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SYSTEMATIC REVIEW AND META-ANALYSIS

# Health State Utility Values in People With Stroke: A Systematic Review and Meta-Analysis

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**BACKGROUND:** Health state utility values are commonly used to provide summary measures of health-related quality of life in studies of stroke. Contemporaneous summaries are needed as a benchmark to contextualize future observational studies and inform the effectiveness of interventions aimed at improving post-stroke quality of life.

**METHODS AND RESULTS:** We conducted a systematic search of the literature using Medline, EMBASE, and Web of Science from January 1995 until October 2020 using search terms for stroke, health-related quality of life, and indirect health utility metrics. We calculated pooled estimates of health utility values for EQ-5D-3L, EQ-5D-5L, AQoL, HUI2, HUI3, 15D, and SF-6D using random effects models. For the EQ-5D-3L we conducted stratified meta-analyses and meta-regression by key subgroups. We screened 14 251 abstracts and 111 studies met our inclusion criteria (sample size range 11 to 12 447). EQ-5D-3L was reported in 78% of studies (study n=87; patient n=56 976). The pooled estimate for EQ-5D-3L at ≥3 months following stroke was 0.65 (95% CI, 0.63–0.67), which was ≈20% below population norms. There was high heterogeneity ($I^2$>90%) between studies, and estimates differed by study size, case definition of stroke, and country of study. Women, older individuals, those with hemorrhagic stroke, and patients prior to discharge had lower pooled EQ-5D-3L estimates.

**CONCLUSIONS:** Pooled estimates of health utility for stroke survivors were substantially below population averages. We provide reference values for health utility in stroke to support future clinical and economic studies and identify subgroups with lower healthy utility.

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Stroke is the second most common cause of death[1] and a leading cause of disability worldwide. Patient-reported physical and social well-being are important outcomes after stroke.[2,3] As such, there has been increasing interest in patient-reported outcomes and capturing health-related quality of life (HRQoL) with validated questionnaires among stroke survivors in observational and interventional studies.[4,5] The EuroQol 5 dimensions (EQ-5D) is the most widely used measure of HRQoL in stroke trials.[6] Both the EQ-5D-3L (3 levels) and EQ-5D-5L (5 levels) have been validated in patients with stroke and are responsive to change.[7–10] HRQoL is impaired across multiple domains in stroke and may be lower in women.[11]

Health state utility values (HSUVs) represent an individual's valuation or preference for being in a particular

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## CLINICAL PERSPECTIVE

### What Is New?

- In this systematic review and meta-analysis of observational studies evaluating health-related quality of life after stroke, EQ-5D-3L was the most common instrument used.
- The pooled health utility index value of EQ-5D-3L at ≥3 months after stroke was 0.65, 95% CI (0.63–0.67), ≈20% below population norms.
- Utility was lower among women, older individuals, and in the early period after stroke.

### What Are the Clinical Implications?

- The findings highlight the impaired health-related quality of life in stroke survivors and in specific subgroups.
- Our pooled estimates may be useful as reference values for clinical or economic studies.

### Nonstandard Abbreviations and Acronyms

| | |
|---|---|
| **15D** | 15 dimensions |
| **AQOL** | assessment of quality of life scale |
| **EQ-5D-3L** | EuroQol 5 dimension 3 level |
| **EQ-5D-5L** | EuroQol 5 dimension 5 level |
| **HRQOL** | health-related quality of life |
| **HSUV** | health state utility value |
| **HUI2** | health Utilities Index Mark 2 |
| **HUI3** | health Utilities Index Mark 3 |
| **PRISMA** | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| **QWB** | quality of well-being scale |
| **SF-6D** | short form 6D |

health state.[12] HSUVs can be obtained through direct or indirect utility measurement. Indirect utility measures are generic preference-based questionnaires that use conversion equations to transform the questionnaire scores into utilities, whereas direct utility measures elicit preferences directly onto the utility scale using techniques such as time trade off, visual analogue scales, or standard gamble.[13] Indirect health utility measures are easier to administer and more interpretable by patients and providers. Researchers will use a set of conversion weights, either derived from the country of the study or the country with the most similar characteristics, in order to best reflect the societal preferences of the cohort under study.[13] The final health utility index score attempts to summarize the desirability of a health outcome, where dead is anchored at 0 and 1 is perfect health. A value of <0 signifies a state considered worse than dead.[13]

Indirect health utility metrics commonly used in the stroke literature include the EQ-5D, Health Utilities Index Mark 3 (HUI-3), and the Assessment of Quality of Life (AQoL) scale.[4,10,14] HSUVs are important for decision models, economic analyses, calculating quality-adjusted life years, and comparing across diseases or disease states.[15] Therefore high quality estimates of health utility are an important foundation for cost-utility models, decision-making, and determining the effects of new treatments on quality of life.[16]

Prior meta-analyses of pooled HSUVs in stroke are outdated (included studies prior to 2000 only)[17–19] or focused exclusively on health utility weighting of the modified Rankin Scale score (mRS),[4] and did not evaluate differences by age and sex. An up-to-date and comprehensive evaluation of HSUVs among stroke survivors and differences between relevant subgroups is therefore needed for resource allocation, planning of post-stroke services, and as a benchmark for future clinical and economic analyses.

We conducted a systematic review and meta-analysis to obtain up-to-date estimates of HSUVs, explore potential sources of heterogeneity, and determine how these estimates vary by key characteristics of age, sex, stroke type, and time since stroke.

## METHODS

### Study Design

The study was developed and reported based on the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[20] (Table S1) and registered online on PROSPERO (ID: CRD42020215942). Title and abstract screening were completed independently by two investigators (R.J. and J.A.). Full text review (through manual review and automatic PDF search with keywords), full text abstraction, and risk of bias assessment were completed by R.J. All data abstraction was verified a second time by R.J., and a 25% random sample was additionally verified by J.A. All conflicts were resolved by consensus.

### Search Strategy

Medline, EMBASE, and Web of Science were searched from January 1995 (publication of pivotal NINDS trial on stroke thrombolysis[21]) until October 25, 2020, with no language limitations. The search strategy was developed in consultation with University of Calgary

librarians using key terms related to stroke and HSUVs (Table S2).

## Eligibility Criteria

Any observational study, including prospective, retrospective, and cross-sectional studies, were included if the main cohort comprised people with prior stroke and at least one indirect HSUV index score was calculated at any time after stroke. Indirect HSUVs included in the search were EQ-5D (3L[22] and 5L[23]), AQoL,[24] HUI2[25] or HUI3,[25] Short Form 6D (SF-6D),[26] Quality of Well-Being Scale (QWB),[27] and 15D[28] (see Table S3 for characteristics of each metric). We did not include controlled trials to avoid the possibility of diverse non-standardized co-interventions in select populations impacting general estimates of HSUVs in stroke survivors. Furthermore, many trials may not be identifiable by title or abstract search due to inclusion of HSUVs as a secondary outcome.

Participants were required to be ≥18 years of age. Stroke type included ischemic stroke, hemorrhagic stroke (may include intracerebral hemorrhage or combined intracerebral hemorrhage/subarachnoid hemorrhage), or unspecified stroke. Unspecified stroke was included as a large majority in this diagnostic category will have ischemic stroke. We excluded studies exclusively reporting transient ischemic attack or subarachnoid hemorrhage, studies which included stroke as a subset of another condition, study protocols, case series, studies not reporting primary data, studies of direct utility measures such as standard gamble or time trade off as these are highly reliant on the scenarios used in the estimates, studies using tools which do not convert to utilities (36-item short form survey, Stroke Specific Quality of Life Scale, EQ-Visual Analogue Scale), or utilities obtained using mapping techniques as mapping algorithms can be unreliable.[29] Studies were also excluded if only adjusted, rather than crude values, of health utility were reported, or if there was no measure of variance reported.

## Data Extraction

Variables extracted included important study and sample characteristics (Table S4). We extracted HSUV type, tariff used, how the survey was administered (eg, in-person, phone, mail), mean or median utility index score, measure of variance (SD, SE, interquartile range, or 95% CIs), and number of subjects.

## Risk of Bias Assessment

We adapted criteria from the "National Institute for Health and Care Excellence Decision Support Unit Technical Support Document: Identification, Review and Synthesis of Health State Utility Values from the Literature" for risk of bias assessments.[30,31] The criteria facilitate assessment of sample size, respondent selection, inclusion/exclusion criteria, response rates, loss to follow-up, and missing data. We also added a category to assess proxy responses. For each study, we assigned the categories to low, medium, or high risk of bias (see Table S5 for explanation of criteria). Lastly, we documented whether the study excluded people who died, assigned a utility value of 0 for being dead, or was not applicable (ie, cross-sectional study of stroke survivors).

## Statistical Analysis

We described study and sample characteristics with proportions and means. If distributions were only reported separately for subgroups within a study, we manually calculated the mean and SD for the entire group using fixed effect meta-analysis. If studies reported HSUVs longitudinally at multiple time points, we used the time point closest to 3 months. If the study reported HSUVs pre- and post- intervention (such as a non-randomized rehabilitation intervention), we reported the HSUV prior to the intervention. In the vast majority of cases, mean HSUVs were reported in the studies. If median with interquartile range or range was reported, approximate corresponding mean and SD were calculated using published methods.[32,33] We pooled estimates only if there were at least 2 relevant studies.

Our primary outcome was health utility in people with stroke at 3 months or more after stroke. We chose this endpoint due to the large improvement in health utility that may occur between stroke onset and 3 months. Studies with population-based community surveys were included in this outcome due to the high likelihood that most subjects were ≥3 months after stroke. Our secondary outcomes were health utility in other time bands or specific time points: (1) prior to acute care discharge (hospital or rehabilitation), (2) prior to hospital discharge, (3) after acute hospitalization and prior to in-patient rehabilitation discharge, (4) at 3 months (3–3.9 months) from stroke onset, (5) from 3 to <12 months from stroke onset, (6) at 12 months (12–12.9 months) from stroke onset, (7) 12 months and over from stroke onset, and (8) at 5 years (+/– 1 year) from stroke onset. Our primary outcome was calculated for all health utility tools but there were only sufficient number of studies for EQ-5D-3L for the secondary outcomes. Additional secondary outcomes for EQ-5D-3L were health utility at ≥3 months after stroke stratified by age (<65, 50–64, 61–74, and 71+), sex, stroke type (ischemic and hemorrhagic). We also stratified by time point (prior to acute care discharge, <4 months, 6 to <12 months,

and 12+ months), only including those studies that stratified by these variables. The common bands for age and time points were chosen to allow all studies with stratified values to be included. We did not include a subgroup by mRS as a recent meta-analysis focused specifically on healthy utility weighting of the mRS and demonstrated high variability in health utility scores for each mRS level.[4] We conducted meta-analyses using DerSimonian and Laird random effects models[34] to estimate the pooled health utility and 95% CIs in people with stroke.

We compared the pooled HSUV estimates to population norms. Heterogeneity was quantified with the $I^2$ statistic. We explored for potential sources of heterogeneity with stratified analysis according to sample size, case definition (self-report or medical diagnosis of stroke), and country.

## Sensitivity Analyses

We conducted multiple sensitivity analyses on the primary outcome to account for potential sources of bias. First, we excluded studies with a high probability of similar or overlapping cohorts (ie, registry, hospital-based, or survey data from the same region with same or overlapping years). We selected the potential duplicate study with the greatest number of subjects for inclusion. Second, we excluded studies that assigned 0 as a value for dead rather than excluding deaths, and also conducted a separate meta-analysis of only those studies. Third, we excluded studies with >1 category with a high risk of bias. Fourth, to explore for potential sources of heterogeneity, we performed random effects meta-regression across studies by incorporating percent female, mean/median study age, and publication date as separate covariates. Meta-regression of percent female was also adjusted by mean/median study age, and vice-versa. Fifth, we repeated the meta-analysis of each utility metric and the different time points of EQ-5D-3L using fixed effect meta-analysis. This was done to obtain an "average effect parameter" where weights are not redistributed from big to small studies as in random effects meta-analysis, and is analogous to combining individual level data.[35]

All analyses were conducted in Stata version 17.0 (College Station, TX). Data available from the corresponding author upon reasonable request.

# RESULTS

## Study Assembly and Study Descriptions

The PRISMA flow diagram showing the study selection process is depicted in Figure S1. Our search strategy identified 14 251 abstracts after duplicates were removed. A total of 211 studies were selected for full text review, and 111 fulfilled the inclusion criteria after full text review (Supplemental Material). There was a random agreement probability of 97.4% and moderate inter-observer agreement (Cohen's Kappa 0.45) for abstract review. All disagreements were resolved through consensus. There was a total of 64 571 individuals in the included studies.

Characteristics of each study in the systematic review are shown in Table S4, and mean values of baseline characteristics across studies weighted by sample size are in Table S6 for all studies & Table S7 for studies of EQ-5D-3L. The mean age across studies was 68.1 years (SD 5.7), mean follow-up time was 13.0 months (SD 15.7), mean proportion of women was 44.2% (SD 6.2), and mean proportion with ischemic stroke was 85.5% (SD 8.3). The majority of studies reported the EQ-5D-3L (78%); studies were international with the greatest representation from Australia, the Netherlands, the UK, and Korea, and the number of publications increased over time from 1995 to 2020 (Figure S2).

## Risk of Bias Assessments

All meta-analyses had very high heterogeneity ($I^2$>90%), except for the HUI3 which was 0%. Risk of bias is reported in Table S8 and the proportion of studies with low, medium, and high risk of bias for each category are shown in Table S9. Missing data were not addressed in 63% of studies, and presence/rate of proxy response was not reported in 71% of studies.

## Overall Pooled Estimates

Among studies using the EQ-5D-3L, case definition of stroke was based on self-report in 14 studies (16.1%) and on medical diagnosis in 73 studies (83.9%). Twelve (13.8%) studies included ischemic stroke only, 1 (1.2%) included hemorrhagic stroke only, and 74 studies (85.1%) included both or undefined stroke types. The distribution of EQ-5D-3L across studies is shown in Figure S2D.

The pooled EQ-5D-3L index estimate at ≥3 months after stroke across all available studies was 0.65, 95% CI: 0.63 to 0.67 ($I^2$=99.0%; study n=73, patient n=52 614; Figure S3), which is ≈20% below the UK population norms for age 65 to74[36] (Figure 1). The pooled value for studies that only included patients with ischemic stroke was similar (0.63, 95% CI 0.56–0.69; study n=11, patient n=7476). Pooled EQ-5D-3L estimates at specific time points are shown in Table S10, with lowest utility during hospitalization (0.39, 95% CI 0.23–0.54), and sequentially higher values at rehabilitation (0.57, 95% CI 0.47–0.67), 3 months (0.65, 95% CI 0.61–0.70), and 5 years after stroke (0.70, 95% CI 0.64–0.76).

The pooled utility value for EQ-5D-5L was 0.68 (95% CI 0.61–0.76; 10 studies), for the AQoL was

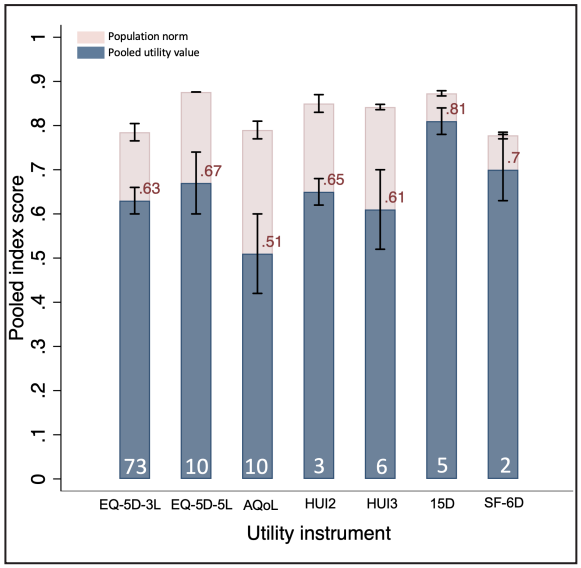


**Figure 1. Pooled health utility values in people ≥3 months after stroke and 95% CIs for all included instruments, with reference values shown for population norms of select countries among those aged 65 to 74 (see below).**
Pooled estimates ranged from 7% (15D) to 35% (AQoL) lower than population norms depending on the instrument. EQ-5D-3L norms were taken from UK as the majority of studies used the UK tariff[36]. EQ-5D-5L taken from Bulgaria as these are the only norms published on the EuroQoL website at the time of submission[37]. AQoL norms taken from Australia as all included studies were done in Australia[24]. HUI2 and HUI3 norms taken from Canada and US as referenced on the Health Utilities Inc. website[38–40]. 15D and SF-6D norms were taken from studies in Finland and UK where they were developed, respectively[26,28]. White number indicates number of studies. Red number indicates pooled estimate.

0.51 (95% CI 0.42–0.61; 10 studies), for HUI2 was 0.65 (95% CI 0.62–0.68, 3 studies), for HUI3 was 0.64 (95% CI 0.54–0.73; 6 studies), for the 15D was 0.81 (95% CI 0.78–0.84; 5 studies), and for SF-6D was 0.70 (95% CI 0.63–0.78; 2 studies). The pooled estimates in sensitivity analyses were similar for EQ-5D-3L, EQ-5D-5L, and AQOL (Table S11). The sensitivity analyses using fixed effect had overall higher utility values at ≥3 months after stroke and much narrower CIs, although the pattern of increased health utility from hospitalization to 3 months was similar (Figure S4 and Table S12). See Figures S5 through S10 for all meta-analyses, and Figure 1 for comparison to population norms obtained from literature.[24,26,28,36–40]

There was heterogeneity in pooled EQ-5D-3L value across study size (lower utility associated with smaller size), self-diagnosis versus medical diagnosis of stroke (higher utility in self-diagnosis), and differences by country (Figure 2), although the number of studies in some individual countries was small and CIs were wide.

## Pooled Stratified Estimates

There were sufficient studies that reported utility by sub-group strata for EQ-5D-3L only. Utility estimates were lower for women compared with men in 12 out of 13 studies that included sex-stratified utility values at ≥3 months after stroke (Figure S11). The pooled estimate for women was 0.62 (95% CI 0.57–0.67) and for men was 0.71 (95% CI 0.66–0.75; Figure 3A).

Utility was lower over age 70 (0.65, 95% CI 0.58 to 0.72) compared with age 65 and under (0.75, 95% CI 0.74 to 0.77; Figure S12; Figure 3B).

There was a lower pooled utility estimate in those with hemorrhagic versus ischemic stroke in 6 out of 7 studies that reported both stroke types (pooled estimate 0.58, 95% CI 0.39 to 0.77 in hemorrhagic stroke versus 0.68, 95% CI 0.60–0.76 in ischemic stroke; Figure S13; Figure 3C).

Lastly, in studies that reported multiple time points there was a markedly lower utility prior to discharge from acute hospitalization or rehabilitation (0.41, 95% CI 0.23–0.58), compared with at <4 months follow-up (0.63, 95% CI 0.50–0.75), with a smaller increase within 6–12 months (0.66, 95% CI 0.61–0.71) and by 12+ months (0.69, 95% CI 0.62–0.76; Figure S14; Figure 3D).

## Meta-Regression

Meta-regression across studies with EQ-5D-3L at ≥3 from stroke demonstrated lower utility score with higher percentage female in the study ($P$=0.017; Figure S15). The association remained significant when adjusting for mean/median study age ($P$=0.018). There was no significant difference in utility by study age, with ($P$=0.3) or without ($P$=0.2) adjusting for percent female. There was no significant change in utility by publication date ($P$=0.6). After meta-regression, large amounts of heterogeneity remained ($I^2$>99%), indicating that there were other unexplained factors present giving rise to between-study differences.

# DISCUSSION

We conducted a comprehensive systematic review and meta-analysis of health-related quality of life after stroke as calculated with indirect utility measures. We obtained pooled estimates for seven indirect healthy utility measures taken at least 3 months after stroke and showed that all estimates were substantially below population norms, although there was a high degree of between-study heterogeneity. The EQ-5D-3L was the most commonly used tool with a pooled utility of 0.65 at ≥3 months after stroke, ≈20% below population norms. We were able to pool EQ-5D-3L studies which stratified by key characteristics, demonstrating lower health utility among individuals >70 years of age

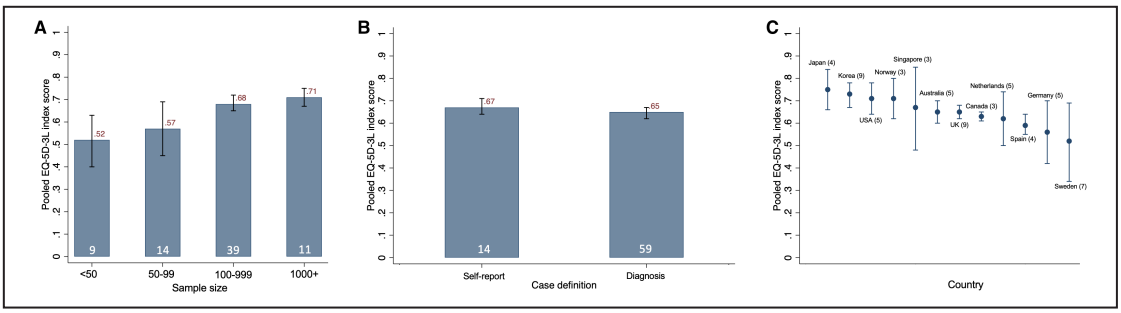


**Figure 2. EQ-5D-3L pooled utility values ≥3 months after stroke stratified by sample size, case definition of stroke, and country.**
Health utility is greater in studies with larger sample size, and in self-reported stroke compared with medical diagnosis. Between-country differences may be driven in part by study sizes and other study-specific differences and therefore may not accurately reflect utility among stroke survivors in that country. White number or number in brackets indicates number of studies. Red number indicates pooled estimate.

and among patients assessed during hospitalization or rehabilitation. Utility increased substantially between acute care and 3 months after stroke with incremental improvements at longer follow-up. Furthermore, women had a lower pooled health utility estimate compared with men. The pooled estimates in this meta-analysis can be used in future economic evaluations and offer a greater understanding of health utility estimates in stroke and differences across important characteristics, although should be interpreted with caution due to high heterogeneity.

Previous meta-analyses synthesizing HSUVs in stroke included studies up until the year 2000 only, and pooled estimates from different metrics.[17–19] Therefore, we did not seek to directly compare utility values to these studies. There has been a substantial increase in the number of publications on health utility in stroke over the last two decades, a time period characterized by marked improvements in stroke systems of care and development of new therapies such as mechanical thrombectomy.[41,42] A recent meta-analysis suggested the need to capture both mRS and health utility in clinical trials.[4] Our study therefore aimed to synthesize the observational literature in the past 25 years, provide reference estimates of health utility in stroke to assist in economic analyses, and support the planning and interpretation of observational studies and clinical trials which incorporate HSUVs. Our pooled estimate of 0.65 for EQ-5D-3L was ≈20% lower than the UK population norm for those aged 65 to 74, and lower than pooled estimates for other chronic conditions such as 0.75 in psoriasis, 0.76 for coronary artery disease, or 0.71 for severe chronic obstructive pulmonary disease,[43–45] suggesting substantial impairment in quality of life among survivors of stroke. Furthermore, there was no significant change in health utility estimate across study years. This result is compatible with a longitudinal study of HRQoL among survivors of stroke in the United Kingdom showing no significant changes over time.[46] While an assessment of utility across study years is limited by the high heterogeneity between studies, the lack of change over time may also represent persistent impairment in most survivors of stroke or improved survival among disabled patients. In addition, improvements in objective disability over time may not correspond directly with patient-reported quality of life, given that domains such as cognition, emotion, and pain are not specifically captured by traditional motor or activity-focused disability scales. HRQoL is a multi-dimensional construct that overlaps with objective disability but may be influenced by shifts in societal and patient expectations of quality of life and changes in HRQoL in the general population, which may partly explain the lack of change over time.

The age and sex differences seen in our study are consistent in direction with large epidemiological studies.[11,47] Lower HRQoL for women may be due to increased anxiety or depression, pain and discomfort, or decreased mobility compared with men.[11,48] Women are also older on average at stroke onset compared with men, have higher stroke severity, and there are known disparities such that women are less likely to receive thrombolysis and in-hospital interventions.[49] In our meta-analysis, age over 70 was associated with lower pooled health utility. These results are expected as elderly individuals have lower utility in the general population, greater co-morbidities, higher stroke severity, longer lengths of stay, and are less likely to be discharged home after stroke.[50–52] Lastly, health utility during acute hospitalization was also very low (≈0.4), likely driven by severity of deficits at onset. There are also likely to be more proxy responses in the early time period which are associated with lower utility

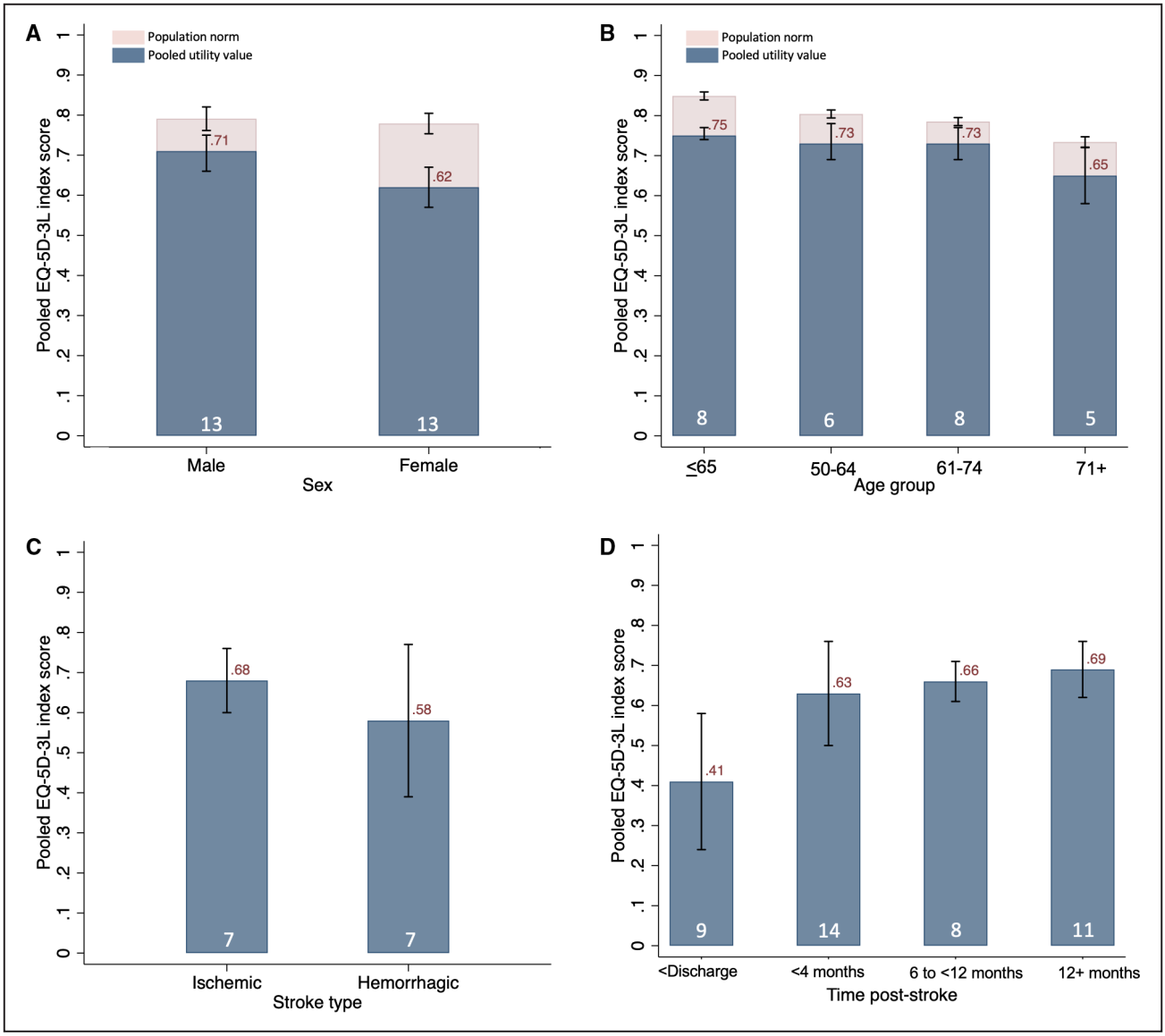


**Figure 3. Pooled health utility value for EQ-5D-3L stratified by sex (A), age group (B), stroke type (C), and time after stroke (D).** UK population norms are shown for sex groups and display a greater reduction in utility in women with stroke. UK population age norms were selected to correspond closest to the pooled study groups: 45 to 54 years norm for age ≤65 group, 55 to 65 years norm for age 50 to 64 group, 65 to 74 years norm for age 61 to 74 group, and 75+ years norm for age 71+ group. There is a greater difference in utility in stroke survivors compared to norms with older age. There is lower pooled utility for hemorrhagic compared with ischemic stroke, and a large increase in utility between acute care and <4 month follow-up. White number indicates number of studies. Red number indicates pooled estimate.

estimates.[53] We saw a large increase in health utility by 3 to 4 months which stabilized and increased only slightly into later time periods, possibly driven by early mortality in those with the worst HRQoL or early time- and rehabilitation-dependent recovery after stroke. These results are compatible with prior longitudinal studies showing most functional recovery occurring by 3 months in those with ischemic stroke.[54,55] As the minimally clinically importance difference of EQ-5D-3L in stroke is estimated to be 0.08 to 0.12, the age- and time-dependent differences were clinically meaningful although the sex difference may be of borderline clinical significance.[56]

Our study has potential limitations. We did not evaluate adjusted estimates of health utility, as most studies reported crude estimates, and our objective was to identify the actual health-related quality of life among survivors of stroke, regardless of potential confounders. Our meta-analyses had high levels of unexplained heterogeneity and therefore may limit generalizability. The heterogeneity was an expected finding due to pooling observational studies of survivors

of stroke from different countries, using different health utility tariffs, and inherent clinical and study-level heterogeneity (eg, sample sizes, differences in timing of assessment, or method of elicitation). Due to the high heterogeneity, the results should be interpreted with caution and with acknowledgment of the uncertainty in the pooled values, in particular less commonly used utility metrics and stratified meta-analyses with smaller number of studies. There is also uncertainty surrounding the methodology of combining health utility estimates.[57] However, we avoided combining utility values from different instruments, and therefore all secondary analyses were limited to the EQ-5D-3L which was reported most often within our included studies. Finally, we pooled utilities across countries, as has been done in previous publications on multiple chronic conditions including heart disease,[44,58] lung disease,[59] psychiatric disease,[60,61] cancer,[62] and others,[63–69] and provided country-specific estimates where possible. However given the differences in health state valuation between countries, researchers should be aware of high heterogeneity, be cautious in the interpretation of results and use in future decision modeling, and use country-specific utility values when available.[57] In summary, our pooled estimates do not precisely represent utility for people with stroke but rather are the rough center of a range of health utility values from different settings, populations, countries, social environments, and conditions of survey administration. Due to these differences, we pre-specified the use of random effects meta-analysis. However, the random effects meta-analysis assigns greater relative weight to smaller studies which may be less reliable, and which in our stratified analysis were associated with lower utility values. As such, a sensitivity analysis using fixed effect meta-analysis expectedly showed higher utility values, although CIs were too narrow and do not reflect the underlying uncertainty in the estimates. As both estimates were presented, researchers can use those that are best suited to their needs. We did not pre-plan any stratification by acute stroke treatment given that few observational studies addressed treatment effects and a more appropriate comparison would require data from clinical trials. We did not stratify health utility by mRS as a recent meta-analysis specifically addressed health utility weighting of the mRS.[4] We did not conduct any comparative evaluation of different indirect utility measures in stroke. The EQ-5D-5L had a higher pooled estimate compared with EQ-5D-3L, compatible with prior studies in stroke and the general population.[70] Although the EQ-5D-5L has more response options than the EQ-5D-3L, a comparison of the accuracy of the EQ-5D-3L versus the EQ-5D-5L, including validity, reliability, and responsiveness to clinical change is out of the scope of this meta-analysis. Furthermore, we are unable to determine how the characteristics of the individual tests influence the utility results, such as the content of the questions or the number of items in the survey, and this could be the focus of future research. Lastly, these pooled utilities may not be representative of people likely to be excluded from studies where proxies were not present, such as those with severe aphasia and those in long-term care institutions. Studies often did not report handling of missing data or inclusion of proxy respondents; future studies should focus on improving the reporting of these factors to better understand selection bias and explore methods to incorporate information from those with severe deficits such as aphasia.[71]

Patient-reported outcomes are increasingly being used to capture the patient experience among survivors of stroke in a more wholistic manner and complement standard disability scales. Recent initiatives have focused on developing standardized sets of patient-centered outcome measures to improve quality of care, such as the International Consortium for Health Outcomes Measurement.[72] To comprehensively evaluate stroke outcomes, incorporating an indirect utility measure to estimate health utilities may be useful in order to evaluate impairment in light of societal preferences, easily measure change over time, assess the impact of different disease states and treatments, and compare with other diseases.

In this systematic review and meta-analysis of 111 observational studies, we provide pooled estimates for indirect health utility metrics among survivors of stroke and found significantly lower health utility than population norms. There was high heterogeneity between studies. Women, the elderly, and patients in the acute stroke period have overall worse healthy utility and may be targets for specific interventions and support. Our results assist in understanding age, sex, and time-dependent differences in health-related quality of life and may be used as reference for future population-based studies, clinical trials, and economic analyses.

## ARTICLE INFORMATION

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## Supplemental Material

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# SUPPLEMENTAL MATERIAL

**Table of Contents**

## Table S1. PRISMA 2020 item checklist

| Section and Topic | Item # | Checklist item | |
|---|---|---|---|
| **TITLE** | | | Yes |
| Title | 1 | Identify the report as a systematic review. | |
| **ABSTRACT** | | | Reviewed/compliant |
| Abstract | 2 | See the PRISMA 2020 for Abstracts checklist (Table 2). | |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of existing knowledge. | Page 2 |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Page 2 |
| **METHODS** | | | |
| Eligibility criteria | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Page 3 |
| Information sources | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | Page 2 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Supplemental Table 1 |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | Supplemental Table 1 |
| Data collection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | Page 2 and 3 |
| Data items | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | Page 3 |
| | 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | Page 2 and 3 |
| Effect measures | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | Page 4 |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis. | |
| | 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Page 4 |
| | 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | |
| | 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | |
| | 13e | Describe any methods used to explore possible causes of heterogeneity among study results. | |
| | 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | |

| Section and Topic | Item # | Checklist item | |
|---|---|---|---|
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | Page 3 and Supp Table 2 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | Page 4 |
| **RESULTS** | | | |
| Study selection | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (see Figure 1). | Page 4 and Supp Figure 1 |
| | 16b | Cite studies that met many but not all inclusion criteria ('near-misses') and explain why they were excluded. | |
| Study characteristics | 17 | Cite each included study and present its characteristics. | Supp Table 3 |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study. | Supp Table 5 |
| Results of individual studies | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | Figure 1-3, Supp Figures 3-12 |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | |
| | 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | Page 5-6 Figure 1-3 Supp Table 6 |
| | 20c | Present results of all investigations of possible causes of heterogeneity among study results. | |
| | 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | Supp Table 5-6 |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | Page 6 |
| **DISCUSSION** | | | |
| Discussion | 23a | Provide a general interpretation of the results in the context of other evidence. | |
| | 23b | Discuss any limitations of the evidence included in the review. | Page 6-8 |
| | 23c | Discuss any limitations of the review processes used. | |
| | 23d | Discuss implications of the results for practice, policy, and future research. | |
| **OTHER INFORMATION** | | | |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | |
| | 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | Page 2 |
| | 24c | Describe and explain any amendments to information provided at registration or in the protocol. | |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | Acknowledgements |
| Competing interests | 26 | Declare any competing interests of review authors. | Disclosures |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | Page 4 |

**Table S2. Search Strategy**

Search Strategy 1: Global search (using Medline syntax)

| | |
|---|---|
| #1 | exp Stroke/<br>OR<br>exp Cerebral Infarction/ or exp Brain Infarction/ or exp brain ischemia/ or cerebral hemorrhage/<br>OR<br>(stroke* OR cerebral infarction OR brain infarction OR brain ischemia OR h?emorrhagic stroke* or cerebral h?emorrhage* or intracerebral h?emorrhage* or brain h?emorrhage*).tw,kf. |
| #2 | exp "Quality of Life"/<br>OR<br>(euroqol or euro qol or eq5d* eq-5d* or short form 6 dimension or short form six dimension or sf-6D* or hui or hui2 or hui3 or health utilit* or assessment of quality of life or aqol* or quality of well being or qwb or 15D).tw,kf. |
| #3 | (#1) AND (#2) |
| #4 | (#3) and NOT (address or autobiography or bibliography or biography or case reports or dataset or dictionary or directory or duplicate publication or editorial or "expression of concern" or festschrift or interactive tutorial or interview or lecture or legal case or legislation or news or newspaper article or patient education handout or periodical index or personal narrative or portrait or technical report or twin study or video-audio media or webcast or letter) |
| #5 | 1995 until day October 26, 2020 |

**Table S3. Indirect health utility metrics**

| HRQoL questionnaire | Description | Range of possible scores |
|---|---|---|
| EuroQol five dimensions three levels (EQ-5D-3L)[22] (main text) | Five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression), each of which is assigned one of three levels, allowing 243 health states | -0.59 to 1.00 (Europe) |
| EuroQol five dimensions five levels (EQ-5D-5L)[23] (main text) | Adaptation of EQ-5D-5L with 5 levels for each dimension, allowing 3,125 possible health states | -0.28 to 1.00 (UK) |
| Short form six dimensions (SF-6D)[26] (main text) | Six dimensions (physical functioning, role limitations, social functioning, pain, mental health, vitality), with four to six levels, allowing 18 000 health states. | 0.30 to 1.00 (UK) |
| Health utilities index mark 2 (HUI2)[25] (main text) | Seven dimensions (sensory, mobility, emotion, cognitive, self-care, pain, fertility), with three to five levels, allowing 24 000 health states | -0.03 to 1.00 (Canada) |
| Health utilities index mark 3 (HUI3)[25] (main text) | Eight dimensions (vision, hearing, speech, ambulation, dexterity, emotion, cognition, pain), with five to six levels, allowing 972 000 health states | -0.36 to 1.00 (Canada) |
| 15D (15 dimensions)[28] (main text) | Fifteen dimensions (mobility, vision, hearing, breathing, sleeping, eating, speech, elimination, usual activities, mental function, discomfort and symptoms, depression, distress, vitality, and sexual activity), with five grades of severity, allowing $3.1 \times 10^{10}$ health states. | 0 to 1 (Finland) |
| Assessment of Quality of Life (AQOL)[24] (main text) | Five dimensions (illness, independent living, social relationships, physical senses, psychological well-being), with four levels, allowing for 1.1 billion health states. | 0 to 1 (Australia) |
| Quality of Well-Being (QWB)*[27] (main text) | Three dimensions (mobility, physical activity, social activity). | 0 to 1 (USA) |

*****No included studies in this systematic review had QWB

# Table S4. Characteristics of studies included in systematic review

| Author | Citation | Publication Date | Translated? | Country | Stroke type | Self-report or diagnosis | Percent ischemic | Percent left hemisphere | Location | Mean or median age | Percent female | Time since stroke | Mean or Median NIHSS | Percent hypertension | Percent diabetes | Percent smoking | Percent coronary disease | Percent prior stroke | Percent atrial fibrillation | Instrument used | If EQ, 3L or 5L? | Tariff used | Survey method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Adey-Wakeling** | 73 | 2016 | No | Australia | B | D | 88.3 | NR | C | NR | 48.5 | At 12 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | Australia | I |
| **Appau** | 74 | 2019 | No | Canada | B | D | NR | NR | C | 71.5 (12.8) | NR | At 3 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Arrospide** | 75 | 2019 | No | Spain | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 5 | Spanish | I |
| **Arwert** | 76 | 2017 | No | Netherlands | B | D | 83 | 50% | C | 47.7 (9.7) | 37 | Mean 36 months (11.4) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M/P |
| **Barton** | 77 | 2008 | No | UK | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E, 6D | 3 | UK | M |
| **Broussy** | 78 | 2019 | No | France | B | D | 88 | NR | C | 69 (14) | 38 | At 12 months | Mean 4.7 (5.5) | 61 | 16 | 32 | NR | 13 | 14 | E | 3 | France | M/P |
| **Burton** | 79 | 2014 | No | UK | B | D | 94 | NR | C | 70.78 (11.12) | 50 | Mean 27.5 months (6.6) | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK | M |
| **Bushnell** | 11 | 2014 | No | USA | I | D | 77.4 | NR | C | 65 (IQR 56-75) | 46.3 | At 3 and 12 months | Mean 3.78 (4.59) | 79.2 | 27.9 | 24.7 | 24.2 | 23 | 10.8 | E | 3 | USA | P |
| **Cadilhac 1** | 80 | 2019 | No | Australia | B | D | 77.7 | NR | C | 78 (IQR 69-85) stroke unit, 76 (IQR 64-85) Non stroke unit | 48.4 | Median 101 days (97-107) | NR | NR | NR | NR | 24.2 | 24 | NR | E | 3 | Australia | I |
| **Cadilhac 2** | 81 | 2010 | No | Australia | B | D | NR | NR | C | NR | 49.2 | At 12 months and 5 years | NR | NR | NR | NR | NR | NR | NR | A | | NR | ? |
| **Cao** | 82 | 2012 | Y | China | B | D | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Chang** | 83 | 2016 | No | Korea | B | D | 80.1 | NR | C | 64.3 (12.8) | 40.4 | At 6 months | NR | 54.4 | 23.2 | 27.6 | 6.4 | NR | 10.3 | E | 3 | NR | I |
| **Chen 1** | 84 | 2015 | No | Taiwan | U | D | NR | 50.7 | R | 52.8 (11.6) | 26 | Median 19.7 months (0.4-94) | NR | NR | NR | NR | NR | NR | NR | E | 5 | Japan | I |
| **Chen 2** | 85 | 2018 | No | USA | H | D | NR | NR | C | 65 (IQR 57-75) resumption group/ 62 (IQR 53.5-73) no resumption group | 38.8 | At 3 months | NR | 90.1 | 31.7 | 43.2 | 5.5 | 11.5 | 12.2 | E | 3 | NR | I |
| **Cheung** | 86 | 2019 | No | Singapore | B | D | 87 | NR | C | 62.7 (10.9) | 32.4 | At 3 months or 12 months | NR | NR | NR | NR | NR | NR | NR | H3 | N/A | Canadian | NR |
| **Cramm** | 87 | 2012 | No | Netherlands | U | D | NR | NR | H | 69.13 (14.24) | 49.8 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | Netherland | I |
| **Cup** | 88 | 2001 | No | Netherlands | B | D | NR | NR | C | 68 (15) | 57.7 | At 6 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Darlington 1** | 89 | 2009 | No | Netherlands | B | D | 79 | NR | H/C | 60.9 (16.9) | 51 | Mean 10.9 months (1.19) | NR | NR | NR | NR | NR | NR | NR | E | 3 | Netherland | I/P |
| **Darlington 2** | 90 | 2007 | No | Netherlands | B | D | 79 | 31 | H/R/N | 60.9 (16.9) | 51 | Mean 10.9 months (1.19) | NR | NR | NR | NR | NR | NR | NR | E | 3 | Netherland | I/P |
| **de Graaf** | 91 | 2020 | No | Netherlands | U | D | 93 | 46 | C | 68.8 (11.7) | 40 | At 3 months | NR | NR | NR | NR | NR | NR | NR | E | 5 | Netherland | P |
| **Deb-Chatterji** | 92 | 2020 | No | Germany | I | D | 100 | NR | C | 76 (IQR 65-81) | 51.8 | At 3 months | Median 15 (IQR 10.25-19) | NR | NR | NR | NR | NR | NR | E | 3 | UK | I/P |
| **Dewilde** | 93 | 2019 | No | Belgium | B | D | NR | NR | C | 68.7 (12.9) | 41.1 | Mean 13.8 (30.8) | NR | 73 | 20.9 | NR | NR | 13.3 | 23.6 | E | 3 | European | I/P |
| **Dorman 1** | 94 | 2000 | No | UK | B | D | NR | NR | C | NR | NR | median 72 weeks (IQR 43-104) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Dorman 2** | 95 | 1997 | No | UK | U | D | NR | NR | C | NR | NR | At least 3 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Du** | 96 | 2018 | Y | China | I | D | 100 | NR | H and C | 61.7 (12.6) | 39.3 | 3 months | NR | NR | NR | NR | NR | NR | NR | E, 6D | 3 | NR | I |
| **Edwards** | 97 | 2010 | No | Canada | B | S | NR | NR | C | NR | 46.8 | NR | NR | NR | 18.3 | NR | 33.4 | NR | NR | H3 | N/A | Canada | NR |
| **Espuela** | 98 | 2017 | Yes | Spain | B | D | NR | NR | C | 71.3 (11.9) | 36.3 | >4 years | | 64.5 | 23.4 | 8.1 | 38.2 | NR | NR | E | 3 | NR | I |
| **Fischer** | 99 | 2008 | No | Switzerland | I | D | 100 | NR | C | 61 (13) | 50.3 | Mean 2.53 years (1.18) | Median 14 (range 3-38) | 54 | 11 | 17 | NR | 13 | NR | E | 3 | NR | M |
| **Ghatnekar** | 100 | 2013 | No | Sweden | B | D | 87 | NR | C | 71 (13) 2006 cohort/ 74 (11) 2009 cohort | 45.8 | At 3 months | NR | 56.8 | 17.8 | 15.1 | NR | 24.2 | 24.8 | E | 3 | UK | I/P |
| **Golicki 1** | 101 | 2014 | No | Poland | B | D | 92.9 | NR | H/C | 70.6 (11) | 51.8 | At 4 months | NR | NR | NR | NR | NR | NR | NR | E | 3, 5 | Poland | NR |
| **Golicki 2** | 9 | 2014 | No | Poland | B | D | 87.4 | NR | H | 69 (12.9) | 48.5 | Median 8 days (during hospitalization) | NR | NR | NR | NR | NR | NR | NR | E | 3, 5 | Poland | I |
| **Graessel** | 102 | 2014 | No | Germany | B | D | 83.3 | 47.4 | R | 68.7 (11) | 42.2 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | European | P |
| **Grasel** | 103 | 2019 | Y | Germany | B | D | 83.3 | 47.5 | R/C | 68.7 (11) | 42.2 | Discharge rehab/2.5/ 5 years | NR | NR | NR | NR | NR | NR | NR | E | 3 | European | P |
| **Groeneveld 1** | 104 | 2018 | No | Netherlands | B | D | 77 | 47.9 | R | 60.2 (12.7) | 41.8 | Mean 29 days | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |
| **Groeneveld 2** | 105 | 2018 | No | Netherlands | B | D | 75.3 | 47.2 | R (inpatient and outpatient) | 57.3 (11.8) | 53 | NR | Median NIH 6 (3-12.5) | 38.6 | 15.5 | 28.9 | 5.9 | NR | NR | E | 3 | Netherlands | P/E |
| **Guo** | 106 | 2017 | No | Singapore | B | D | 87.8 | NR | C | 64.1 (9.96) | 29.5 | 3 months and 12 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | Singapore | I |
| **Haacke** | 107 | 2005 | No | Germany | B | D | 70 | NR | C | 71.7 (11.3) | 54.5 | At 4 years | NR | NR | NR | NR | NR | NR | NR | E, H2, H3 | 3 | NR | I |
| **Hansson** | 108 | 2012 | No | Sweden | B | D | NR | NR | C | 75.2 (11.8) | 48.4 | At 12 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Hokstad** | 109 | 2016 | No | Norway | B | D | 85.6 | NR | C | 76.8 (11.3) | 51.9 | At 3 months | Mean NIHS 7.9 (7.7) | NR | NR | NR | NR | 27.7 | NR | E | 5 | Denmark | I/P |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jeon** | [110] | 2017 | No | Korea | B | D | 67 | NR | C | 65 (11) | 45.7 | Mean 35.5 days (37.2) | Mean NIH 6.3 (4.8) | 60.9 | 30.4 | NR | NR | NR | NR | E | NR, assumed 3 | NR | I |
| **Katona** | [111] | 2015 | No | Germany | B | D | 82 | NR | C | 67.4 (11.1) | 40 | Mean 57 (28) days after discharge from rehab | NR | NR | NR | NR | NR | NR | NR | E | 3 | European | P |
| **Katzan** | [112] | 2017 | No | USA | I | D | 100 | NR | C | 63.5 (14.4) | 46 | Median 58 days (IQR 32-258) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Kelly** | [113] | 2014 | No | USA | I | D | 100 | 27% | O | 55 (IQR 42-62) | 64 | Mean for early: 3months, for late: 9 months | Median 17 (IQR 16-22) | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Khiaocharoen** | [114] | 2012 | No | Thailand | B | D | 56.5 | NR | H | 60.9 (12.6) | 42 | <2 weeks | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK | I |
| **Kil** | [115] | 2008 | Y | Korea | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | NR |
| **Kim 1** | [116] | 2019 | No | Korea | B | S | NR | NR | C | 64.4 (SE 0.7) | 44.3 | NR | NR | 81.1 | 56.7 | 15.2 | NR | NR | NR | E | 3 | NR | NR |
| **Kim 2** | [117] | 2018 | No | Korea | B | S | NR | NR | C | 67.4 (SE 0.53) | 50.5 | NR | NR | NR | NR | 48 | NR | NR | NR | E | 3 | Korea | NR |
| **Kuo** | [118] | 2017 | No | Japan | U | S | NR | NR | C | 75.8 (6.58) | 36.7 | NR | NR | 77.3 | 35.5 | NR | NR | NR | NR | E | 3 | Japan | I |
| **Kuroda 1** | [119] | 2007 | Y | Japan | B | D | NR | NR | C | NR | NR | Mean 39.6 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |
| **Kuroda 2** | [120] | 2003 | Y | Japan | B | D | 75 | NR | C | 71.6 (9.9) | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |
| **Kuwano** | [121] | 2001 | Y | Japan | B | D | NR | NR | C | 64.3 (12.4) | NR | Two groups; short term (1-2.6 yrs) and long term (4.3-5 years) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | NR |
| **Kwon** | [122] | 2018 | No | Korea | B | S | NR | NR | C | 64.8 (0.6 SE) | 42.6 | NR | NR | 70.1 | 32.1 | 15.3 | NR | NR | NR | E | 3 | Korea | NR |
| **Labberton** | [123] | 2020 | No | Norway | B | D | 61.4 | NR | C | 71 (12.5) | 39.2 | At 3 and 12 months | Median 3 | NR | NR | NR | NR | NR | NR | E | 3 | UK | NR |
| **Lannin** | [124] | 2017 | No | Australia | B | D | 84 | NR | C | NR | NR | Median 156 days | NR | NR | NR | NR | NR | NR | NR | E | 3 | Australia | P |
| **Leach** | [125] | 2010 | No | Australia | B | D | NR | NR | C | 67.6 (13.8) | 49.7 | At 7 years | Median 3 (IQR 1-7) | 55.8 | 18.3 | 16.2 | 15.6 | 12.2 | 11.3 | A | N/A | NR | I |
| **Lee** | [126] | 2010 | No | Taiwan | B | D | 76.3 | NR | R/O | 64.8 (12.2) | 36.6 | Mean 4.3 years (4.2) | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK/US | I |
| **Leeds** | [127] | 2004 | No | UK | U | D | NR | NR | R/C/N | 79.9 (7.3) | 74 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Lindgren** | [128] | 2007 | No | Sweden | B | D | NR | NR | C | 64.4 (9.3) | 40.4 | At 3/6/9/12 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK | M |
| **Lopez-Bastida** | [129] | 2012 | No | Spain | U | D | NR | NR | C | 67.1 (12.2) | 43.3 | 1/2/3 years | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |
| **Lu** | [130] | 2016 | No | Taiwan | B | D | NR | NR | R | 65.3 (13.7) | 37.9 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | Taiwan | I |
| **Luengo-Fernandez** | [131] | 2013 | No | UK | B | D | 83 | NR | C | 75 (12) | 51 | 1/6/12 months, 2/5 years | NR | 60 | 10 | NR | 13 | 20 | 19 | E | 3 | UK | I/P |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lunde** | 132 | 2012 | No | Norway | U | D | NR | NR | C | 68.7 (12.9) | 36 | Mean 12.2 (4.6) | NR | NR | NR | NR | NR | NR | NR | E, 15D | 3 | UK | M |
| **Mahesh** | 133 | 2019 | No | Sri Lanka | U | D | NR | NR | R/O | NR | NR | At 28-32 days | NR | NR | NR | NR | NR | NR | NR | E | 3 | Sri Lanka | I |
| **Mar 1** | 134 | 2015 | No | Spain | B | D | 90.7 | NR | H/C | 72.1 (13.2) | 45.2 | At 3/12 months | NR | NR | NR | NR | NR | NR | 50.2 | E | 3 | NR | I |
| **Mar 2** | 135 | 2005 | No | Spain | B | D | 57.8 | NR | C | 70.9 (SE 12.3) | 38.5 | At 1 year | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Mathias** | 136 | 1997 | No | USA | B | D | NR | NR | C | 69.2 (range 35-92) | 61 | Within 3 months | NR | NR | NR | NR | NR | NR | NR | H2 | N/A | NR | I |
| **McDonnell** | 137 | 2014 | No | Australia | B | S | NR | NR | C | 70 (10) exercise, 65 (7) no exercise | 25.9 | NR | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | I |
| **Min** | 138 | 2015 | No | Korea | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | Korea | M |
| **Mittmann 1** | 139 | 2001 | No | Canada | U | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | H3 | N/A | NR | I/P |
| **Mittmann 2** | 140 | 1999 | No | Canada | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | H3 | N/A | NR | I/P |
| **Mulhern** | 141 | 2018 | No | UK | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3, 5 | UK | P |
| **Oemrawsingh** | 142 | 2019 | No | Netherlands | I | D | 100 | NR | C | 74 (IQR 64-82) | 43 | At 3 months | Median 4 (IQR 2-12) | 53 | 4 | 22 | 10 | 27 | NR | E | 5 | Dutch | I/P |
| **Olsson 1** | 143 | 2007 | No | Sweden | B | D | 70 | 46 | C | 50 | 48 | Median 32 months (range 27-44) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Olsson 2** | 144 | 2006 | No | Sweden | B | D | 71.2 | 44 | R (outpatient0 | 51.3 (8.3) | 46.2 | Mean 180 days (range 22-473) | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Park** | 145 | 2013 | No | Korea | B | D | NR | NR | C | 69 (7) | 38 | At 3 months | NR | 67 | 34 | 41 | 5 | NR | 2 | E | 3 | Korean | I |
| **Paul** | 146 | 2005 | No | Australia | B | D | NR | NR | C | 75.5 (13.8) | 55% | At 5 years | NR | NR | NR | NR | NR | NR | NR | A | N/A | Australia | I |
| **Peng** | 147 | 2019 | No | Taiwan | B | D | 80 | NR | H | 65.6 (IQR 57-75) | 37.1 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | Taiwan | I |
| **Pettersson** | 148 | 2007 | No | Sweden | B | S | NR | NR | C | 67 (range 43-85) | 31 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Peters** | 149 | 2014 | No | UK | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK | M |
| **Phan 1** | 150 | 2020 | No | Australia | B | D | NR | NR | C | 71.2 (IQR 62-79.5) men/ 77.1 (IQR 65.7-84.4) women | 44 | Median 11.5 months (IQR 10.5-13.4) | NR | 72.7 | 19.6 | 21.5 | 24.2 | NR | 34.7 | E | 3 | NR | NR |
| **Phan 2** | 151 | 2019 | No | Australia | B | D | 88.8 | NR | C | 68.6 (10) for EQ-5D/ 69 (14) for AQOL | 48.3 for EQ-5D/ 49.2 for AQOL | At 1 year and 5 years | NR | 60.7 (Oxford sample) | 12.5 | NR | 11.5 | NR | 15.5 | E, A | 3 | UK for EQ-5D/Australia for AQoL | I |
| **Pickard 1** | 10 | 2005 | No | Canada | I | D | NR | NR | H/C | 67 (15) | 48 | Before discharge (95% within 2 weeks of stroke) | NR | NR | NR | NR | NR | NR | NR | E, H2, H3 | 3 | NR | S |

| | | | | | | | | | | | | and 6 months | | | | | | | | | | | |
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| **Pickard 2** | 53 | 2004 | No | Canada | I | D | NR | NR | H/C | 68.3 (14.6) | 47% | At 1/3/6 months | NR | NR | NR | NR | NR | NR | NR | E, H3 | 3 | UK | NR |
| **Pinto** | 152 | 2011 | No | Brazil | B | D | NR | NR | O | 59.3 (13.3) | 55.2 | Mean 28 (36) months | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Price** | 153 | 2018 | No | Australia | B | S | NR | 34.5 | C | 62.3 (10.89) | 48.3 | Mean 3.8 years (4.1) | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | I |
| **Ramirez-Moreno** | 154 | 2018 | No | Spain | B | D | NR | NR | C/O | 59.5 (8.2) | 23.5 | At 3 months | NR | 58.7 | 30.4 | 64.8 | NR | 27.2 | 12 | E | 5 | NR | I |
| **Ran** | 155 | 2015 | Y | China | I | D | NR | NR | NR | 61.9 (12.3) | 40.9 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | I |
| **Rivero-Arias** | 156 | 2009 | No | UK | B | D | NR | NR | C | 72.8 | 53 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | UK | I |
| **Saarni** | 157 | 2006 | No | Finland | B | S | NR | NR | C | 70 | 48 | NR | NR | NR | NR | NR | NR | NR | NR | E, 15D | 3 | UK | I |
| **Sallinen** | 158 | 2018 | No | Finland | H | D | 0 | NR | C | 70.5 (IQR 62-78) | 48 | At 3 months | Median 5 | NR | 13.7 | NR | 10.1 | 18.8 | 24.8 | E, 15D | 5 | Crosswalk | I/M |
| **Sanchez-Iriso** | 159 | 2017 | No | Spain | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 5 | Spain | NR |
| **Sand** | 160 | 2015 | No | Norway | I | D | NR | NR | C | 71.8 (14.3) vision problems/ 66.5 (12.4) noo vision problems | 37.3 | Mean 372 days (range 185-757) | Mean 5.9 (6.4) vision problems, 3.8 (4.2) no vision problems | 51.7 | 9.6 | 58.8 | 11.6 | 13.5 | NR | E, 15D | 3 | NR | M |
| **Sasaki** | 161 | 2018 | No | Japan | B | D | NR | NR | O | 69.5 (12) | 27.3 | Mean 6.3 months (6.2) | mean 1.7 (1.5) | 90.1 | 22.7 | NR | NR | NR | NR | E | 3 | Japan | S |
| **Slaughter** | 162 | 2019 | No | USA | H | D | NR | NR | C | 63.9 (14.9) | 38 | At 3 months | Median 11 (IQR 3-22) | 77.6 | 28 | 15.1 | 10.8 | 26.2 | 11.1 | E | 5 | NR | P |
| **Sturm 1** | 163 | 2004 | No | Australia | B | D | 85 | NR | C | 71 (95% CI 69-73) | 49 | Mean 737 days (range 646-898) | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | I |
| **Sturm 2** | 164 | 2002 | No | Australia | B | D | NR | NR | C | 72 (range 28-89) | 55 | At 3 months | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | I |
| **Szocs** | 165 | 2020 | No | Budapest | I | D | NR | NR | C | 68.5 (12.9) | 44 | At 3 months | Mean 7.88 (6.37) | NR | NR | NR | NR | NR | NR | E, 15D | 5 | NR | I/P |
| **Teoh** | 166 | 2009 | No | Australia | B | D | 76.5 | NR | C | 67.5 (14.3) | 32% | Mean 11.7 months (4.9) | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | NR |
| **Tran** | 167 | 2015 | No | Vietnam | B | D | 72.7 | NR | C | 60.9 (12) | 49.1 | At 3 months | Mean 7.7 (0.6) | NR | NR | NR | NR | NR | NR | E | 3 | South Korea | S |
| **Vahlberg** | 168 | 2013 | No | Sweden | B | D | 88 | NR | C | 74 (5.2) | 29.2 | 1-3 years after | NR | 64 | 16 | 15 | 12 | 21 | 22 | E | 3 | NR | I |
| **van Eeden** | 169 | 2015 | No | Netherlands | B | D | 92.9 | 38.2 | H/C | 66.8 (12.27) | 35.2 | At 2/6/12 months | Mean 2.6 (2.96) | NR | NR | NR | NR | NR | NR | E | 3 | Netherlands | I/O/M |
| **Visser** | 170 | 2015 | No | Cyprus | B | D | 73.5 | 40.3 | R | 53.06 (10.19) | 47 | 83.7% <1 year post stroke | NR | NR | NR | NR | NR | NR | NR | E | 5 | NR | NR |
| **Wartenberg** | 171 | 2020 | No | Germany | I | D | NR | NR | C | 62.1 (12.6) | 48.8 | At 12 months | Median 19 (IQR 12-36) | 74.4 | 27.9 | NR | 11.6 | 16.3 | 0 | E | 3 | NR | M |
| **White** | 172 | 2016 | No | Australia | B | D | NR | NR | R/C | 75 (12) | 55 | NR | NR | NR | NR | NR | NR | NR | NR | A | N/A | NR | I |
| **Wu 1** | 173 | 2014 | No | UK | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wu 2** | 174 | 2015 | No | UK | B | S | NR | NR | C | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | M |
| **Xie** | 175 | 2006 | No | USA | B | S | NR | NR | C | NR | 56.1 | NR | NR | 67.9 | 27.4 | 23.6 | 33.9 | NR | NR | E | 3 | USA | I |
| **Yan** | 176 | 2015 | Y | China | B | D | NR | NR | H | 61.8 (12.67) | 61 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | China | I |
| **Yang** | 177 | 2017 | No | Korea | B | D | 64.7 | NR | R (outpatient) | 65.11 (2.39) | 41.1 | NR | NR | NR | NR | NR | NR | NR | NR | E | 3 | NR | NR |
| **Yeoh 1** | 178 | 2018 | No | Singapore | B | D | 89.7 | NR | H/C | 62.2 (10.6) | 34 | At 3/12 months | NR | NR | NR | NR | NR | NR | NR | E | 3 | Singapore | I |
| **Yeoh 2** | 179 | 2019 | No | Singapore | B | D | 90.9 | NR | H/C | 61.8 (10.3) | 32.5 | At 3/12 months | Mean 3.8 (3.5) | 71.1 | 37.1 | NR | NR | NR | NR | E | 3 | Singapore | I |

Y = Yes; I=ischemic only; H=hemorrhagic only; B=Both ischemic and hemorrhagic; U=Unknown stroke type; S=Self-report of stroke; D=medical diagnosis of stroke; C=Community based; R=Rehabilitation facility; H=hospital; O=outpatient clinic; E=EQ-5D; A=AQoL; H2= HUI2; H3=HUI3; M=mail; P=phone; I=in-person interview; NR = not reported; N/A = Not applicable.
Numbers in brackets denote standard deviation unless specifically indicated otherwise.

**Table S5. Risk of bias assessment criteria**

| Item | Description |
|---|---|
| Sample size | Very small <50<br>Small 50-99<br>Medium size 100-999<br>Large ≥1000 |
| Respondent selection and recruitment* | Does this result in a population comparable to that being modelled?<br>Is this sample broadly representative of stroke patients or skewed towards one subgroup?<br>Was the selection of patients consecutive or population-based, or is there evidence of enrollment bias? |
| Inclusion/exclusion criteria* | Does this study exclude important groups, ie. very elderly, young adult, severe or mild strokes, or include only a narrow or select group of patients (ie. hemispheric infarcts). |
| Response rates to instrument used | Are response rates reported and if so, are the rates likely to be a threat to validity? |
| Loss to follow-up | How large is the loss to follow-up and are these reasons given? Are these likely to threaten the validity of the estimates? |
| Missing data | What are the levels of missing data and how are they dealt with? Could they threaten the validity of the estimates? |
| Proxy responses | Is the presence, proportion, and method of proxy responses reported? |

*A high risk of bias does not necessarily imply methodological or quality concerns, as the objective of the study may have been to report utility in a specific sub-group (ie. patients with hemisphere stroke), but this value would be less representative of stroke patients as a whole.

**Table S6. Baseline characteristics across all studies weighted by study size, among studies where variables were reported**

| Variable | Pooled mean (SD) weighted by study size | Number of studies for pooled mean |
|---|---|---|
| Mean Age | 68.1 (5.7) | 90 |
| Percent Female | 44.2 (6.2) | 91 |
| Mean Follow-up time | 13.0 months (15.7) | 69 |
| Mean National Institutes of Health Stroke Scale score | 6.5 (4.1) | 19 |
| Percent Ischemic stroke | 85.5 (8.3) | 50 |
| Percent Left hemisphere | 43.9 (5.2) | 14 |
| Percent Hypertension | 68.8 (10.3) | 27 |
| Percent Diabetes | 22.6 (9.2) | 29 |
| Percent Smoking | 24.5 (9.3) | 20 |
| Percent Coronary artery disease | 19.2 (8.9) | 19 |
| Percent Prior stroke | 20.7 (5.9) | 17 |
| Percent Atrial fibrillation | 24.1 (12.0) | 17 |

**Table S7. Baseline characteristics across studies reporting EQ-5D-3L weighted by study size, among studies where variables were reported**

| Variable | Pooled mean (SD) weighted by study size | Number of studies for pooled mean |
|---|---|---|
| Mean Age | 68.2 (5.7) | 65 |
| Percent Female | 44.3 (5.8) | 64 |
| Mean Follow-up time | 10.9 months (11.1) | 49 |
| Mean National Institutes of Health Stroke Scale score | 6.2 (4.3) | 14 |
| Percent Ischemic stroke | 85.2 (8.3) | 40 |
| Percent Left hemisphere | 43.6 (5.8) | 10 |
| Percent Hypertension | 69.0 (10.3) | 23 |
| Percent Diabetes | 22.7 (9.4) | 23 |
| Percent Smoking | 24.7 (8.9) | 17 |
| Percent Coronary artery disease | 19.6 (9.1) | 14 |
| Percent Prior stroke | 20.5 (5.8) | 12 |
| Percent Atrial fibrillation | 25.0 (12.1) | 12 |

**Table S8. Risk of bias assessment**

| Author | Sample size | Respondent selection/recruitment | Inclusion/Exclusion | Response rates | Loss to FU | Missing data | Proxy responses | Death |
|---|---|---|---|---|---|---|---|---|
| Adey-Wakeling | 100-999 | Low risk | Low risk | Low risk | Low risk | Medium risk* | ? | Low risk |
| Appau | 100-999 | Medium risk | Low risk | ? | ? | ? | ? | ? |
| Arrospide | 100-999 | Medium risk | Low risk | ? | N/A | Low risk | ? | N/A |
| Arwert | <50 | Medium risk | Medium risk | High risk | ? | ? | ? | N/A |
| Barton | 50-99 | Medium risk | Medium risk | Medium risk | N/A | Medium risk | ? | N/A |
| Broussy | 100-999 | Medium risk | Low risk | Low risk | Medium risk | Low risk | Low risk | Low risk |
| Burton | 50-99 | Medium risk | Medium risk | High risk | N/A | Medium risk | Low risk | N/A |
| Bushnell | 1000+ | Low risk | Low risk | Low risk | Medium risk | Medium risk | Medium risk | Low risk |
| Cadilhac 1 | 100-999 | Low risk | Low risk | Medium risk | Medium risk | Low risk | ? | N/A |
| Cadilhac 2 | 100-999 | Low risk | Low risk | ? | ? | ? | ? | N/A |
| Cao | 100-999 | Low risk | Medium risk | ? | N/A | ? | ? | N/A |
| Chang | 1000+ | Low risk | Low risk | Low risk | Medium risk | Medium risk | ? | N/A |
| Chen 1 | 50-99 | Medium risk | Medium risk | Low risk | N/A | Low risk | ? | N/A |
| Chen 2 | 100-999 | Medium risk | Medium risk | Low risk | Medium risk | ? | ? | Low risk |
| Cheung | 100-999 | Medium risk | Low risk | High risk | Medium risk | ? | ? | N/A |
| Cramm | 100-999 | High risk | High risk | High risk | N/A | ? | Low risk | N/A |
| Cup | <50 | Medium risk | Medium risk | Low risk | N/A | ? | ? | N/A |
| Darlington 1 | 50-99 | Medium risk | Medium risk | Medium risk | Medium risk | Medium risk | ? | Low risk |
| Darlington 2 | 50-99 | Medium risk | Medium risk | Medium risk | Medium risk | Medium risk | ? | Low risk |
| de Graaf | 100-999 | Low risk | Low risk | ? | N/A | ? | ? | N/A |
| Deb-Chatterji | 100-999 | High risk | High risk | Low risk | Low risk | Low risk | ? | Low risk |
| Dewilde | 100-999 | Medium risk | Low risk | ? | N/A | ? | ? | N/A |
| Dorman 1 | 100-999 | Medium risk | Low risk | Low risk | N/A | ? | Low risk | N/A |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dorman 2 | 100-999 | Medium risk | Low risk | Low risk | N/A | ? | Low risk | Medium risk |
| Du | 100-999 | Medium risk | Low risk | Low risk | N/A | ? | ? | N/A |
| Edwards | 100-999 | Medium risk | Low risk | ? | N/A | ? | ? | N/A |
| Espuela | 100-999 | Medium risk | Medium risk | Medium risk | Medium risk | ? | ? | Medium risk |
| Fischer | 100-999 | Medium risk | High risk | Low risk | N/A | Low risk | Medium risk | N/A |
| Ghatnekar | 100-999 | Low risk | Low risk | ? | N/A | ? | Low risk | N/A |
| Golicki 1 | 100-999 | Medium risk | Low risk | Low risk | Low risk | Low risk | Medium risk | N/A |
| Golicki 2 | 100-999 | Medium risk | Medium risk | Low risk | N/A | Low risk | Medium risk | N/A |
| Graessel | 100-999 | High risk | Medium risk | Low risk | N/A | ? | ? | Low risk |
| Grasel | 100-999 | High risk | Medium risk | Low risk | N/A | ? | ? | Medium risk |
| Groeneveld | 100-999 | Medium risk | Medium risk | High risk | N/A | Medium risk | ? | Low risk |
| Groeneveld | 100-999 | Medium risk | Medium risk | Medium risk | Low risk | ? | ? | Low risk |
| Guo | 50-99 | Medium risk | Low risk | Medium risk | Medium risk | ? | Low risk | Low risk |
| Haacke | 50-99 | Medium risk | Low risk | Medium risk | Medium risk | ? | Low risk | Medium risk |
| Hansson | 100-999 | Medium risk | Medium risk | Medium risk | Medium risk | ? | Medium risk | Low risk |
| Hokstad | 50-99 | Medium risk | Low risk | Medium risk | Medium risk | Medium risk | ? | Medium risk |
| Jeon | <50 | High risk | Medium risk | Medium risk | N/A | ? | ? | N/A |
| Katona | 100-999 | High risk | Medium risk | Low risk | Medium risk | ? | ? | Medium risk |
| Katzan | 1000+ | Medium risk | Medium risk | Low risk | N/A | ? | ? | N/A |
| Kelly | <50 | High risk | High risk | High risk | High risk | High risk | High risk | High risk |
| Khiaocharoen | 100-999 | Medium risk | Medium risk | Medium risk | N/A | ? | ? | N/A |
| Kil | <50 | Medium risk | High risk | ? | N/A | Medium risk | ? | N/A |
| Kim 1 | 100-999 | Medium risk | Low risk | ? | N/A | ? | ? | N/A |
| Kim 2 | 100-999 | Medium risk | Low risk | ? | N/A | Low risk | ? | N/A |
| Kuo | 100-999 | Medium risk | Low risk | ? | N/A | ? | Low risk | N/A |
| Kuroda 1 | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | ? | Medium risk | Medium risk |
| Kuroda 2 | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | ? | ? | Medium risk |
| Kuwano | 100-999 | High risk | Medium risk | Medium risk | Medium risk | ? | ? | Medium risk |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Kwon | 100-999 | Medium risk | Low risk | ? | N/A | ? | ? | N/A |
| Labberton | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | Low risk | Low risk | Medium risk |
| Lannin | 1000+ | Low risk | Low risk | Medium risk | Medium risk | ? | ? | Low risk |
| Leach | 100-999 | Low risk | Low risk | Low risk | Low risk | Low risk | Low risk | High risk |
| Lee | 100-999 | Medium risk | Low risk | Low risk | High risk | ? | ? | Medium risk |
| Leeds | 50-99 | High risk | Medium risk | Medium risk | Medium risk | Medium risk | ? | Medium risk |
| Lindgren | 100-999 | Low risk | High risk | Medium risk | N/A | ? | Medium risk | N/A |
| Lopez-Bastida | 100-999 | Low risk | Low risk | Medium risk | N/A | Medium risk | ? | N/A |
| Lu | 100-999 | Medium risk | High risk | Low risk | Medium risk | Medium risk | ? | ? |
| Luengo-Fernandez | 100-999 | Low risk | Low risk | Medium risk | Medium risk | Medium risk* | ? | N/A |
| Lunde | 100-999 | Medium risk | Low risk | Medium risk | N/A | Low risk | ? | N/A |
| Mahesh | 100-999 | Medium risk | Medium risk | ? | N/A | ? | Low risk | N/A |
| Mar 1 | 100-999 | Low risk | Low risk | Low risk | Low risk | ? | ? | Low risk |
| Mar 2 | 100-999 | Medium risk | Low risk | High risk | Medium risk | ? | ? | Medium risk |
| Mathias | <50 | Medium risk | High risk | Low risk | N/A | Low risk | Low risk | N/A |
| McDonnell | <50 | High risk | High risk | Low risk | N/A | ? | ? | N/A |
| Min | 1000+ | Medium risk | Low risk | Low risk | N/A | Low risk | ? | N/A |
| Mittmann 1 | 50-99 | Medium risk | Medium risk | ? | N/A | High risk | ? | N/A |
| Mittmann 2 | 50-99 | Medium risk | Medium risk | ? | N/A | ? | ? | N/A |
| Mulhern | 50-99 | Medium risk | Medium risk | ? | N/A | ? | ? | N/A |
| Oemrawsingh | 1000+ | Medium risk | Low risk | ? | High risk | High risk | ? | ? |
| Olsson 1 | 50-99 | High risk | High risk | ? | N/A | ? | ? | Low risk |
| Olsson 2 | 50-99 | High risk | High risk | ? | N/A | ? | ? | N/A |
| Park | 100-999 | High risk | High risk | Medium risk | N/A | ? | ? | N/A |
| Paul | 100-999 | Low risk | Low risk | Medium risk | Medium risk | ? | Medium risk | High risk |
| Peng | 1000+ | Medium risk | High risk | ? | ? | ? | ? | ? |
| Peterrsson | <50 | High risk | High risk | Low risk | Medium risk | ? | ? | N/A |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Peters | 50-99 | Medium risk | Low risk | High risk | N/A | ? | ? | N/A |
| Phan 1 | 1000+ | Low risk | Low risk | Medium risk | Medium risk | Medium risk* | Medium risk | Medium risk |
| Phan 2 | 1000+ | Low risk | Low risk | Medium risk | Medium risk | Low risk* | ? | Medium risk |
| Pickard 1 | 50-99 | Medium risk | Medium risk | Medium risk | Medium risk | Low risk | Low risk | Low risk |
| Pickard 2 | 100-999 | Medium risk | Medium risk | Medium risk | Medium risk | ? | Low risk | Medium risk |
| Pinto | 50-99 | Medium risk | High risk | ? | N/A | ? | ? | N/A |
| Price | <50 | Medium risk | Medium risk | ? | N/A | ? | ? | N/A |
| Ramirez-Moreno | 50-99 | High risk | High risk | Medium risk | ? | ? | ? | ? |
| Ran | 100-999 | Medium risk | Medium risk | Low risk | ? | ? | ? | ? |
| Rivero-Arias | 1000+ | Low risk | Low risk | Medium risk | Medium risk | Medium risk | ? | Low risk |
| Saarni | 100-999 | Medium risk | Low risk | Low risk | N/A | ? | ? | N/A |
| Sallinen | 100-999 | Medium risk | Medium risk | Medium risk | Medium risk | Low risk | Medium risk | Medium risk |
| Sanchez-Iriso | 100-999 | Medium risk | Low risk | ? | N/A | ? | ? | N/A |
| Sand | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | ? | ? | ? |
| Sasaki | <50 | High risk | High risk | High risk | N/A | ? | ? | N/A |
| Slaughter | 100-999 | Medium risk | Medium risk | Medium risk | Medium risk | ? | Medium risk | Medium risk |
| Sturm 1 | 100-999 | Low risk | Low risk | Medium risk | Medium risk | ? | Medium risk | Medium risk |
| Sturm 2 | 100-999 | Low risk | Low risk | Medium risk | Medium risk | ? | Medium risk | Medium risk |
| Szocs | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | Medium risk* | ? | Medium risk |
| Teoh | 100-999 | Medium risk | Medium risk | High risk | N/A | ? | ? | Low risk |
| Tran | 100-999 | Medium risk | Medium risk | Medium risk | ? | ? | Low risk | ? |
| Vahlberg | 100-999 | Medium risk | High risk | Medium risk | N/A | ? | ? | N/A |
| van Eeden | 100-999 | Medium risk | Low risk | Low risk | N/A | Medium risk* | ? | Low risk |
| Visser | 100-999 | High risk | High risk | Medium risk | N/A | ? | ? | N/A |
| Wartenberg | <50 | High risk | High risk | ? | N/A | ? | ? | N/A |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| White | 100-999 | Medium risk | Medium risk | Low risk | Medium risk | ? | ? | Medium risk |
| Wu 1 | 100-999 | Medium risk | Low risk | High risk | N/A | ? | ? | N/A |
| Wu 2 | 100-999 | Medium risk | Low risk | High risk | N/A | ? | ? | N/A |
| Xie | 1000+ | Medium risk | Low risk | ? | N/A | Low risk | Medium risk | N/A |
| Yan | 100-999 | Medium risk | Medium risk | ? | Medium risk | ? | ? | Medium risk |
| Yang | <50 | High risk | High risk | ? | N/A | ? | ? | N/A |
| Yeoh 1 | 100-999 | Medium risk | Low risk | ? | Medium risk | Medium risk* | ? | Low risk |
| Yeoh 2 | 100-999 | Medium risk | Low risk | Medium risk | Medium risk | Low risk | Low risk | Low risk |

**? = information not provided; N/A = follow-up not applicable, typically due to cross-sectional design**
***8 studies used imputation for missing data: Adey-Wakeling, Luengo-Fernandez, Phan 1, Phan 2, Pickard 1, Szocs, van Eeden, Yeoh 1**

**Table S9. Summary statistics of risk of bias assessment**

| Category | Percent with high risk | Percent with medium risk | Percent with low risk | Percent with missing information |
|---|---|---|---|---|
| Sample size | 10.8 | 79.3 | 9.91 | 0 |
| Respondent selection | 17.1 | 64.9 | 18.0 | 0 |
| Inclusion/Exclusion | 18.0 | 33.3 | 48.7 | 0 |
| Response rates | 10.8 | 36.0 | 27.0 | 26.1 |
| Loss to follow-up* | 2.7 | 36.0 | 5.4 | 6.3 |
| Missing data | 2.7 | 17.1 | 17.1 | 63.1 |
| Proxy responses | 0.90 | 12.6 | 15.3 | 71.2 |

***Question not applicable in 49.6% due to cross-sectional nature of study**

**Table S10. Pooled EQ-5D-3L values for different time ranges and time points**

| Time category | Pooled health utility value (95% CI) | Number of studies | Patient N |
|---|---|---|---|
| **Ranges** | | | |
| Prior to acute care discharge (hospital or in-patient rehabilitation) | 0.45 (0.33-0.58) | 16 | 4764 |
| Prior to hospital discharge | 0.39 (0.23-0.54) | 10 | 3517 |
| Prior to in-patient rehabilitation discharge | 0.57 (0.47-0.67) | 6 | 1247 |
| ≥ 3 months | 0.65 (0.63-0.67) | 73 | 52614 |
| 3 to <12 months | 0.66 (0.63-0.68) | 54 | 48020 |
| 12 months and over | 0.66 (0.62-0.69) | 31 | 7610 |
| **Specific time points** | | | |
| 3 months | 0.65 (0.61-0.70) | 20 | 11624 |
| 12 months | 0.65 (0.59- 0.71) | 17 | 4917 |
| 5 years | 0.70 (0.64-0.76) | 6 | 2455 |

**Table S11. Sensitivity analyses**

| Utility metric and sensitivity analysis | Pooled health utility value | Number of studies |
|---|---|---|
| **EQ-5D-3L** | | |
| Exclude studies with similar/overlapping cohorts | 0.66 (0.64-0.68) | 65 |
| Exclude studies that assigned subjects who died to a utility of 0 | 0.66 (0.64-0.68) | 70 |
| Include only studies assigning subjects who died to a utility of 0 | 0.50 (0.33-0.67) | 3 |
| Exclude studies with >1 high risk of bias category | 0.68 (0.65-0.70) | 50 |
| **EQ-5D-5L** | | |
| Exclude studies with similar/overlapping cohorts | 0.68 (0.60-0.76) | 9 |
| Exclude studies that assigned subjects who died to a utility of 0 | N/A | |
| Include only studies assigning subjects who died to a utility of 0 | N/A | |
| Exclude studies with >1 high risk of bias category | 0.66 (0.59-0.74) | 9 |
| **AQOL** | | |
| Exclude studies with similar/overlapping cohorts | 0.54 (0.41-0.66) | 7 |
| Exclude studies that assigned subjects who died to a utility of 0 | N/A | |
| Include only studies assigning subjects who died to a utility of 0 | N/A | |
| Exclude studies with >1 high risk of bias category | 0.49 (0.44-0.54) | 5 |

*Sensitivity analyses not performed for certain categories above and for HUI2, HUI3, and 15D due to small number of studies

**Table S12. Comparison of summary estimates using random effects and fixed effect meta-analysis**

| | **Random effects** | **Fixed effect** |
|---|---|---|
| **Main (EQ-5D-3L)** | 0.65 (0.63-0.67) | 0.73 (0.73-0.73) |
| **Ranges (EQ-5D-3L)** | | |
| Prior to acute care discharge (hospital or in-patient rehabilitation) | 0.45 (0.33-0.58) | 0.40 (0.39-0.40) |
| Prior to hospital discharge | 0.39 (0.23-0.54) | 0.28 (0.27-0.29) |
| Prior to in-patient rehabilitation discharge | 0.57 (0.47-0.67) | 0.59 (0.58-0.61) |
| ≥3 months | 0.65 (0.63-0.67) | 0.73 (0.73-0.73) |
| 3 to <12 months | 0.66 (0.63-0.68) | 0.73 (0.73-0.73) |
| 12 months and over | 0.66 (0.62-0.69) | 0.71 (0.70-0.71) |
| **Specific time points (EQ-5D-3L)** | | |
| 3 months | 0.65 (0.61-0.70) | 0.76 (0.76-0.77) |
| 12 months | 0.65 (0.59- 0.71) | 0.78 (0.77-0.78) |
| 5 years | 0.70 (0.64-0.76) | 0.72 (0.71-0.74) |
| **Other metrics** | | |
| **EQ-5D-5L** | 0.68 (0.61-0.76) | 0.72 (0.71-0.73) |
| **AQOL** | 0.51 (0.42-0.61) | 0.40 (0.39-0.41) |
| **HUI2** | 0.65 (0.62-0.68) | 0.65 (0.62-0.68) |
| **HUI3** | 0.64 (0.54-0.73) | 0.71 (0.69-0.72) |
| **15D** | 0.81 (0.78-0.84) | 0.82 (0.82-0.83) |
| **SF-6D** | 0.70 (0.63-0.78) | 0.73 (0.72-0.75) |

**Figure S1. PRISMA flowchart**

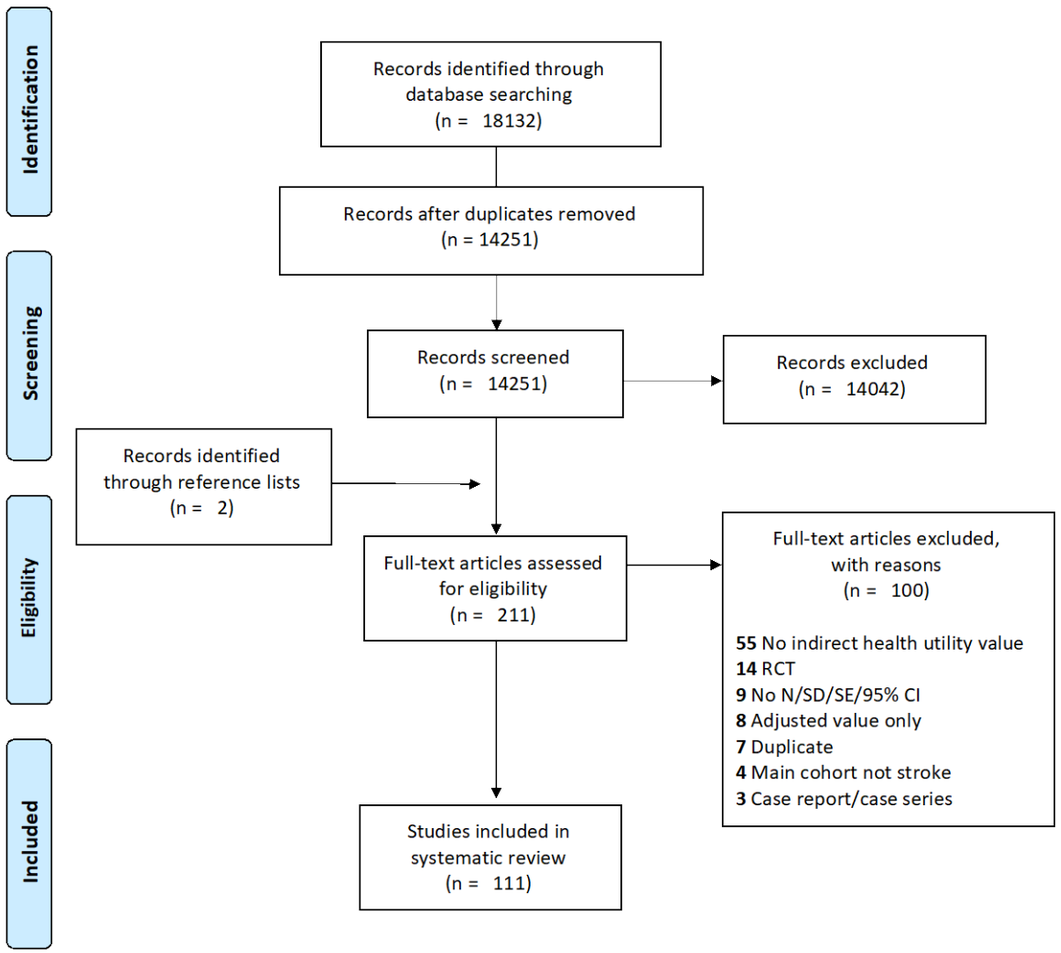


**Figure S2. General characteristics of the included papers, showing frequency of studies with each health utility instrument (A), frequency of studies by country (B), frequency of studies by year from 1995 to October 2020 (C), and distribution of EQ-5D-3L values from 3 months onwards (D).**

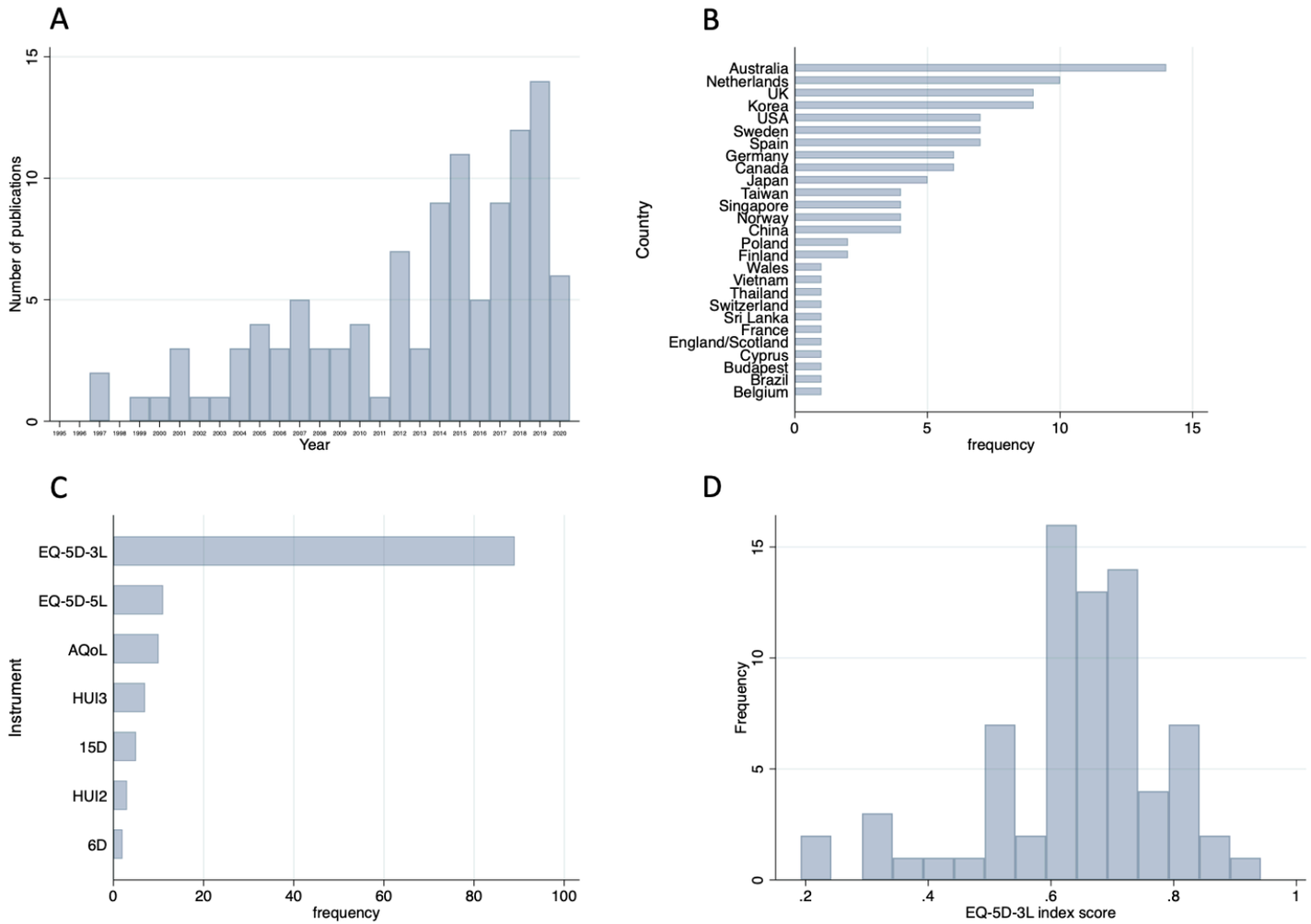


**Figure S3. Random effects meta-analysis for EQ-5D-3L utility values**

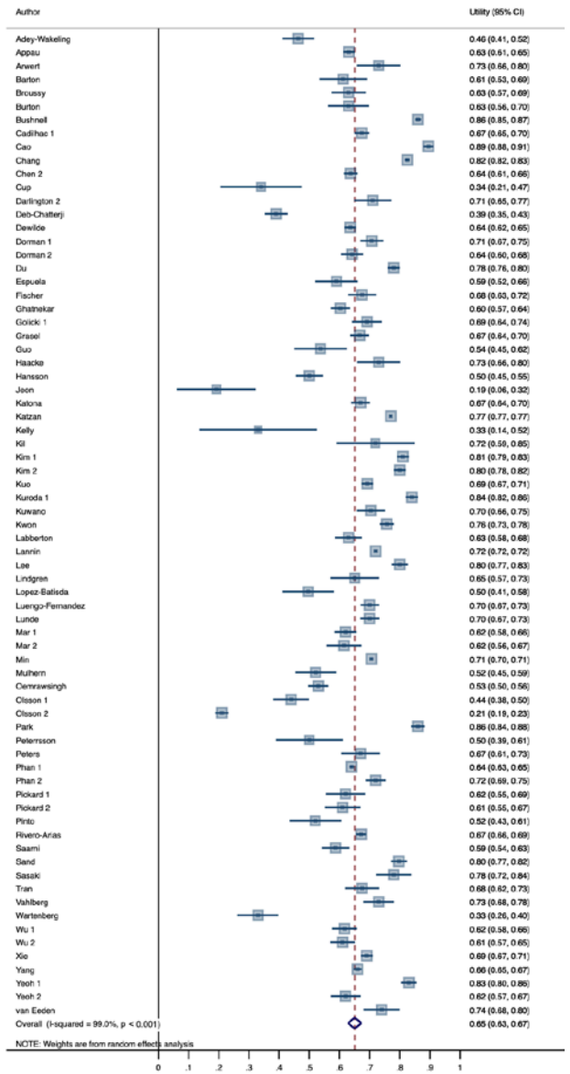


**Figure S4. Fixed effect meta-analysis for EQ-5D-3L utility values**

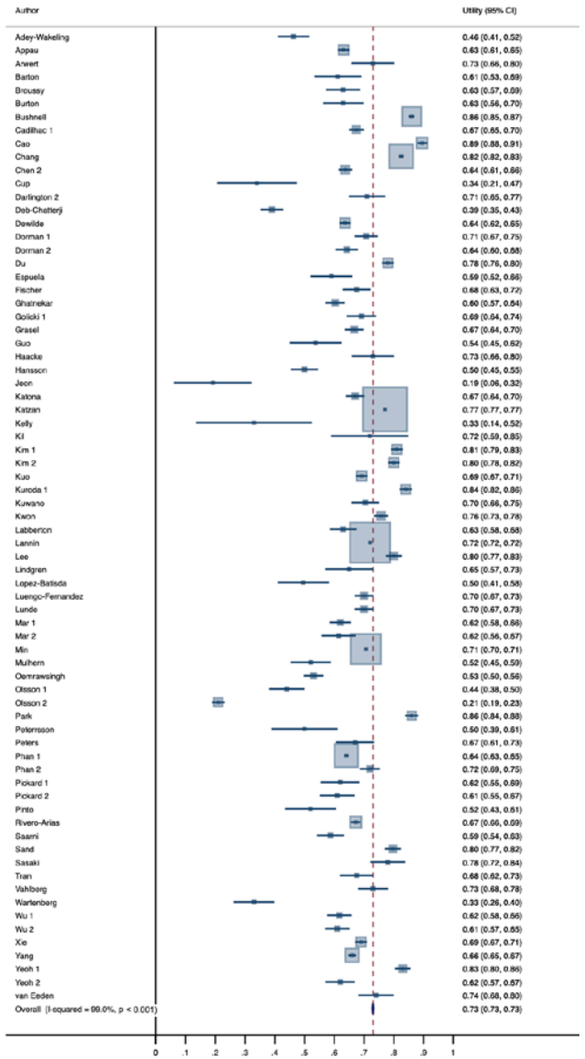


**Figure S5. Random effects meta-analysis for EQ-5D-5L**

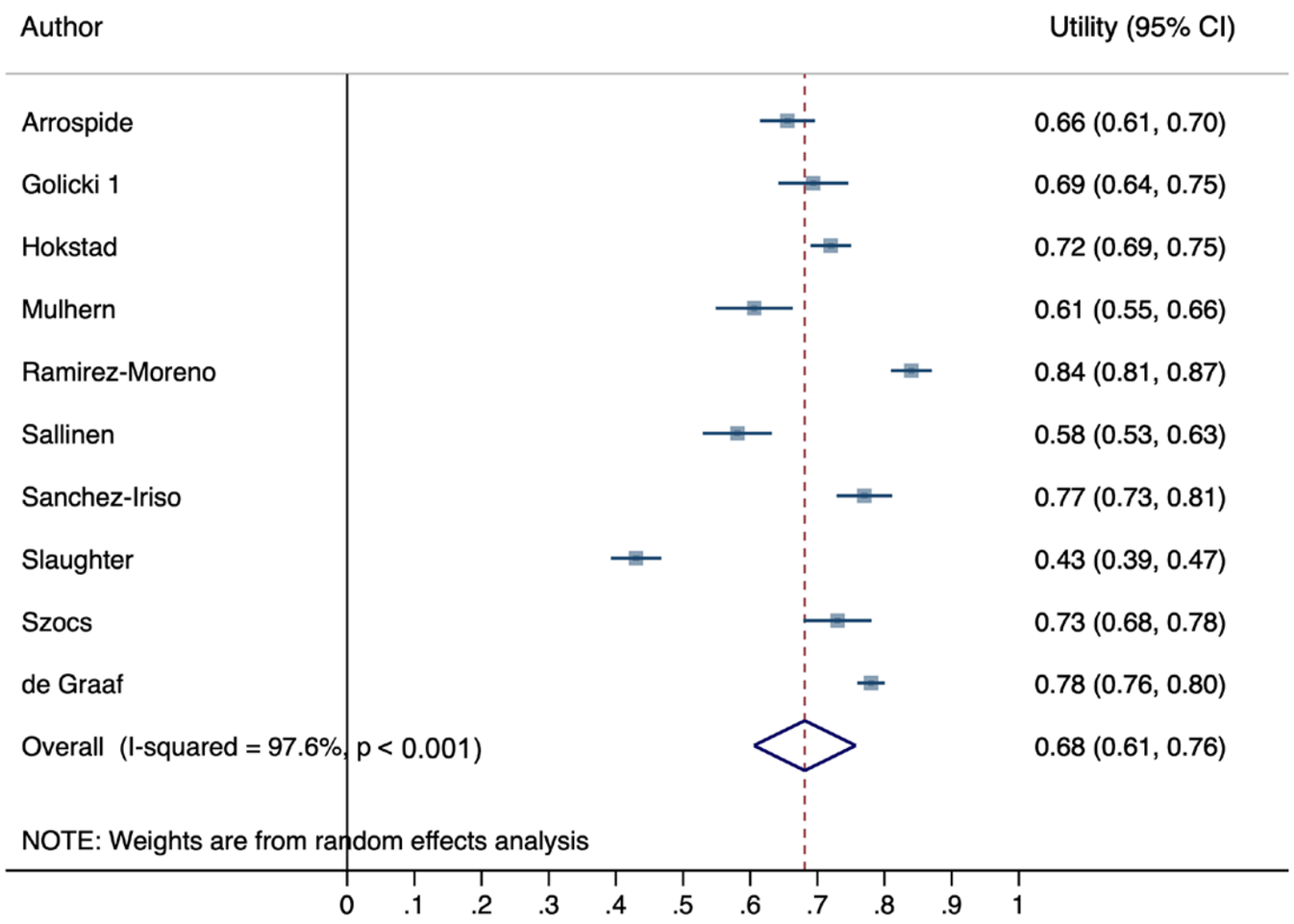


**Figure S6. Random effects meta-analysis for AQoL**

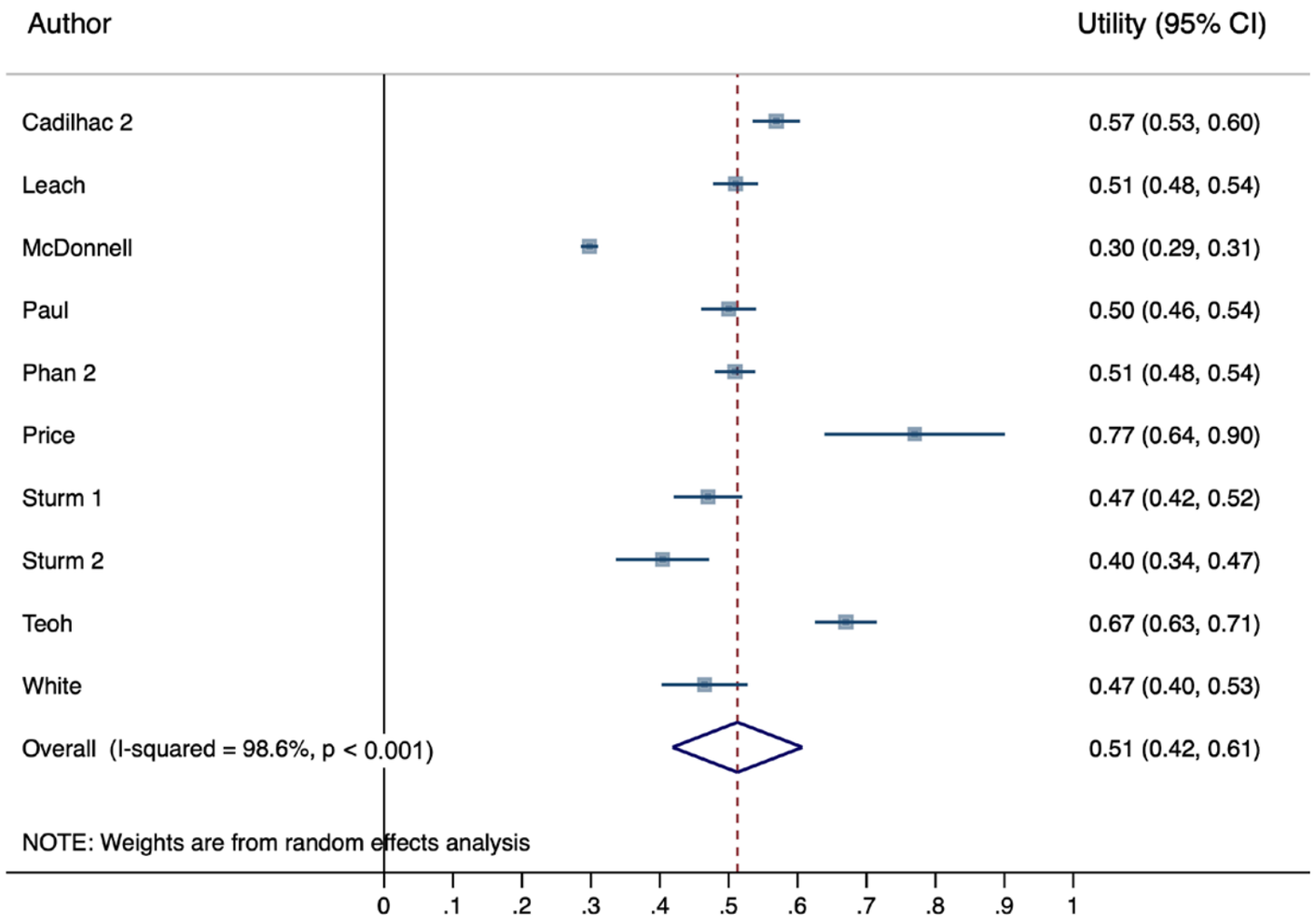


**Figure S7. Random effects meta-analysis for HUI2**

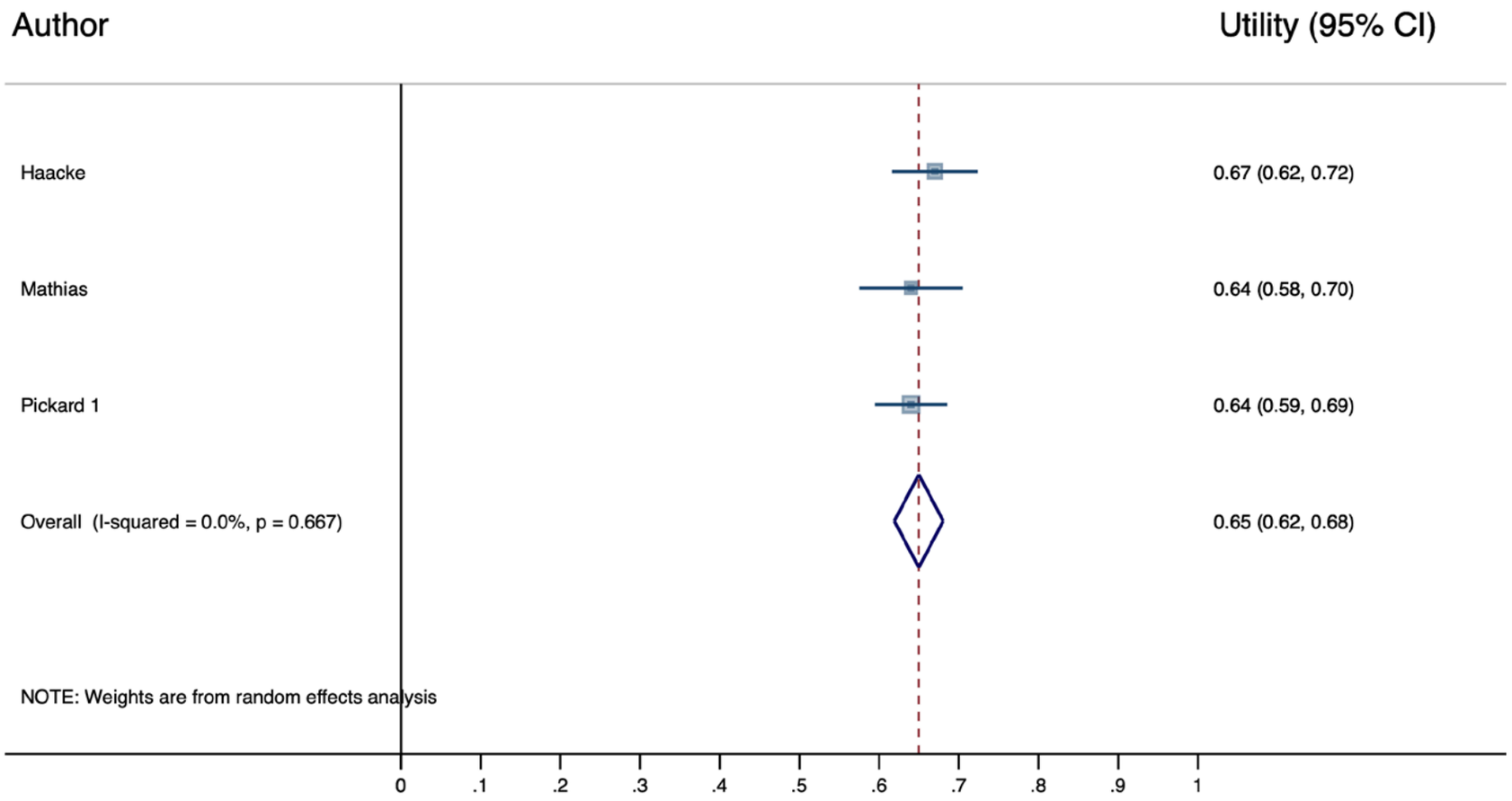


**Figure S8. Random effects meta-analysis for HUI3**

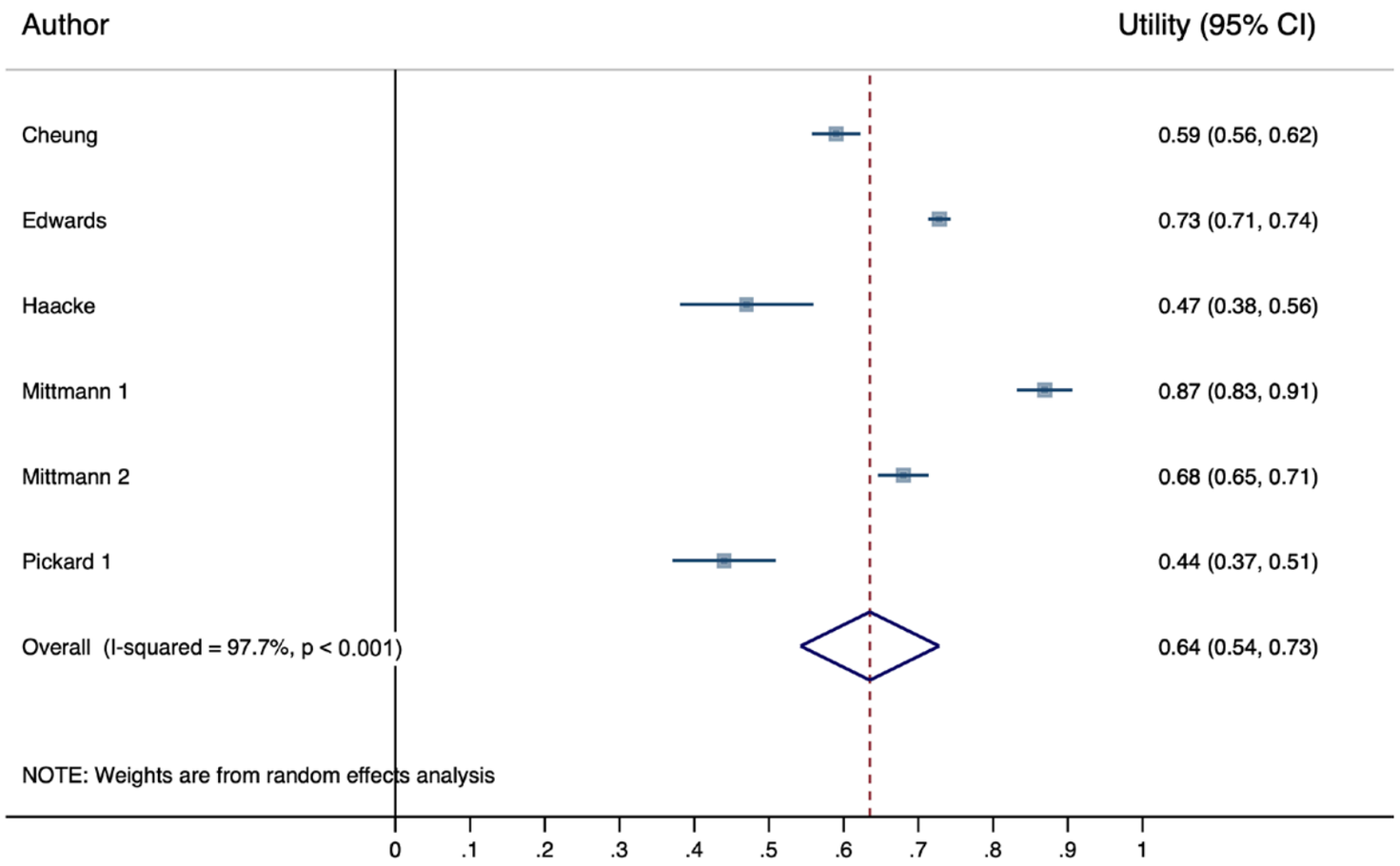


**Figure S9. Random effects meta-analysis for 15D**

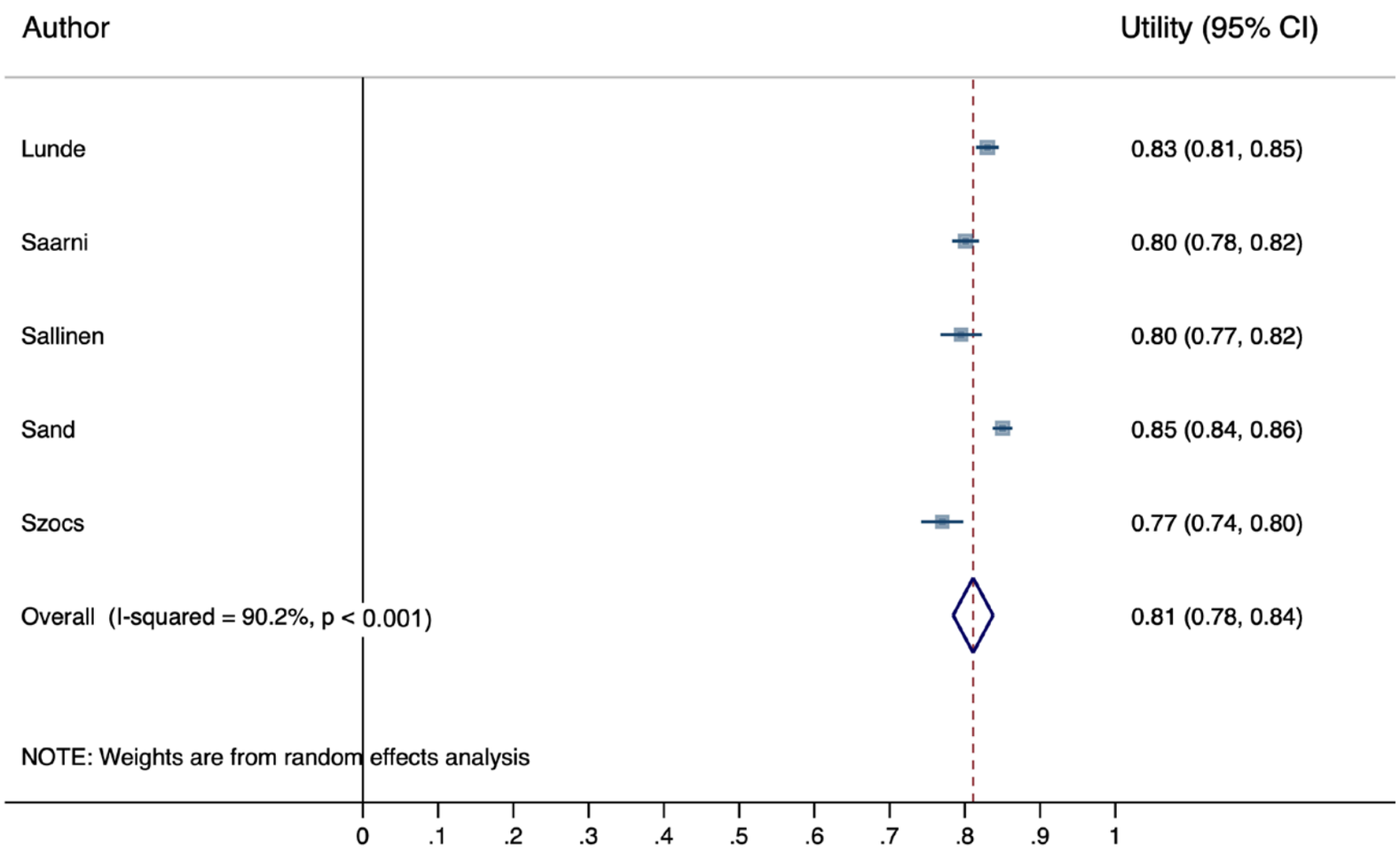


**Figure S10. Random effects meta-analysis for SF-6D**

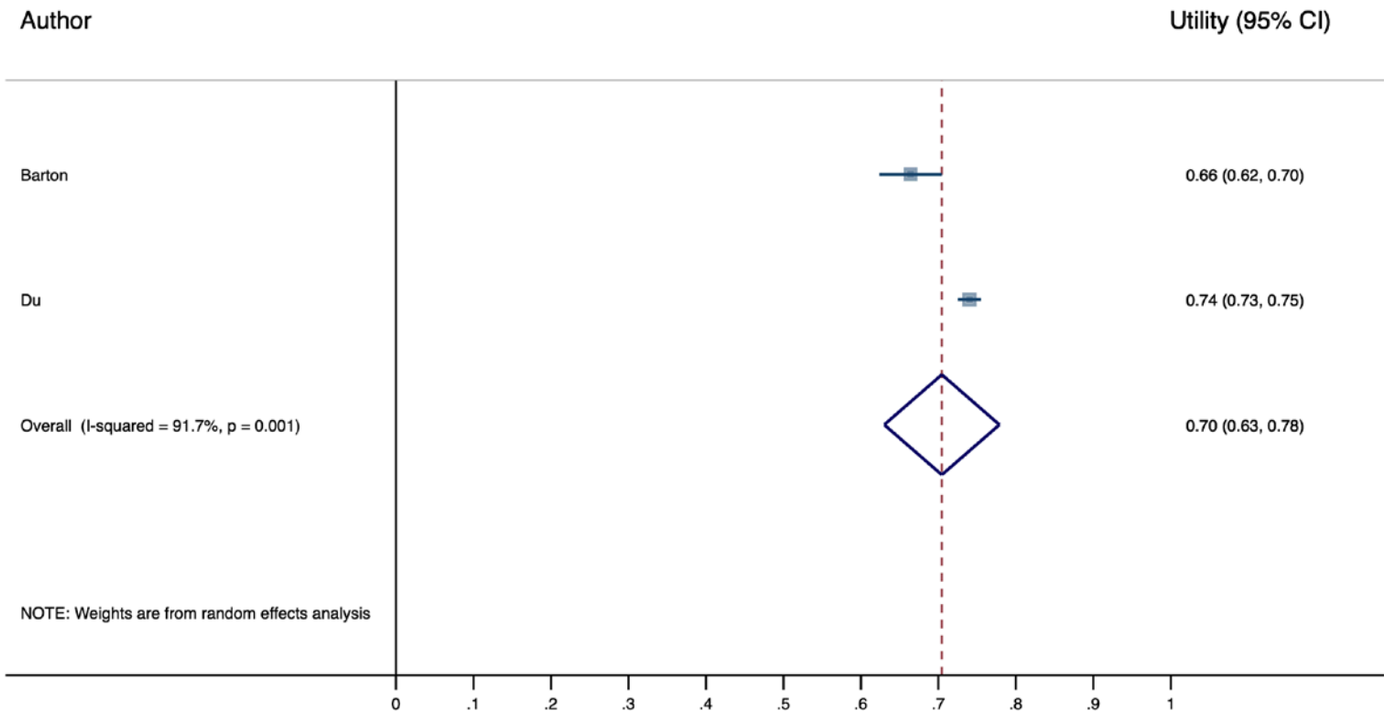


**Figure S11. Sex-stratified random effects meta-analysis for EQ-5D-3L**

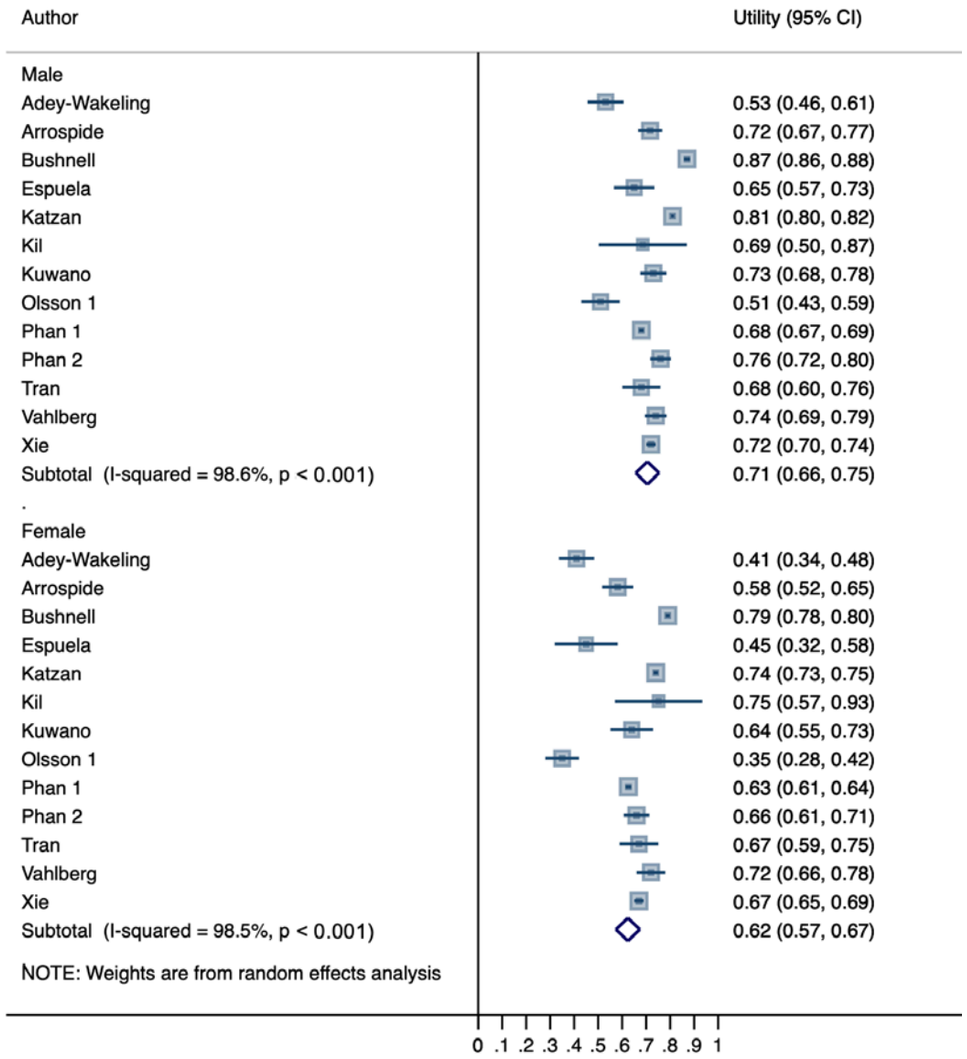


**Figure S12. Age-stratified random effects meta-analysis for EQ-5D-3L**

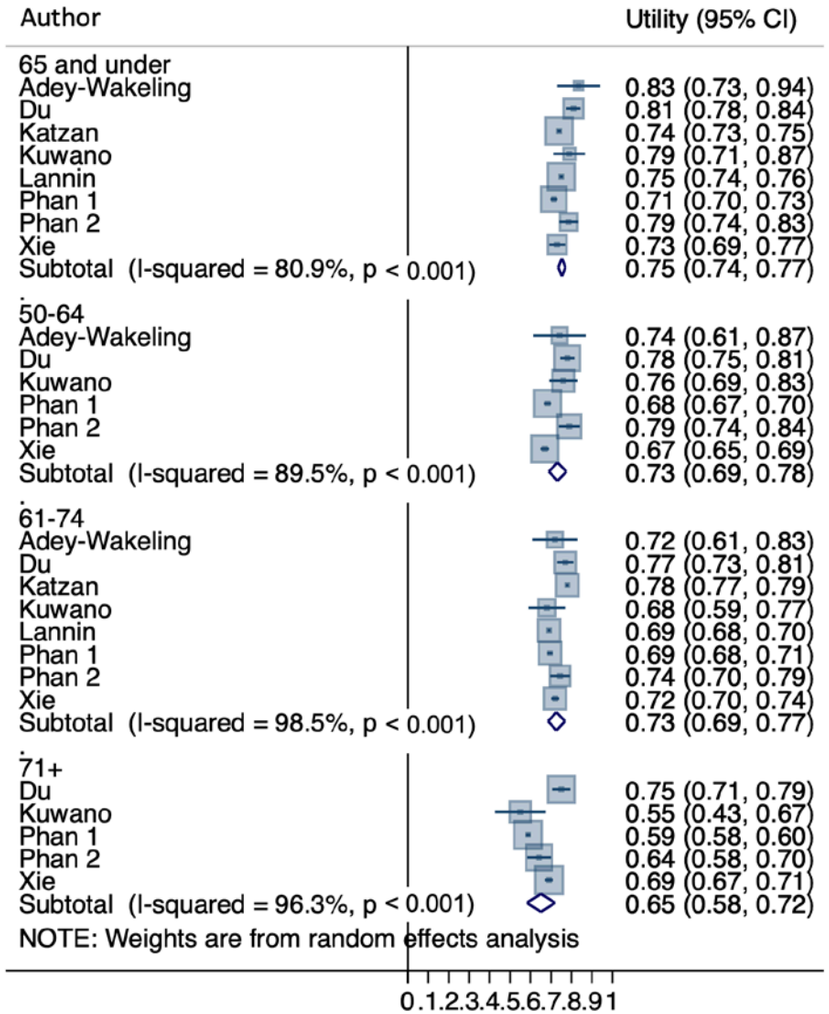


**Figure S13. Stroke type-stratified random effects meta-analysis for EQ-5D-3L**

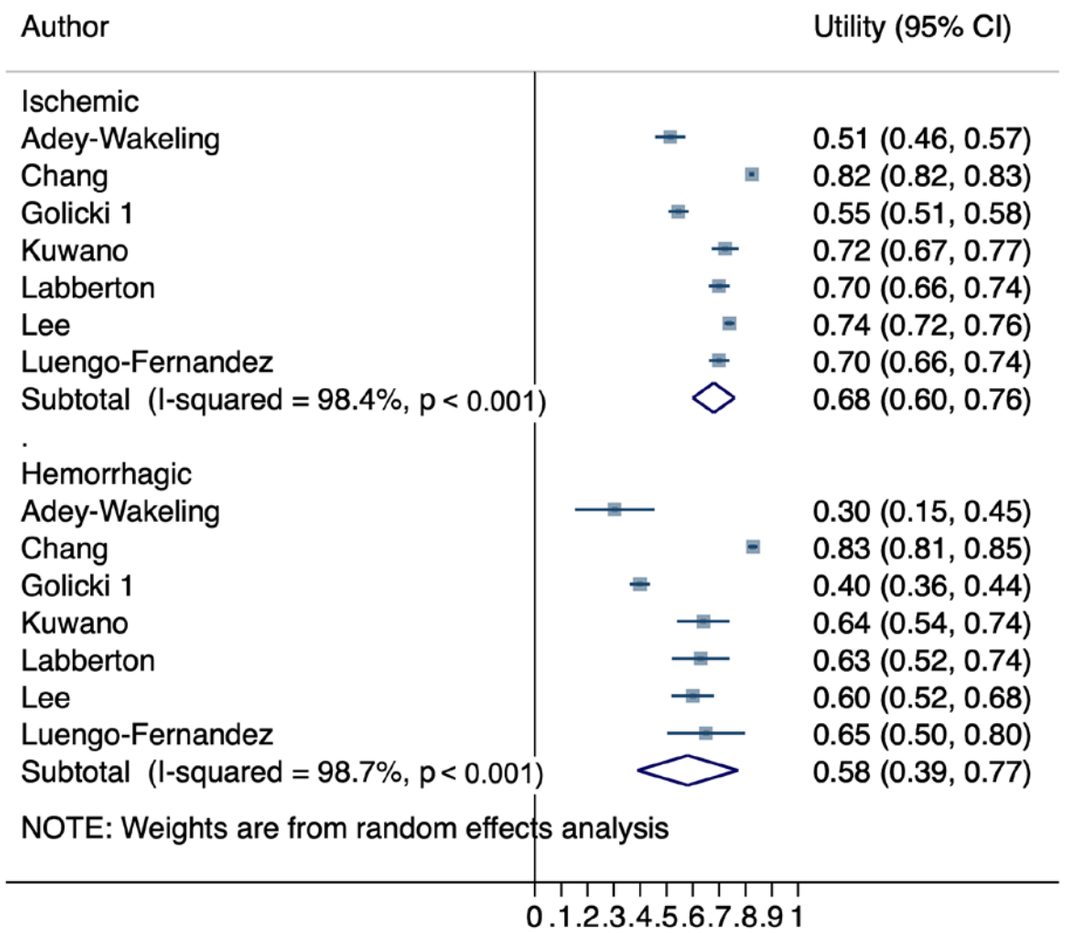


**Figure S14. Random effects meta-analysis for EQ-5D-3L stratified from time from stroke**

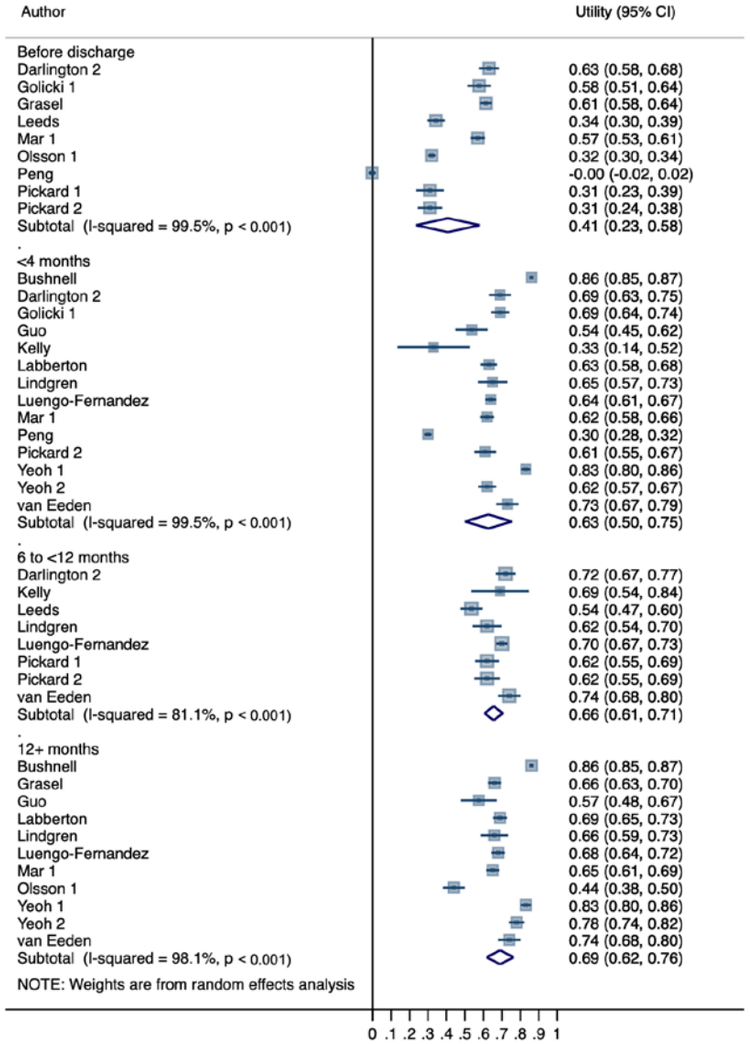
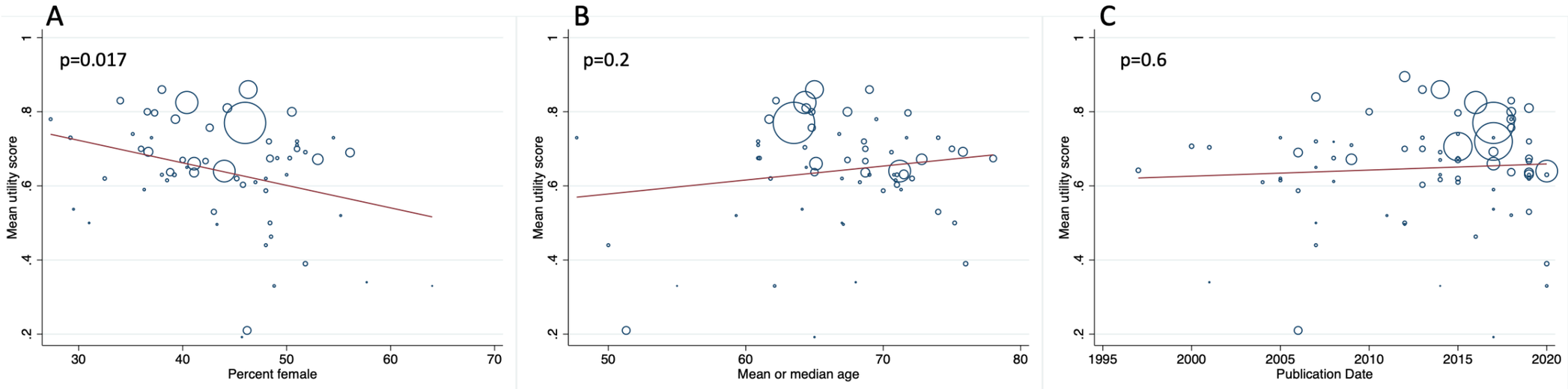


**Figure S15. Meta-regression analyses of mean EQ-5D-3L utility score across percentage females, mean/median age, and publication date. Higher percentage female in the study is associated with lower health utility.**



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