



# Health-Related Quality of Life in Home Dialysis Patients Compared to In-Center Hemodialysis Patients: A Systematic Review and Meta-analysis

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**Rationale & Objective:** Dialysis patients judge health-related quality of life (HRQoL) as an essential outcome. Remarkably, little is known about HRQoL differences between home dialysis and in-center hemodialysis (HD) patients worldwide.

**Study Design:** Systematic review and meta-analysis.

**Setting & Study Populations:** Search strategies were performed on the Cochrane Library, Pubmed, and EMBASE databases between 2007 and 2019. Home dialysis was defined as both peritoneal dialysis and home HD.

**Selection Criteria for Studies:** Randomized controlled trials and observational studies that compared HRQoL in home dialysis patients versus in-center HD patients.

**Data Extraction:** The data extracted by 2 authors included HRQoL scores of different questionnaires, dialysis modality, and subcontinent.

**Analytical Approach:** Data were pooled using a random-effects model and results were expressed as standardized mean difference (SMD) with 95% CIs. Heterogeneity was explored using subgroup analyses.

**Results:** Forty-six articles reporting on 41 study populations were identified. Most studies were cross-sectional in design (90%), conducted on

peritoneal dialysis patients (95%), and used the 12-item or 36-item Short-Form Health Survey questionnaires (83%). More than half the studies showed moderate or high risk of bias. Pooled analysis of 4,158 home dialysis patients and 7,854 in-center HD patients showed marginally better physical HRQoL scores in home dialysis patients compared with in-center HD patients (SMD, 0.14; 95% CI, 0.04 to 0.24), although heterogeneity was high ( $I^2 > 80\%$ ). In a subgroup analysis, Western European home dialysis patients had higher physical HRQoL scores (SMD, 0.39; 95% CI, 0.17 to 0.61), while home dialysis patients from Latin America had lower physical scores (SMD, -0.20; 95% CI, -0.28 to -0.12). Mental HRQoL showed no difference in all analyses.

**Limitations:** No randomized controlled trials were found and high heterogeneity among studies existed.

**Conclusions:** Although pooled data showed marginally better physical HRQoL for home dialysis patients, the quality of design of the included studies was poor. Large prospective studies with adequate adjustments for confounders are necessary to establish whether home dialysis results in better HRQoL.

**Trial Registration:** PROSPERO 95985.

Complete author and article information provided before references.

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End-stage renal disease (ESRD) is associated with poor survival. Patients starting on dialysis therapy have a median 5-year survival rate of only 45%.<sup>1</sup> Observational studies comparing patients performing home dialysis, mostly peritoneal dialysis (PD), with in-center hemodialysis (HD) show comparable survival between groups.<sup>2-4</sup> Therefore, these survival studies will not help patients in choosing a dialysis modality.

Counterintuitive to what some clinicians assume, patients with ESRD consider quality of life (QoL) far more important than survival.<sup>5-10</sup> Many patients experience dialysis as a heavy burden; they even have poorer health-related QoL (HRQoL) than patients with diabetes or malignancies.<sup>11,12</sup> Patients also indicate HRQoL aspects as important research topics.<sup>13,14</sup> This has affected the research performed in the medical field during the last decade, with focus shifting from clinical outcomes to patient-reported outcomes.<sup>15,16</sup> Indeed, the number of articles reporting HRQoL in dialysis patients has multiplied during the last 10 years.

Reducing the impact of ESRD and its treatment on daily life could potentially improve HRQoL. Performing dialysis at home, instead of being treated with in-center HD, has the advantage of more independence and flexibility during the day.<sup>17-20</sup> Moreover, due to the possibility of self-care and fewer hospital visits with home-based therapies, patients are able to return to work and engage in daily social activities.<sup>18,21-23</sup> Home HD (HHD) enables an intensified dialysis regimen, allowing a reduction in medication burden.<sup>24</sup> All these factors could contribute to an improvement in HRQoL.

Many cross-sectional and some cohort studies from different regions across the world have reported on HRQoL of home dialysis patients in comparison to in-center HD patients. Interpretation of these studies is hampered by a large variety in type of questionnaire used and applied study design.<sup>25-27</sup> In addition, because these studies are conducted in different countries, disparity exists in study populations since the percentage of patients

receiving home dialysis varies across the world. This difference in practice patterns, together with a difference in local cultures, is suggested to influence HRQoL.<sup>28</sup> Investigators of the Dialysis Outcomes and Practice Patterns Study found different HRQoL scores between in-center HD patients across Japan, Europe, and the United States after adjustment for several confounders, including comorbid conditions.<sup>28</sup> Due to inequalities among studies, it is difficult to determine whether home dialysis patients have better HRQoL. Differences in HRQoL of home dialysis patients and in-center HD patients should be interpreted in relation to the country of residence.

Hence, a systematic review and meta-analysis was conducted to summarize and evaluate the available studies on HRQoL of home dialysis and in-center HD patients, with a special focus on differences across the world.

## METHODS

### Search Strategy and Selection Criteria

The Cochrane Library, PubMed, and EMBASE databases were searched for relevant articles using all synonyms and abbreviations of the terms “dialysis” and “quality of life” (Table S1). The search was limited to publications during the last 10 years because the perception of QoL in patients treated with dialysis has changed over time, for example, by improved metabolic control over the years.<sup>29</sup> After removing the duplicates, 2 authors (A.A.B. and A.v.E.v.d.S.) independently performed screening of titles and abstracts according to predetermined inclusion and exclusion criteria. All articles comparing the HRQoL of adult (ie,  $\geq 18$  years) home dialysis patients with the HRQoL of in-center HD patients were included. Articles other than randomized controlled trials and observational studies were excluded, such as validation and reliability studies on QoL questionnaires. In addition, articles in a language other than English were excluded.

The remaining articles were read full text by 2 authors (A.A.B. and A.v.E.v.d.S.) and screened for additional references. All articles assessing HRQoL by applying worldwide most commonly used questionnaires<sup>30</sup> were included (Table S2). The full-text articles were also checked for outdated patient data (data collected before 2007), which was reason for exclusion, and missing HRQoL scores. When no quantitative scores were reported for home dialysis and in-center HD patients, the authors were e-mailed. If they provided the quantitative data, the article was subsequently included in the critical appraisal. Final inclusion was based on consensus between the 2 authors (A.A.B. and A.v.E.v.d.S.). In case they failed to reach consensus, a third author (T.H.) was asked for an opinion that was decisive. The selection process is summarized in Figure 1.

### Data Extraction

Data extraction was performed and checked by 2 authors (A.A.B. and A.v.E.v.d.S.). The included studies were

structured according to dialysis modality, country and subcontinent of conductance, number of participants with characteristics (age, dialysis vintage, and sex), and type of HRQoL questionnaire used. From all studies, HRQoL scores were extracted and evaluated. If no standard deviation was reported, it was calculated (eg, from interquartile range [IQR], confidence interval [CI], or standard error) or substituted from another study with similar characteristics.<sup>31</sup> Subcontinents were classified according to the regional boards of the International Society of Nephrology.<sup>32</sup>

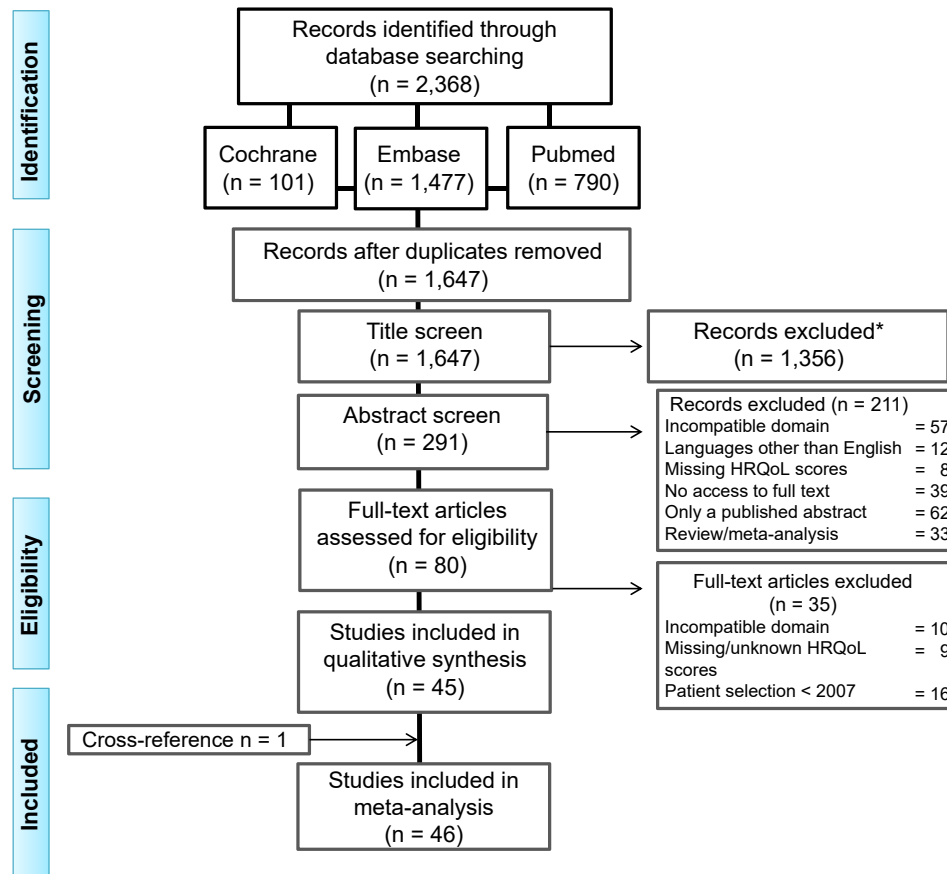
For the meta-analysis, the Physical Component Summary (PCS) was used as score for the physical domain, and the Mental Component Summary (MCS) for the mental domain. If summary scores of the 12-item or 36-item Short Form Health Survey (SF) were not available, the physical functioning or mental health score was used, respectively. If the abbreviated World Health Organization Quality of Life (WHOQOL-BREF) was assessed, the physical health score was used for the physical domain, and the psychological health score for the mental domain. If the EuroQoL-5D (EQ-5D) was reported, the visual analogue scale was used for the analysis.

### Risk of Bias Assessment

After full-text screening, articles eligible for critical appraisal were independently appraised by 2 authors (A.A.B. and A.v.E.v.d.S.) using criteria based on the Critical Appraisal Skills Programme Cohort Study checklist and the Newcastle-Ottawa Scale.<sup>33,34</sup> The following criteria were assessed: study design, patient selection, comparability of patients between groups, accurate measurement of outcome, correction for confounding, duration of follow-up, selective reporting, and conflict of interest (details are provided in Table S3). They were scored as + (low risk of bias), – (high risk of bias), or ? (unclear) based on consensus between the 2 authors (A.A.B. and A.v.E.v.d.S.). In case of disagreement, a third opinion (B.C.v.J.) was decisive. After completing the critical appraisal, the corresponding authors of the articles were contacted if any uncertainty remained (ie, criteria scored as unclear). Any given comment was taken into account for the final critical appraisal.

### Analytical Approach

With the extracted HRQoL scores, a meta-analysis was performed. Heterogeneity, both in clinical characteristics (eg, variability in patients) and methodological aspects (ie, design and risk of bias), was explored by visual inspection and quantified by  $I^2 > 75\%$ .<sup>35</sup> Significant heterogeneity was expected due to the use of different types of HRQoL questionnaires and differences between countries regarding practice patterns and accessibility for home dialysis leading to differences between patient populations.<sup>28</sup> Therefore, the standardized mean difference (SMD) of HRQoL scores and a random-effects model were used.



**Figure 1.** Selection flow diagram. Abbreviation: HRQoL, health-related quality of life. \*Exclusion criteria: articles describing data older than 10 years, case reports, congress abstracts, editorials, language other than English, letters, opinion papers, reviews, and validation and reliability studies on quality of life questionnaires.

The following subgroup analyses were performed: different subcontinents and subgroups of studies according to overall risk of bias (as scored by authors: low, moderate, or high). When appropriate, type of home dialysis (PD or HHD) was compared with in-center HD. Additional analyses were conducted for the following subgroups: type of questionnaire used, different age categories (<45, 45-60, and >60 years), and dialysis vintage (<36 vs ≥36 months). Finally, a sensitivity analysis was conducted that excluded articles for which the standard deviation was calculated or substituted. All analyses were performed using Stata/SE, version 14.1, for Windows (StataCorp LP).

### Protocol and Registration

This systematic review was registered in PROSPERO, the International prospective register of systematic reviews. The study protocol can be retrieved from the PROSPERO website (<https://www.crd.york.ac.uk/prospero/>) using registration number 95985.

## RESULTS

### Study Selection

The initial literature search was performed on November 21, 2017, and last updated in January 2019. The final

search yielded 1,647 articles, after removal of duplicates. Subsequently, articles were excluded based on title and abstract, according to previously determined inclusion and exclusion criteria. Systematic reviews that were among these articles were checked for references before they were excluded.<sup>21,25,26,30,36-46</sup> This resulted in 1 article; however, its data collection was performed before 2007 and therefore it was excluded.<sup>47</sup>

The full texts of the remaining 80 articles were retrieved and assessed for eligibility. A total of 35 articles were excluded for the following reasons: comparison group other than in-center HD,<sup>48-50</sup> groups were not separately presented,<sup>51-55</sup> unspecified HRQoL questionnaire,<sup>56-59</sup> HRQoL data exclusively presented in graphs,<sup>60-62</sup> unclear calculation of HRQoL scores,<sup>63,64</sup> and outdated population data (data collected before 2007).<sup>65-80</sup> The studies of Garg et al<sup>17</sup> (Frequent Hemodialysis Network trials) and Jardine et al<sup>81</sup> (ACTIVE dialysis trial) were excluded because they focused on frequent HD that was not exclusively performed at home. The remaining 45 articles were screened for additional references, resulting in 1 article that was evaluated and included (Fig 1).<sup>82</sup>

A total of 46 articles was eligible for critical appraisal.<sup>82-127</sup> The following articles presented overlapping patient data and were appraised as one: Bujang et al<sup>91</sup> and Liu et al,<sup>92</sup>

Chkhotua et al<sup>94</sup> and Maglakelidze et al,<sup>95</sup> Griva et al<sup>103</sup> and Yang et al,<sup>104</sup> 2 articles by Kontodimopoulos<sup>111,112</sup> and 2 articles by Theofilou,<sup>120,121</sup> leaving 41 studies for analysis.

### Study Characteristics

Characteristics of the included studies are described in Table 1. Most (32%) of the studies were conducted in Western Europe, followed by Asia (27%). From the 41 studies included, only 3 compared the HRQoL of HHD patients with in-center HD patients,<sup>82,123,124</sup> while the rest focused on the comparison PD versus in-center HD. The predominantly used questionnaire was the SF, either as a separate questionnaire or part of the Kidney Disease Quality of Life (KDQOL) questionnaire (83%).

Mean age of the home dialysis population was  $55.9 \pm 13.8$  years, while in-center HD patients were slightly younger (mean age,  $54.8 \pm 14.1$  years). There was a difference in dialysis vintage between both groups, with a median of 34.1 months for home dialysis patients (IQR, 22.8-43.4 months) and 56.9 months for in-center HD patients (IQR, 31.0-77.2 months). Most (55%) of the total dialysis population was male. One study was conducted in females only.<sup>87</sup> Half the home dialysis population was male (range, 27%-90%) compared with 57% of the in-center HD population (range, 44%-85%). In the included studies, there were no randomized controlled trials of in-center HD versus home dialysis. Furthermore, most studies had a cross-sectional design, comparing prevalent patients receiving in-center HD with prevalent home dialysis patients.

It should be noted that 4 studies were observational cohort studies with a longitudinal follow-up. Da Silva-Gane et al<sup>97</sup> assessed HRQoL of dialysis patients every 3 months until 12 months after dialysis initiation. Baseline PCS scores were lower in in-center HD patients. However, after a median follow-up period of 14.7 months, HRQoL between dialysis modalities was equal. Because follow-up results of PD and in-center HD patients were not shown in the article, in the following meta-analysis, only baseline data of this study could be used. The study by Neumann et al<sup>114</sup> investigated the change in social networks and social support, and their association with HRQoL, of dialysis patients over a 12-month period. The PCS and MCS scores of PD and in-center HD patients decreased equally during follow-up. The follow-up HRQoL scores at 12 months were used in this meta-analysis. The study by Painter et al<sup>82</sup> examined exercise capacity after modality switch from in-center HD to HHD, yet also assessed HRQoL. Modality switch was associated with a significant improvement in physical HRQoL scores after 6 months. The follow-up HRQoL scores at 6 months were used in this meta-analysis. The study by Ruiz de Alegría-Fernández de Retana et al<sup>118</sup> related coping mechanisms to HRQoL. SF-36 questionnaires were collected at 3, 6, and 12 months after dialysis initiation. Separate HRQoL scores for PD and in-center HD were obtained from

the author. These unpublished data showed improvement in MCS scores for in-center HD patients, but PCS scores remained the same in both groups. HRQoL scores 12 months after initiation of dialysis treatment were used in this meta-analysis.

### Risk of Bias Assessment

Results of the critical appraisal are presented in Table S4. Seventeen of the 41 studies were assessed as having an overall low risk of bias. There was a general lack of adequate presentation of patient characteristics, with 6 studies presenting baseline data without separation by dialysis modality<sup>86,106,110,126</sup> or no baseline data at all.<sup>95,96</sup> Few studies adequately adjusted HRQoL scores for confounding between groups.<sup>84,97,98,108,109,114</sup> Apart from adjustment for confounders, also a stratified analysis was considered as a low risk of bias. HRQoL, as a patient-reported outcome measure, should be self-reported or assessed by a trained research assistant.<sup>128</sup> For 8 studies, it was unknown whether the professional performing the interview was trained to assess HRQoL, leading to potential bias in outcome assessment.<sup>89,99,102,106,115,116,120,126</sup>

### Meta-analysis

The included studies for the meta-analysis compared HRQoL for a total of 4,158 home dialysis patients with 7,854 in-center HD patients. The study by Wright et al compared 2 home dialysis populations (HHD and PD) with in-center HD patients and is presented twice in the meta-analysis.<sup>124</sup> Although heterogeneity was high, HRQoL on the physical domain was marginally better in home dialysis patients compared with in-center HD patients, with an SMD of 0.14 (95% CI, 0.04 to 0.24). HRQoL on the mental domain was equal between the 2 groups (SMD, 0.06; 95% CI, -0.03 to 0.15).

A comparison among subcontinents showed that patients receiving home dialysis in Western Europe had higher physical HRQoL scores compared with in-center HD patients (SMD, 0.39; 95% CI, 0.17 to 0.61), whereas patients receiving home dialysis from Latin America had lower physical HRQoL scores (SMD, -0.20; 95% CI, -0.28 to -0.12; Fig 2A). HRQoL on the mental domain showed no difference among the subcontinents (Fig 2B).

If studies were divided according to overall level of bias, increased risk of bias was associated with an increase in SMD in physical HRQoL (high risk of bias: SMD, 0.26; 95% CI, -0.01 to 0.52; Fig 3A). For the mental domain, there was no difference among the different levels of bias (Fig 3B). The subgroup analysis regarding type of home dialysis (PD or HHD) provided no additional insights, recognizing that only 3 studies focused on HHD (data not shown). Heterogeneity remained after all subgroup analyses. Additional analyses regarding type of questionnaire used, different age categories, and dialysis vintage did not alter results or influence heterogeneity (Figs S1A and B and S2A and B).

**Table 1.** Study Characteristics of 41 Studies

Study	Home Dialysis Modality	Country, Subcontinent <sup>a</sup>	No. of Patients (home/ICHD)	Age, y (SD) (home/ICHD)	Dialysis Vintage, mo (SD) (home/ICHD)	HRQoL Questionnaire	Physical Score, mean (SD) (home/ICHD)	Mental Score, mean (SD) (home/ICHD)	Study Conclusion
Al Wakeel <sup>83</sup> (2012)	PD	Saudi Arabia, Middle East	100/100	51.0 (13.5)/47.5 (13.8)	34.1 (26.9)/77.2 (75.5)	KDQOL	47.7 (23.6)/53.1 (32.0)	61.9 (13.5)/50.5 (14.8)	Favors PD
Alvares <sup>84</sup> (2012)	PD	Brazil, Latin America	788/1,621	55.6 (15.3)/48.9 (14.5)	39.7 (42.5)/53.9 (55.1)	SF	41.0 (9.4)/43.0 (9.6)	44.7 (8.0)/44.6 (7.6)	Favors ICHD
Atapour <sup>85</sup> (2016)	PD	Iran, Middle East	46/46	51.0 (12.5)/47.8 (10.6)	18.8 (13.7)/24.4 (14.8)	SF	60.5 (10.4)/56.2 (10.3)	55.7 (7.1)/55.1 (6.2)	Favors PD
Barata <sup>86</sup> (2015)	PD	Portugal, Western Europe	31/94	NA	NA	WHOQOL-BREF	61.7 (12.7)/43.7 (13.9)	56.1 (11.4)/46.0 (12.2)	Favors PD
Basok <sup>87</sup> (2009)	PD	Turkey, Eastern Europe	21/24	45.2 (8.9)/43.1 (12.4)	NA	SF	43.2 (9.8)/47.4 (10.2)	44.5 (10.9)/50.2 (12.6)	NA
Baykan <sup>88</sup> (2012)	PD	Turkey, Eastern Europe	41/42	40.6 (11.9)/49.1 (12.0)	NA	SF	53.2 (7.6)/47.0 (9.2)	45.2 (6.7)/42.2 (6.7)	NA
Borowiak <sup>89</sup> (2009)	PD	Poland, Eastern Europe	50/50	58.9 (13.2)/59.6 (13.4)	NA	EQ-5D VAS <sup>b</sup>	55.3 (21.7)/53.2 (16.2)	55.3 (21.7)/53.2 (16.2)	Equal
Brown <sup>90</sup> (2010)	PD	UK, Western Europe	70/70	73.1 (5.5)/73.4 (5.1)	30.5 (28.3)/31.4 (26.5)	SF	36.0 (12.1)/34.3 (9.7)	55.0 (8.4)/51.3 (12.9)	Favors PD
Bujang <sup>91</sup> (2015) and Liu <sup>92</sup> (2014)	PD	Malaysia, Asia	539/793	52.8 (15.4)/55.5 (15.3)	45.6 (37.2)/91.2 (74.4)	WHOQOL-BREF	55.5 (15.5)/56.6 (16.1)	60.2 (16.0)/59.6 (17.3)	Favors PD
Chen <sup>93</sup> (2017)	PD	China, Asia	103/253	63.1 (12.7)/56.6 (12.1)	NA	KDQOL	40.3 (12.0)/37.4 (12.6)	50.3 (10.0)/51.0 (10.3)	Favors PD
Chkhotua <sup>94</sup> (2011) and Maglakelidze <sup>95</sup> (2011)	PD	Georgia, Eastern Europe	43/120	NA	NA	SF	55.7 (52.2)/56.9 (53.4)	47.5 (47.9)/49.9 (51.4)	Equal
Czyzewski <sup>96</sup> (2014)	PD	Poland, Eastern Europe	30/40	NA	39.6/78.0	KDQOL	37.5 (10.6)/34.7 (7.4)	49.9 (7.0)/43.7 (11.1)	Equal
Da Silva-Gane <sup>97</sup> (2012)	PD	UK, Western Europe	44/80	48.0 (15.6)/60.6 (14.9)	NA	SF	30.1 (6.5)/25.2 (8.8)	45.9 (10.6)/47.6 (10.7)	Favors PD
De Fijter <sup>98</sup> (2018)	PD	The Netherlands, Western Europe	33/42	66.0 (14.0)/66.0 (11.0)	16/27	KDQOL	43.0 (20.0)/35.0 (21.0)	56.0 (24.0)/49.0 (20.0)	Favors PD
Fructuoso <sup>99</sup> (2011)	PD	Portugal, Western Europe	14/37	38.9 (13.3)/67.3 (14.9)	22.8 (15.6)/73.2 (78.0)	KDQOL	44.9 (5.6)/35.9 (9.0)	46.2 (10.2)/42.6 (12.6)	Favors PD
Garcia-Llana <sup>100</sup> (2013)	PD	Spain, Western Europe	31/30	47.9 (15.9)/60.6 (16.7)	31.4 (28.6)/56.9 (81.7)	SF	39.4 (8.7)/34.3 (8.7)	49.8 (11.5)/47.1 (10.7)	Favors PD
Ginieri-Coccosis <sup>101</sup> (2008)	PD	Greece, Western Europe	48/41	64.1 (10.4)/65.3 (8.4)	43.4 (24.0)/49.8 (30.8)	WHOQOL-BREF	13.5 (2.8)/12.4 (3.8)	13.2 (3.2)/12.9 (3.5)	Favors PD
Goncalves <sup>102</sup> (2015)	PD	Brazil, Latin America	116/222	58 (13.9)/54.4 (15.2)	NA	KDQOL	45.8/52.8	44.3/56.6	Favors ICHD
Griva <sup>103</sup> (2014) and Yang <sup>104</sup> (2015)	PD	Singapore, Asia	266/236	59.3 (12.5)/54.4 (10.6)	42.6 (39.4)/76.4 (66.5)	KDQOL	37.1 (9.7)/38.9 (9.6)	46.6 (11.2)/46.3 (10.4)	Favors ICHD

(Continued)

**Table 1 (Cont'd).** Study Characteristics of 41 Studies

Study	Home Dialysis Modality	Country, Subcontinent <sup>a</sup>	No. of Patients (home/ICHD)	Age, y (SD) (home/ICHD)	Dialysis Vintage, mo (SD) (home/ICHD)	HRQoL Questionnaire	Physical Score, mean (SD) (home/ICHD)	Mental Score, mean (SD) (home/ICHD)	Study Conclusion
Günalay <sup>105</sup> (2018)	PD	Turkey, Eastern Europe	10/50	52.4 (15.1)/50.0 (18.9)	38.5 (14.2)/53.5 (48.3)	EQ-5D VAS <sup>b</sup>	58.1 (13.1)/66.7 (22.3)	58.1 (13.1)/66.7 (22.3)	Equal
Ibrahim <sup>106</sup> (2011)	PD	Malaysia, Asia	91/183	NA	NA	SF	74.6/68.4	77.1/70.9	Favors PD
Ikonomou <sup>107</sup> (2015)	PD	Greece, Western Europe	39/90	58.0 (16.0)/57.9 (13.8)	NA	SF	42.4 (10.0)/40.7 (11.3)	52.3 (9.1)/49.3 (10.3)	Equal
Iyasere <sup>108</sup> (2016)	PD	UK, Western Europe	129/122	76.0/75.0	22.0/27.5	SF	33.0/ 31.7	49.3/50.8	Equal
Kang <sup>109</sup> (2017)	PD	Korea, Asia	366/1,250	54.1 (11.9)/56.4 (13.2)	63.6 (46.8)/61.2 (55.2)	KDQOL	58.5 (23.0)/61.9 (21.2)	55.5 (24.9)/59.8 (21.2)	Favors ICHD
Kim <sup>110</sup> (2013)	PD	Korea, Asia	65/172	NA	NA	KDQOL	38.7 (9.0)/39.3 (9.7)	44.8 (6.4)/44.6 (7.0)	Favors PD
Kontodimopoulos <sup>111</sup> (2008) and Kontodimopoulos <sup>112</sup> (2009)	PD	Greece, Western Europe	65/642	58.7 (12.9)/58.1 (14.9)	63.6 (67.2)/74.4 (68.4)	SF	49.2 (30.7)/49.2 (30.6)	53.0 (26.1)/55.1 (22.7)	Equal
Nakayama <sup>113</sup> (2015)	PD	Japan, Asia	102/77	62.5 (12.0)/63.5 (12.4)	NA	SF	25.4 (25.3)/32.1 (20.6)	45.6 (12.1)/46.1 (10.5)	N/A
Neumann <sup>114</sup> (2018)	PD	Germany, Western Europe	153/200	59.0 (15.4)/59.8 (16.0)	NA	SF	Baseline: 38.3 (9.8)/39.9 (10.8) 12 mo: 35.4 (11.6)/37.9 (11.5)	Baseline: 52.1 (9.4)/52.1 (10.0) 12 mo: 45.8 (10.6)/46.1 (11.6)	Equal
Okpechi <sup>115</sup> (2013)	PD	South Africa, Africa	26/56	36.0 (6.1)/38.6 (10.5)	14.5 (11.6)/49.8 (71.5)	KDQOL	67.5 (27.5)/65.4 (53.1)	75.0 (23.5)/74.6 (21.0)	Equal
Ören <sup>116</sup> (2013)	PD	Turkey, Eastern Europe	125/175	46.4 (14.6)/47.6 (15.3)	45.4 (34.8)/94.4 (60.0)	SF	58.4 (25.9)/48.6 (26.5)	63.3 (18.9)/57.0 (19.8)	Favors PD
Painter <sup>82</sup> (2012)	HHD	USA, North America	10/13	42.6 (12.4)/45.5 (10.4)	33.8 (44.3)/28.5 (21.2)	KDQOL	Baseline: 45.3 (11.3)/48.8 (10.0) 6 mo: 49.6 (9.1)/48.4 (7.4)	Baseline: 48.1 (14.6)/51.1 (9.1) 6 mo: 48.9 (12.6)/51.7 (9.6)	Favors HHD
Ramos <sup>117</sup> (2015)	PD	Brazil, Latin America	60/257	56.5 (15.3)/57.9 (15.9)	NA	SF	51.3 (27.8)/53.5 (29.7)	71.7 (20.4)/68.7 (22.6)	Equal
Ruiz de Alegría - Fernández de Retana <sup>118</sup> (2013)	PD	Spain, Western Europe	45/53	50.8 (13.3)/52.3 (13.1)	NA	SF	3 mo: 42.6 (8.9)/40.8 (8.9) 6 mo: 40.6 (9.8)/42.2 (9.7) 12 mo: 43.9 (9.8)/39.9 (9.7)	3 mo: 50.5 (13.0)/46.3 (13.4) 6 mo: 50.3 (11.6)/49.3 (11.6) 12 mo: 50.5 (11.6)/49.6 (11.6)	NA
Tannor <sup>119</sup> (2017)	PD	South Africa, Africa	48/58	36.1 (10.7)/42.8 (9.8)	26.4/72.0	KDQOL	55.5 (21.7)/54.7 (19.4)	62.7 (19.7)/68.6 (17.9)	Equal

(Continued)

**Table 1 (Cont'd).** Study Characteristics of 41 Studies

Study	Home Dialysis Modality	Country, Subcontinent <sup>a</sup>	No. of Patients (home/ICHD)	Age, y (SD) (home/ICHD)	Dialysis Vintage, mo (SD) (home/ICHD)	HRQoL Questionnaire	Physical Score, mean (SD) (home/ICHD)	Mental Score, mean (SD) (home/ICHD)	Study Conclusion
Theofilou <sup>120</sup> (2011) and Theofilou <sup>121</sup> (2013)	PD	Greece, Western Europe	60/84	64.3 (12.5)/ 58.1 (16.1)	38.4 (24.0)/ 87.6 (85.2)	WHOQOL-BREF	13.7 (3.0)/ 12.7 (3.7)	13.4 (3.1)/ 13.3 (3.7)	Favors PD
Turkmen <sup>122</sup> (2012)	PD	Turkey, Eastern Europe	64/90	52.4 (15.3)/ 55.0 (15.7)	19.8 (14.3)/ 22.7 (13.1)	SF	47.6 (18.5)/ 59.4 (20.7)	41.7 (17.2)/ 63.9 (20.6)	Favors ICHD
Watanabe <sup>123</sup> (2014)	HHD	Japan, Asia	46/34	54.0 (8.3)/ 57.1 (7.6)	76.8 (68.4)/ 88.8 (99.6)	KDQOL	48.7 (9.2)/ 37.1 (12.9)	51.2 (8.9)/ 49.6 (6.2)	Favors HHD
Wright <sup>124</sup> (2015) <sup>c</sup>	HHD	USA, North America	22/29	NA	NA	KDQOL	40.4 (12.7)/ 42.8 (9.8)	50.6 (9.4)/ 50.4 (10.0)	Equal
Wright <sup>124</sup> (2015) <sup>c</sup>	PD	USA, North America	26/29	NA	NA	KDQOL	43.2 (8.8)/ 42.8 (9.8)	51.1 (8.2)/ 50.4 (10.0)	Equal
Wu <sup>125</sup> (2013)	PD	China, Asia	93/97	54.5 (15.5)/ 58.3 (17.5)	25.5/31.0	SF	34.0 (11.9)/ 30.5 (14.5)	41.3 (10.0)/ 38.5 (12.0)	Equal
Ying <sup>126</sup> (2014)	PD	Malaysia, Asia	73/147	NA	NA	SF	60.2 (21.9)/ 49.6 (20.2)	67.1 (19.4)/ 58.0 (20.3)	Favors PD
Yongsiri <sup>127</sup> (2014)	PD	Thailand, Asia	26/34	53.0 (14.4)/ 61.1 (15.5)	NA	WHOQOL-BREF	3.0 (0.9)/ 2.9 (0.8)	3.7 (0.7)/ 3.7 (0.6)	Equal
Total			4,158/7,854	55.9 (13.8)/ 54.8 (14.1)	34.1 <sup>d</sup> (22.8-43.4)/ 56.9 <sup>d</sup> (31.0-77.2)				

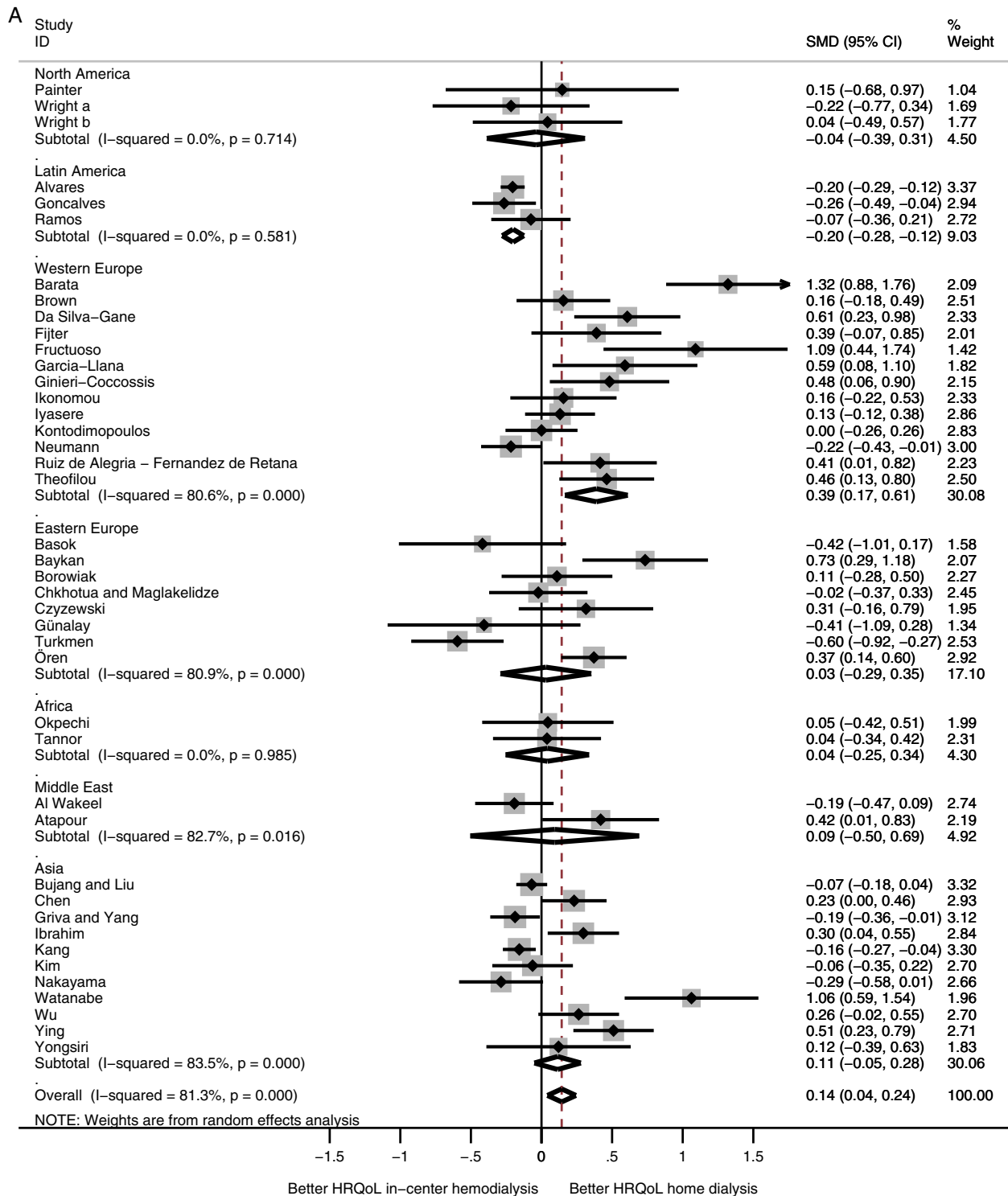
Abbreviations: EQ-5D VAS, EuroQol-5D visual analogue scale; HHD, home hemodialysis; HRQoL, health-related quality of life; ICHD, in-center hemodialysis; KDQOL, Kidney Disease Quality of Life instrument; NA, not available; PD, peritoneal dialysis; SD, standard deviation; SF, Short Form Health Survey (12-item or 36-item); UK, United Kingdom; USA, United States of America; WHOQOL-BREF, abbreviated World Health Organization Quality of Life questionnaire.

<sup>a</sup>The regional boards of the International Society of Nephrology were used for the classification of countries into subcontinents.

<sup>b</sup>EQ-5D VAS score was used as a surrogate for both physical score and mental score.

<sup>c</sup>Wright et al included 3 patient populations: HHD, PD, and ICHD.

<sup>d</sup>Median with interquartile range.



**Figure 2.** Meta-analysis of health-related quality of life (HRQoL) among subcontinents. Abbreviations: CI, confidence interval; SMD, standardized mean difference. (A) Physical and (B) mental HRQoL among subcontinents.

The standard deviation for the HRQoL scores in 5 studies had to be calculated, if sufficient data were available,<sup>95,98,108</sup> or substituted.<sup>102,106</sup> Also, WHOQOL-BREF scores in 2 studies were transformed into a 100-scale.<sup>101,121</sup> To further explore the robustness of data, sensitivity analysis was performed that did not change the mentioned results.

**DISCUSSION**

This meta-analysis shows better physical HRQoL for patients treated with home dialysis compared with patients treated with in-center HD, while mental HRQoL is comparable between these 2 patient groups. However, higher physical HRQoL scores in home dialysis patients were



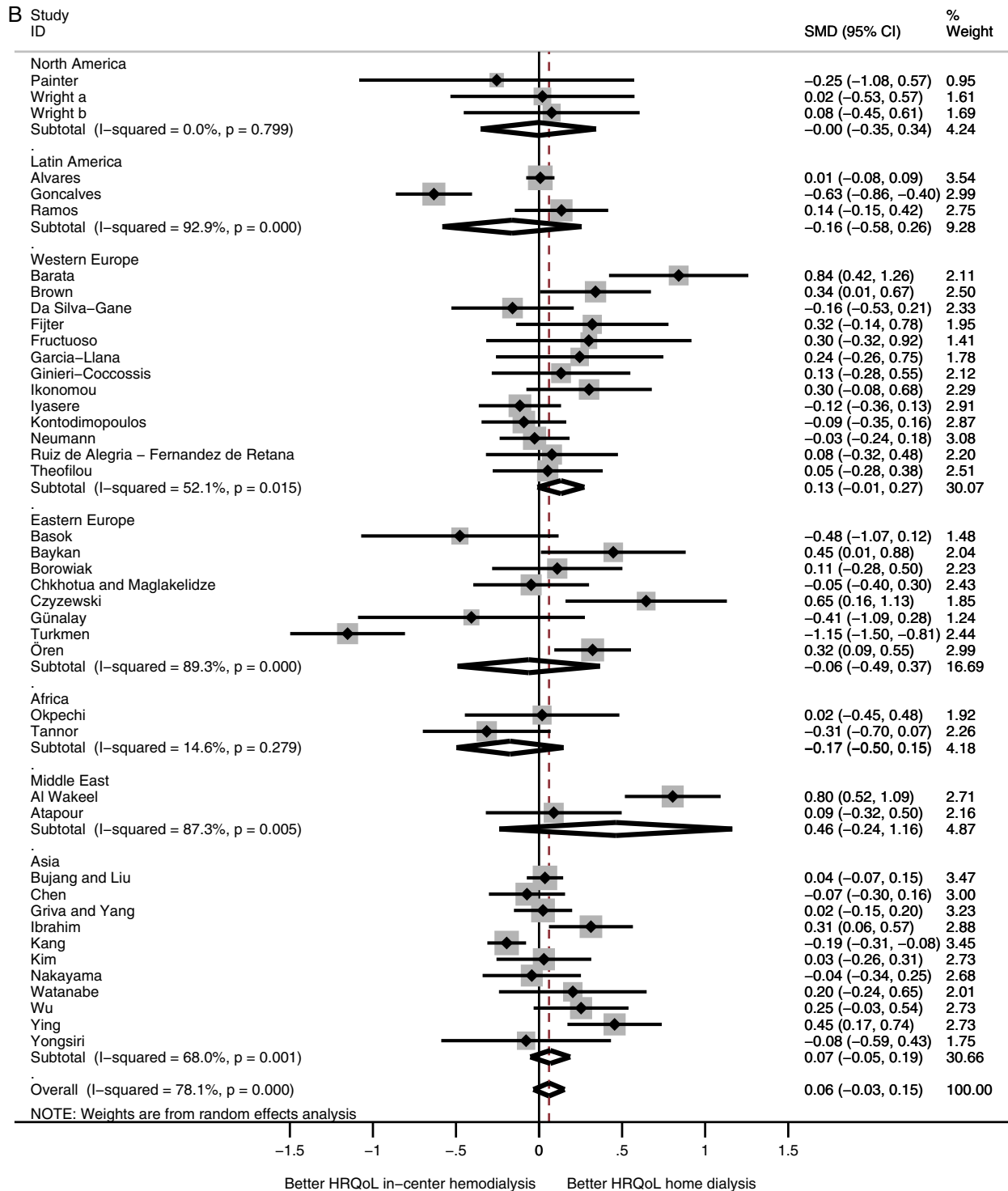
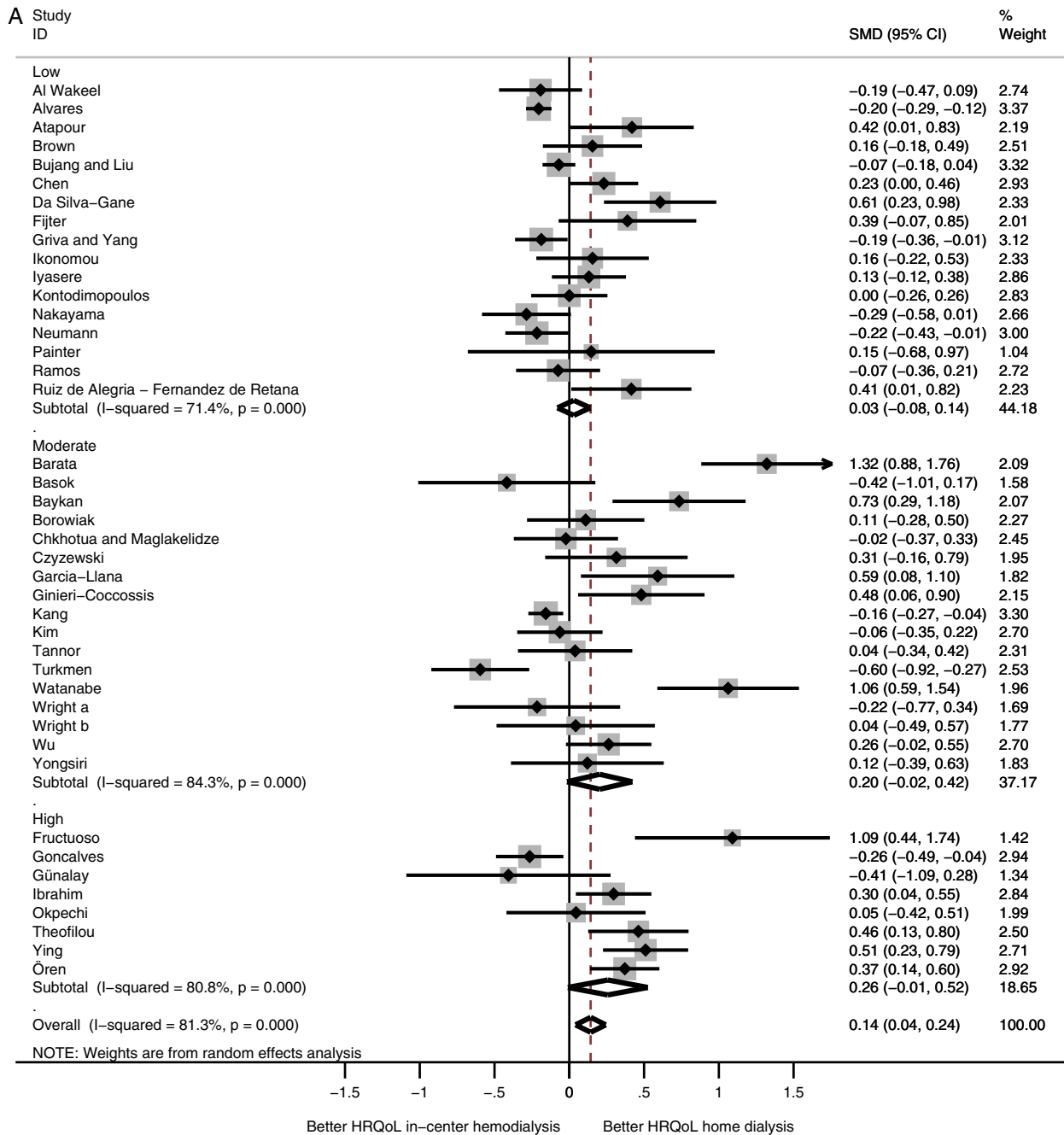


Figure 2. (continued).

found only in Western Europe. Home dialysis patients from Latin America were found to have poorer physical HRQoL compared with in-center HD patients. No studies were conducted in Oceania or Russia and only a few in Africa and the Middle East, hampering the comparison regarding HRQoL in the dialysis population worldwide. Furthermore, it should be noted that included studies were

generally low in quality and showed high heterogeneity. Therefore, the conclusion regarding better HRQoL of home dialysis patients compared with in-center HD patients lacks the necessary robustness.

The finding that home dialysis patients from Western Europe had better physical HRQoL compared with in-center HD patients could be explained because PD patients



**Figure 3.** Meta-analysis of health-related quality of life (HRQoL) among level of bias. Abbreviations: CI, confidence interval; SMD, standardized mean difference. (A) Physical and (B) mental HRQoL among level of bias.

from some of the Western European studies were younger due to practice patterns, suggestive for confounding by indication.<sup>97,99,100</sup> Although most studies performed statistical adjustments of their analyses, important residual confounding between these patient groups might still be present. In contrast to West European home dialysis patients, those from Latin America were found to have poorer physical HRQoL. However, these results could also be subject to confounding by indication because in Brazil, the country in which these studies were conducted, it is

common practice to perform PD only if patients are not eligible for in-center HD.<sup>84</sup> Brazilian in-center HD patients may be healthier and therefore physically in better condition than PD patients in general.<sup>84,102</sup> This was emphasized by Ramos et al<sup>117</sup> because in this study, PD and in-center HD patients were more comparable and physical HRQoL scores were found to be equal.

The differences in HRQoL of dialysis patients across the world could also be explained by differences in access to dialysis. Liyanage et al<sup>129</sup> modeled inaccessibility among

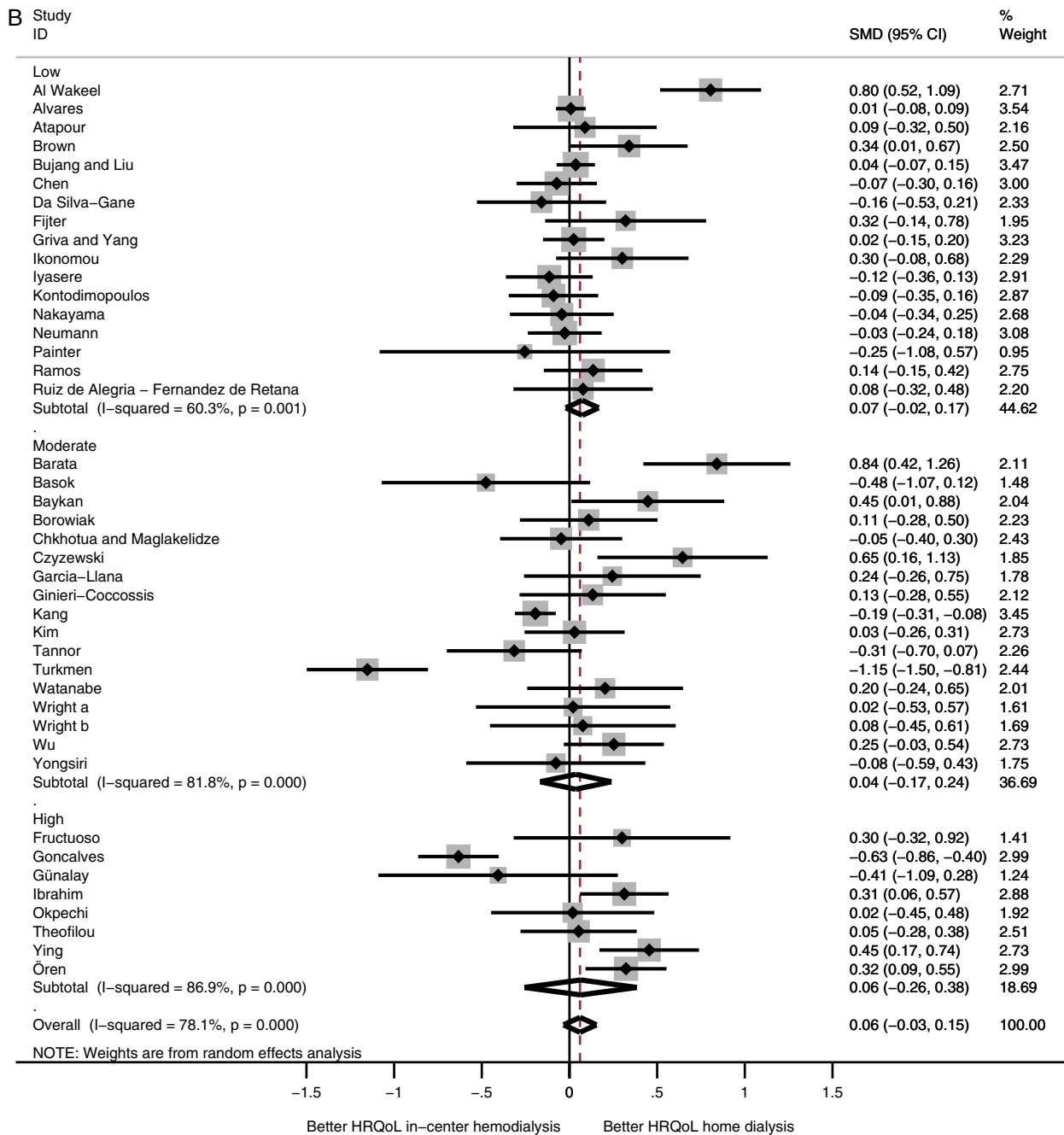


Figure 3. (continued).

countries and estimated that at least 47% and at most 73% of the world population has no access to renal replacement therapy (RRT). In Latin America, up to 52% of patients with ESRD have no access to dialysis, while Africa and Asia have the highest inaccessibility rates, 83% and 91%, respectively.<sup>129</sup> In South Africa, more than half the patients in need of RRT cannot be treated.<sup>130,131</sup> Due to limited resources, prolonged maintenance dialysis is not applied and only patients suitable for transplantation are eligible for RRT. As a result, the elderly or unemployed and patients with diabetes or drug abuse are rarely accepted for dialysis

treatment.<sup>130,131</sup> In India, less than 10% of patients start RRT and yet more than two-thirds cease dialysis treatment due to financial problems, often within 3 months. Most dialysis facilities belong to private hospitals and although PD has gained popularity, due to financial restrictions both home dialysis and in-center HD are reserved for the rich minority.<sup>132</sup> In most countries of North and South Asia, dialysis care is publicly funded, as is most common in the rest of the world, whereas only 31% of countries in Southeast Asia provide free publicly funded dialysis care.<sup>133</sup> Particularly patients from low-income countries worldwide depend on

private funding.<sup>133,134</sup> In high-income countries, inaccessibility is very low, with a maximum of 30%, in comparison to 98% in low-income countries.<sup>129,135</sup> Due to these accessibility issues, dialysis patients from high-income countries (eg, Western Europe) substantially differ from patients worldwide, which could influence HRQoL scores importantly.

This meta-analysis also underscores the effect of bias in HRQoL. A high risk of bias was associated with better HRQoL in favor of home dialysis if compared with studies with low risk of bias. Remarkably, in all studies with a high risk of bias, HRQoL questionnaires were not completed by patients themselves, yet were administered by researchers for whom it was unclear whether they had been trained. In the manual of the Short Form Health Survey, it is stated that the questionnaire should be completed by the patient alone before any contact with the clinician to avoid influencing the patient and reduce the risk of socially desirable answers.<sup>128</sup> Hood et al<sup>136</sup> has found that assessment by an interviewer is a potential risk of significant bias. The aforementioned conclusion is confirmed by results of this meta-analysis.

No randomized controlled trials with randomization between home and in-center dialysis were found in the literature search, presumably because previous experiences have shown that a patient's choice between home dialysis and in-center HD is too fundamental to let it be determined by fate.<sup>20,137</sup> In this meta-analysis, most studies had a cross-sectional design and did not adjust for confounding, even though populations were not comparable at baseline. However, patients performing home dialysis are principally different from in-center HD patients. Therefore, in cross-sectional studies, the observed associations are less likely to be causative. Korevaar et al<sup>138</sup> showed that patients starting home dialysis had higher HRQoL scores than in-center HD patients even in adjusted analysis, while Manns et al<sup>139</sup> reported that choosing home dialysis improved HRQoL even before initiation of home dialysis. The prospective studies in this meta-analysis had a follow-up period of 6 to 12 months. However, it might take longer for patients to return to social activities and work, 2 factors suggested to be of major influence on HRQoL.<sup>18,21-23</sup> Therefore, prospective studies with at least 1 year of follow-up will be necessary to provide a valid assessment of HRQoL of home dialysis patients.

Unfortunately, few studies reported on disease-specific domains, whereas dialysis modality possibly has a greater impact on specific symptoms or domains than on generic physical and mental HRQoL scores.<sup>140,141</sup> Future studies should also incorporate disease-specific domains as an outcome measure.

The most important limitation of this meta-analysis is the high heterogeneity among studies. High heterogeneity remained despite several subgroup analyses, emphasizing the clinical and methodological diversity among studies. However, this systematic review and meta-analysis provides a detailed overview of current literature on HRQoL of home dialysis patients across the

world, while previous reviews were unable to provide such a detailed insight.<sup>25-27</sup> Another limitation was that only 3 studies focused on HHD, illustrating the knowledge gap regarding this modality.

In conclusion, although pooled data in this meta-analysis show marginally better physical HRQoL for home dialysis patients; the quality of design of the included studies is poor and large heterogeneity among studies exist. Therefore, no definitive conclusions on HRQoL of patients treated with home dialysis can be drawn. Large prospective studies with adequate follow-up and adjustments for confounders are necessary to evaluate HRQoL of home dialysis patients.

## SUPPLEMENTARY MATERIAL

### Supplementary File (PDF)

**Figure S1:** Meta-analysis of health-related quality of life in different questionnaires.

**Figure S2:** Meta-analysis of health-related quality of life in different age categories.

**Table S1:** Search strings for Cochrane, EMBASE, and PubMed databases

**Table S2:** HRQoL questionnaires

**Table S3:** Criteria used in risk of bias assessment

**Table S4:** Critical appraisal of 41 studies

## ARTICLE INFORMATION

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