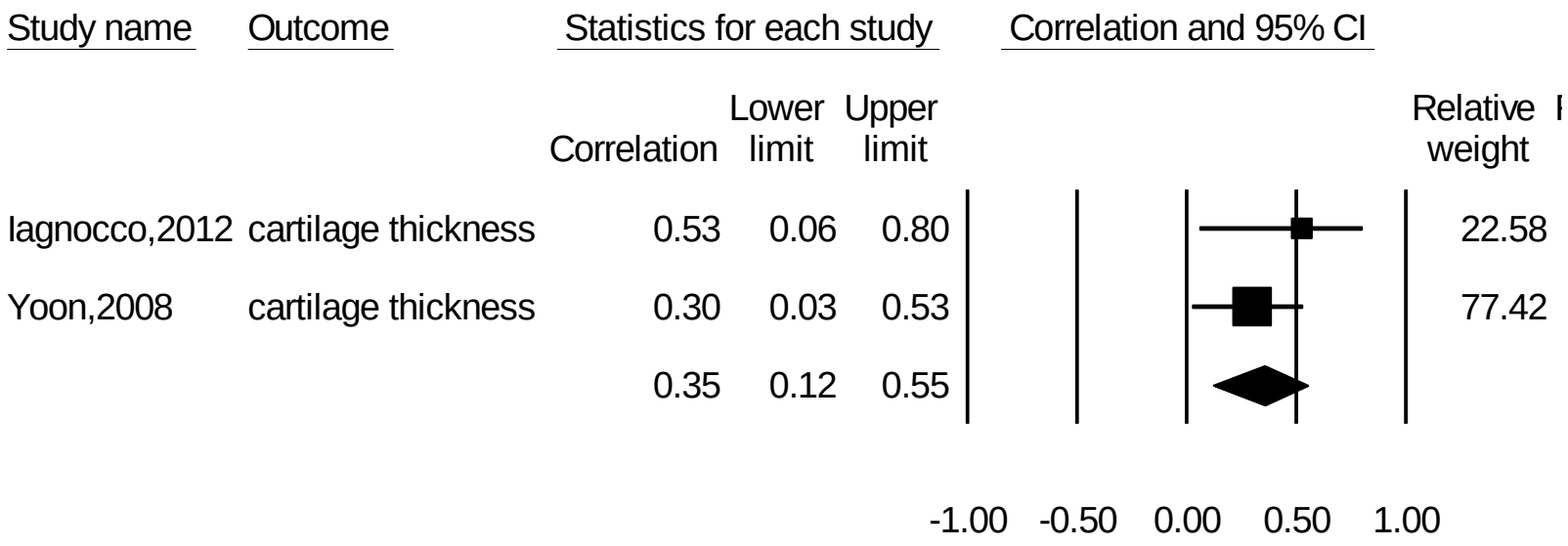
b. Forest plot for meta-analysis of osteophyte in knee OA



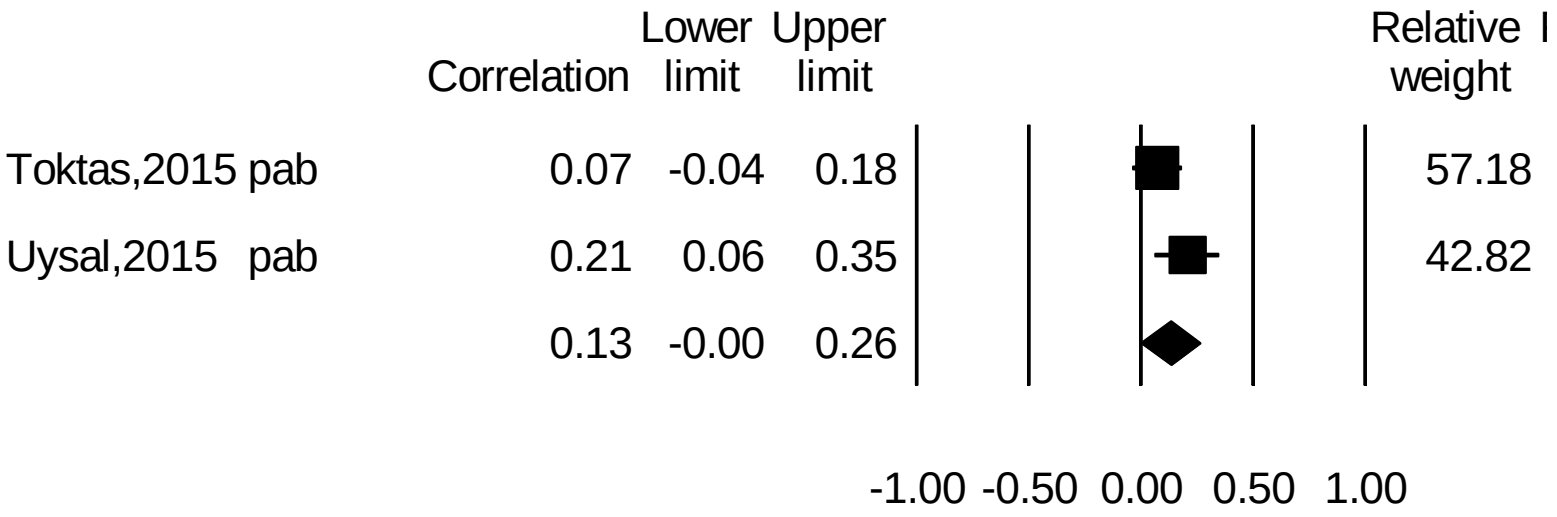
c. Forest plot for meta-analysis of meniscal protrusion in knee OA



d. Forest plot for meta-analysis of cartilage thickness in knee OA

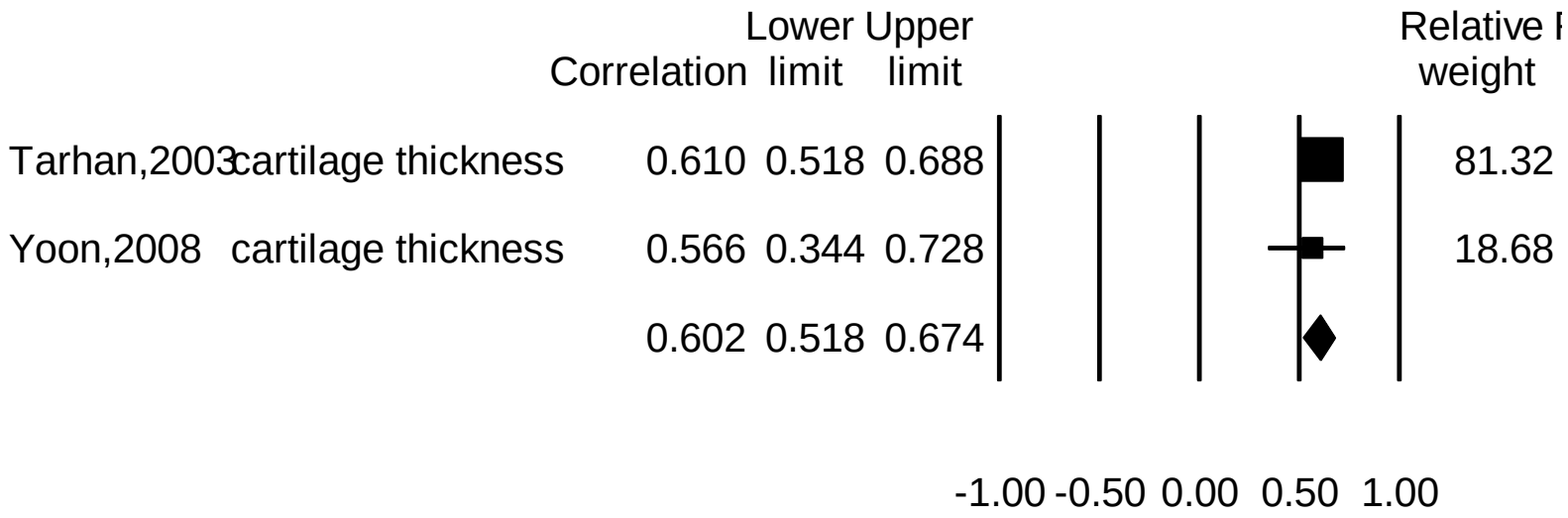


e. Forest plot for meta-analysis of pes anserine bursitis (pab) in knee OA



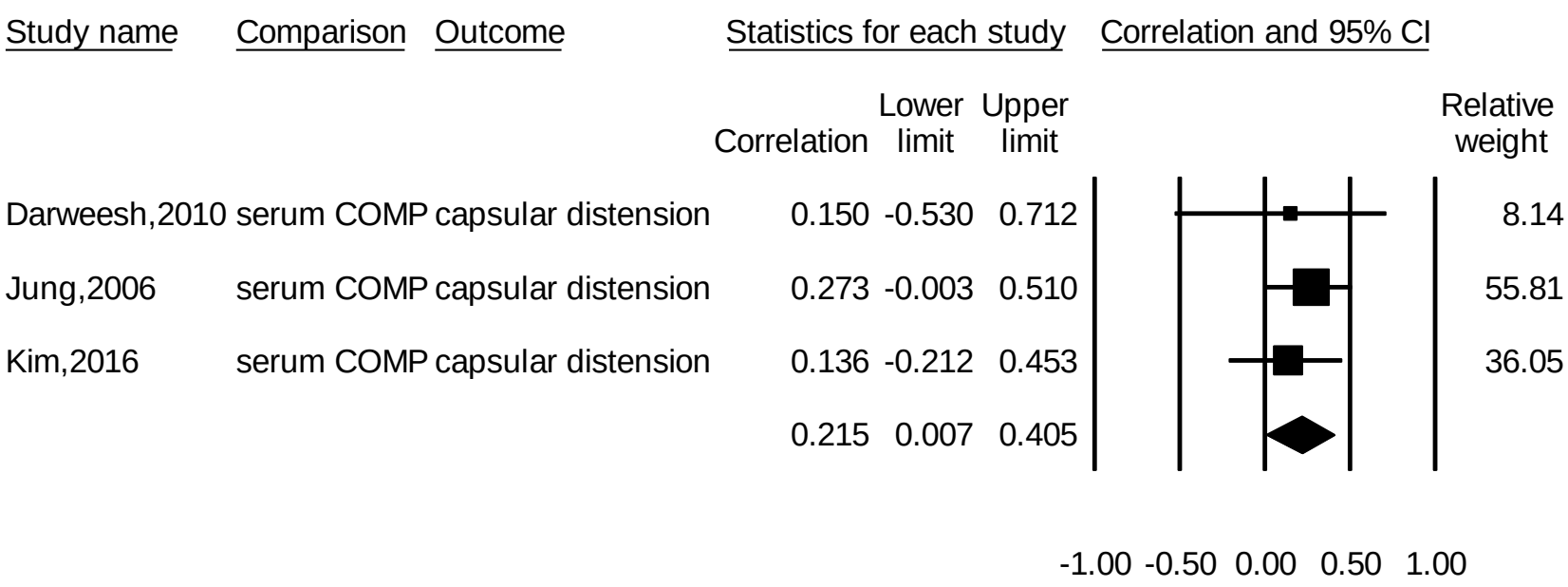
V. Construct validity of ultrasound features with MRI

a. Forest plot for meta-analysis of cartilage thickness in knee OA

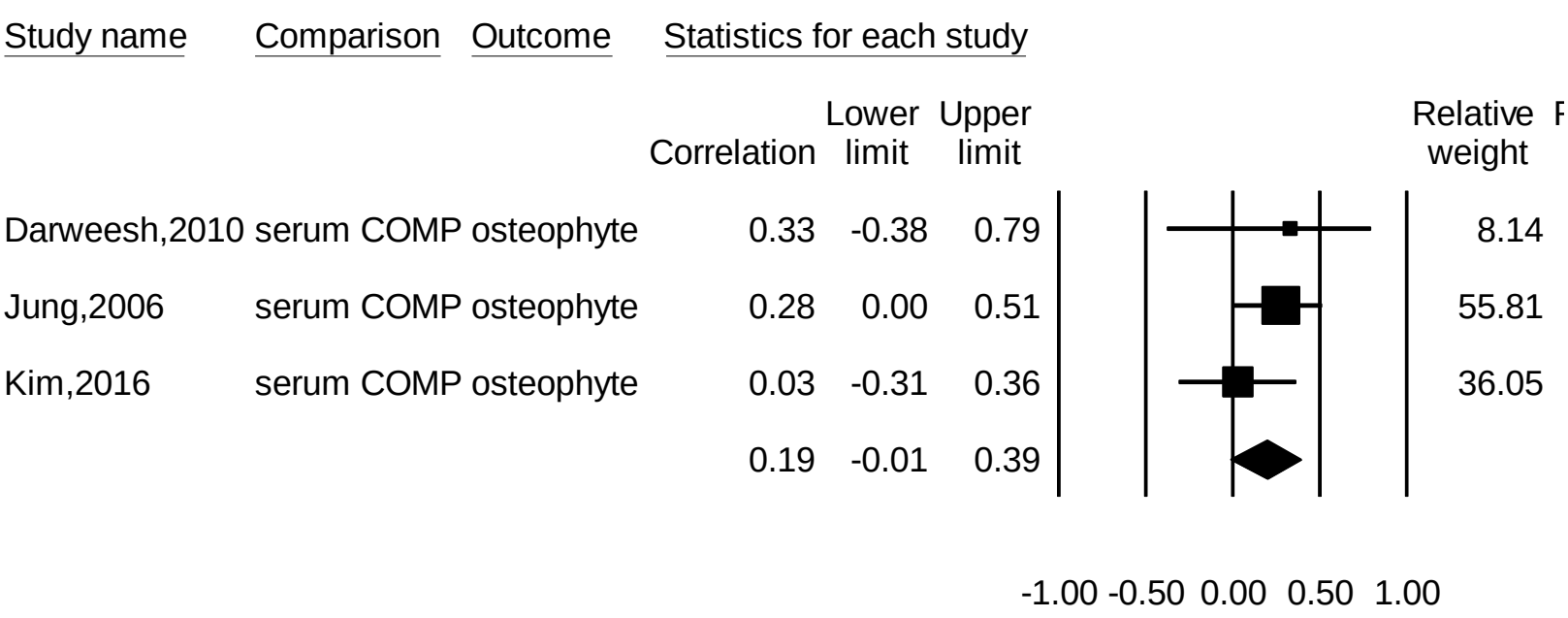


VI. Construct validity of ultrasound features with blood biomarkers

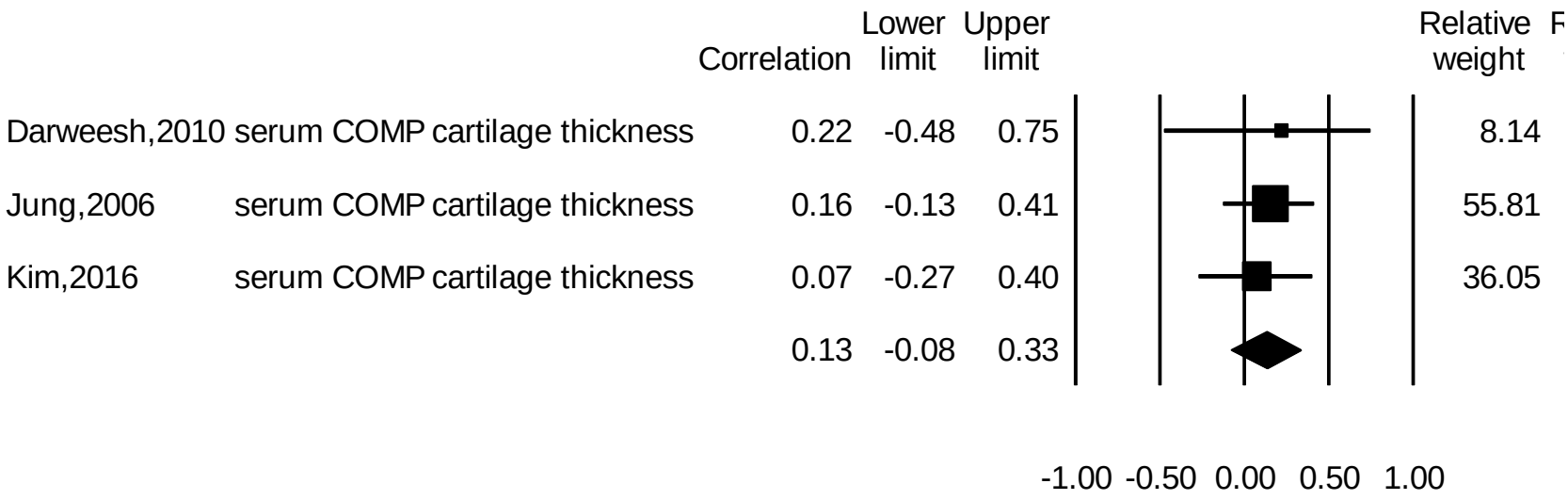
a. Forest plot for meta-analysis of capsular distension in knee OA



b. Forest plot for meta-analysis of osteophyte in knee OA



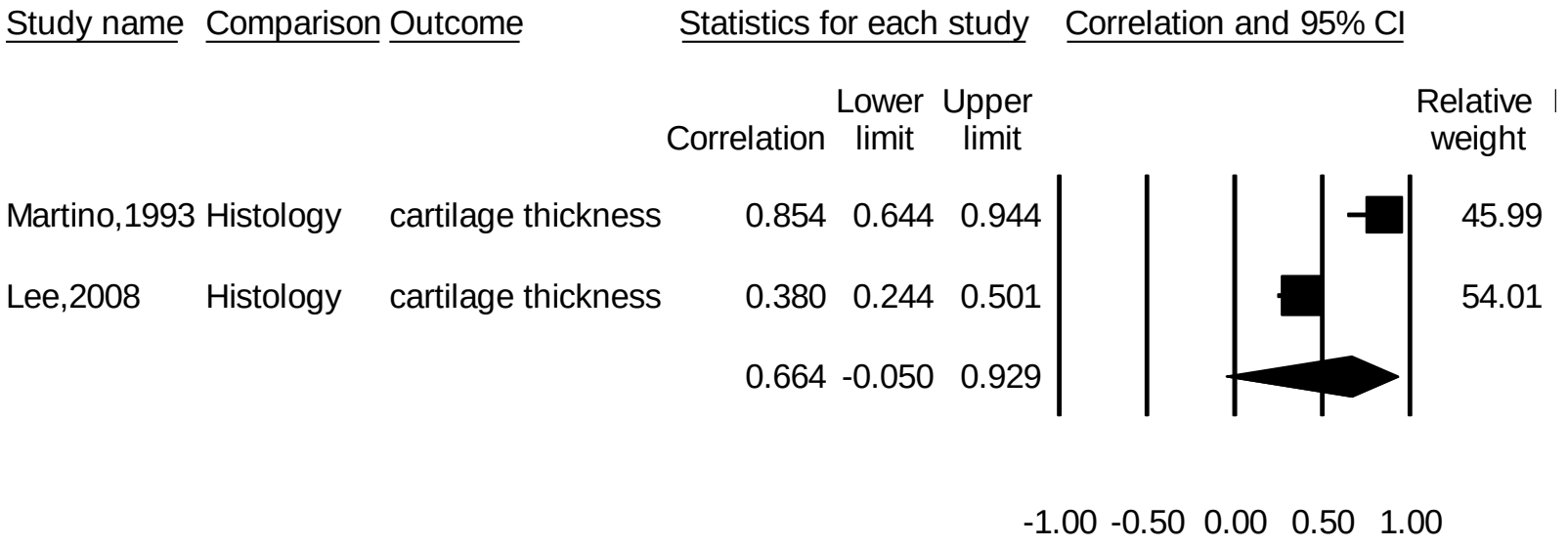
c. Forest plot for meta-analysis of cartilage thickness in knee OA



C. Criteria validity

I. Criteria validity of ultrasound features with histology

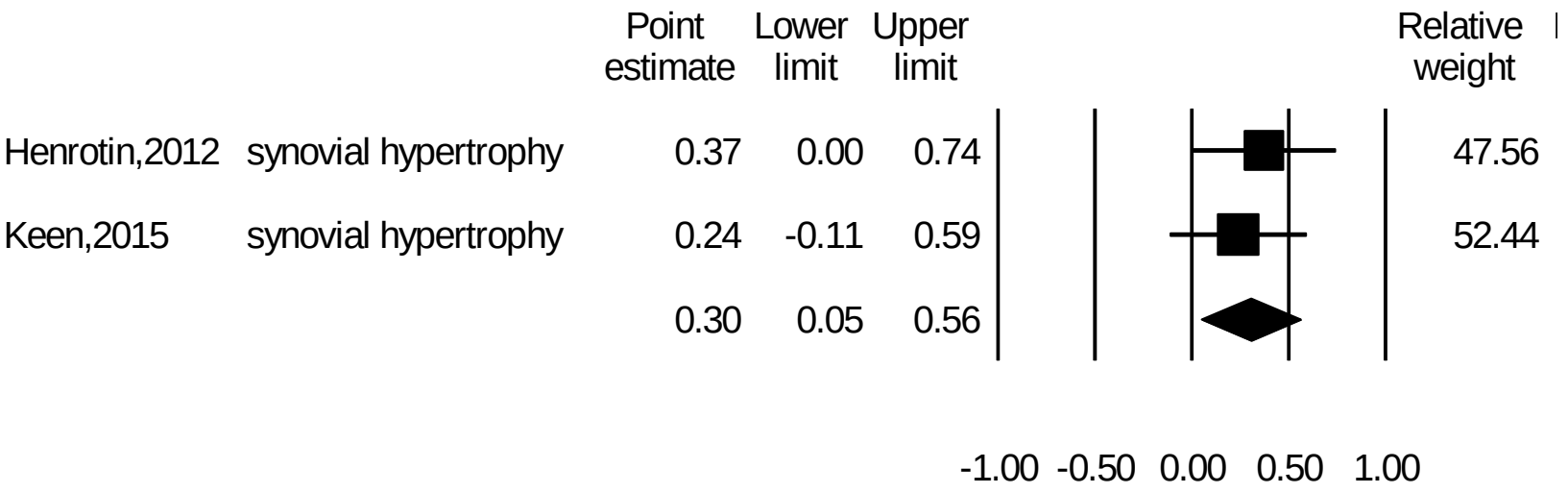
a. Forest plot for meta-analysis of cartilage thickness in knee OA



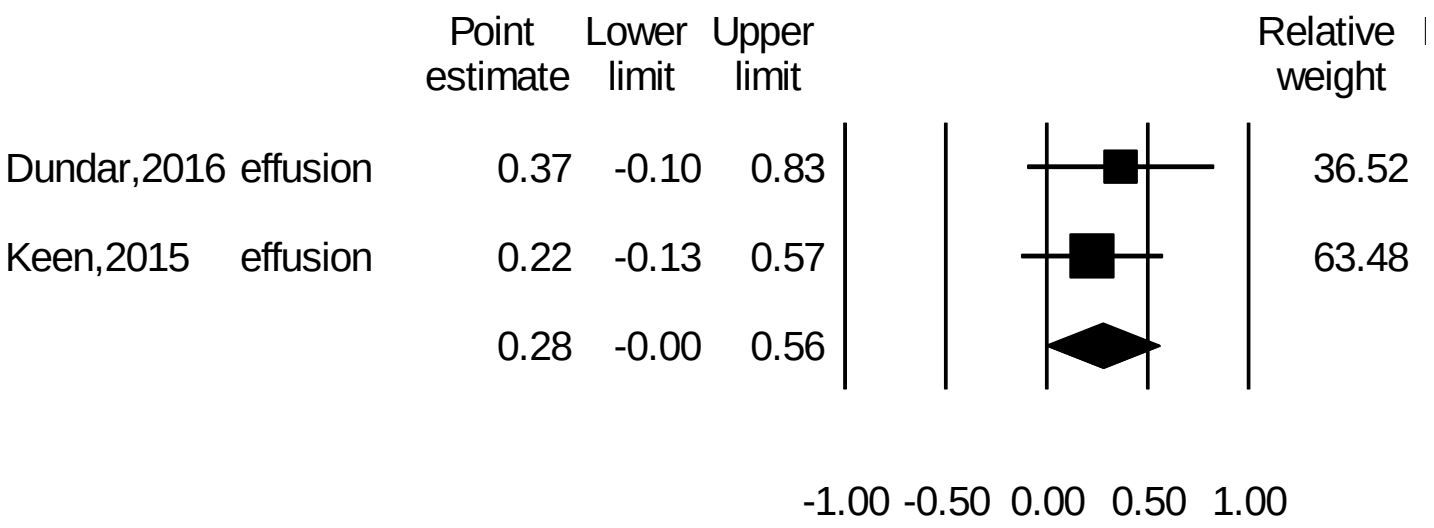
D. Responsiveness

I. Internal responsiveness of ultrasound features (paired sample)

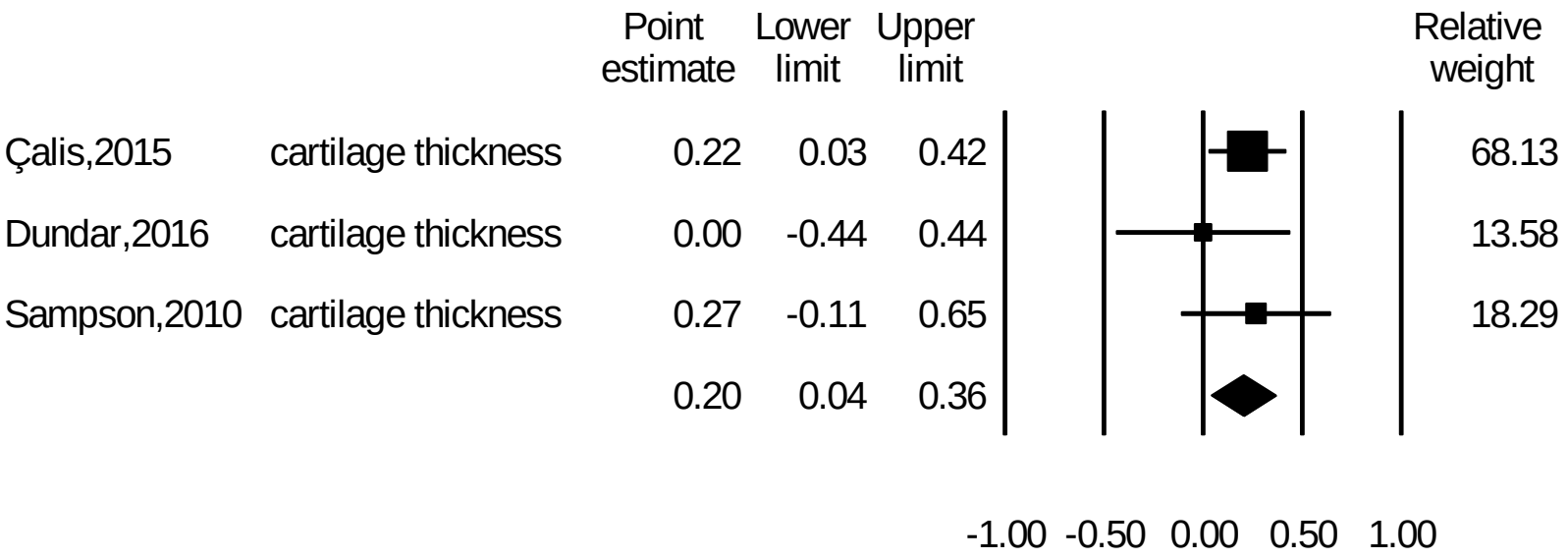
a. Forest plot for meta-analysis of synovial hypertrophy in knee OA



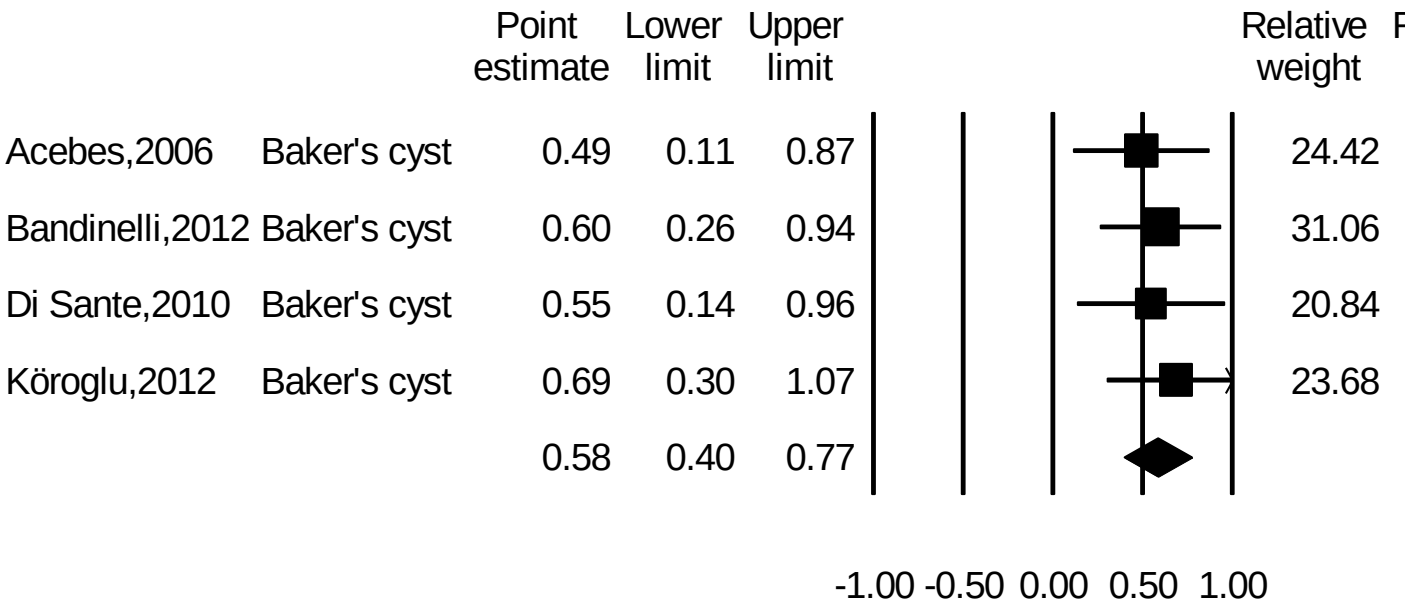
b. Forest plot for meta-analysis of effusion in knee OA



c. Forest plot for meta-analysis of cartilage thickness in knee OA

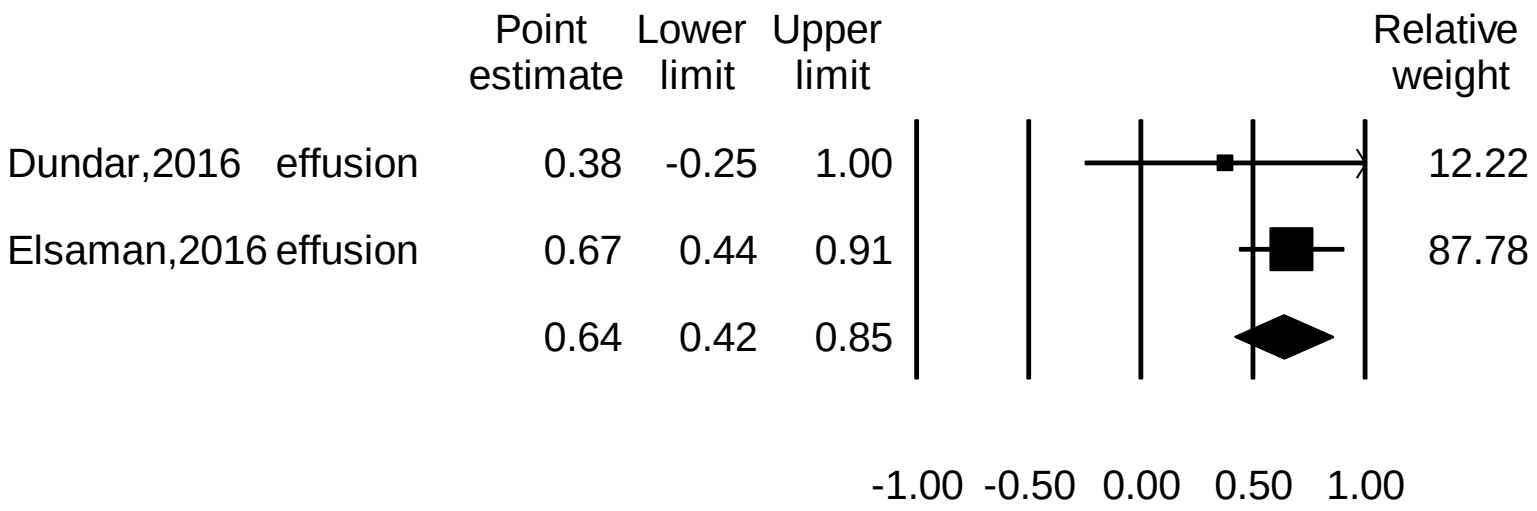


d. Forest plot for meta-analysis of Baker's cyst in knee OA

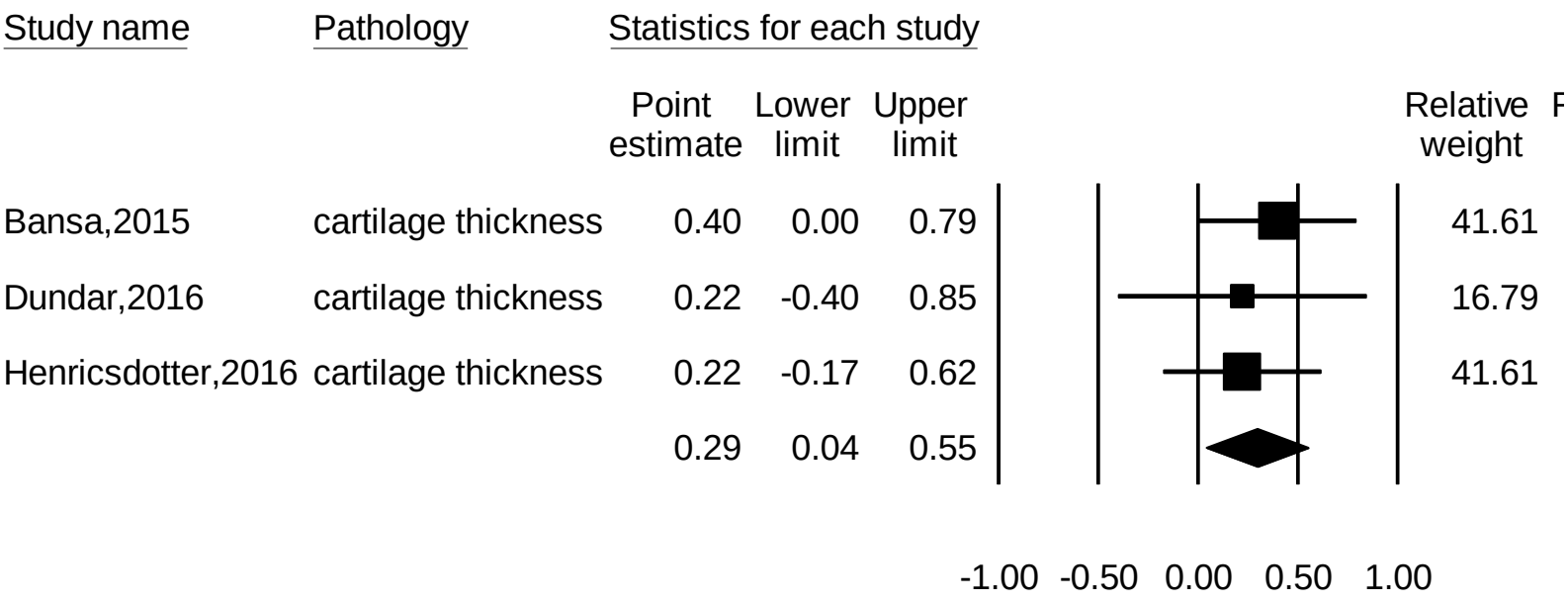


II. Internal responsiveness (independent sample)

a. Forest plot for meta-analysis of effusion in knee OA

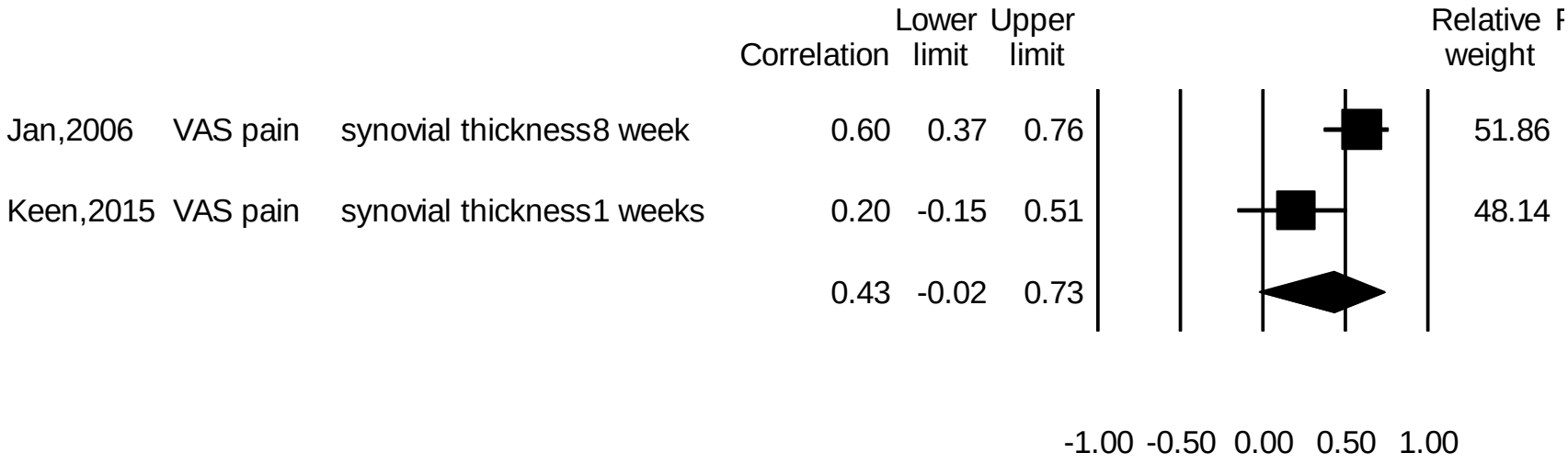


b. Forest plot for meta-analysis of cartilage thickness in knee OA



III. External responsiveness

a. Forest plot for meta-analysis of synovial thickness in knee OA



b. Forest plot for meta-analysis of Baker's cyst in knee OA