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Review

The role of social isolation in social anxiety disorder: A systematic review and meta-analysis

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ABSTRACT

Introduction: Social isolation in the context of social anxiety disorder has not been closely examined. This study aimed to describe the role and measurement of social isolation in those with social anxiety disorder.
Method: A systematic review and meta-analyses were conducted using a prospectively prepared protocol for search strategy, selection criteria, and data extraction. DerSimonian–Laird random effects models were used to calculate pooled estimates of effect.
Results: Thirty-four studies, containing 20 formal instruments and four other measures of social isolation, were included. Most formal instruments were utilized in single studies, whereas simple structural measures (e.g., living alone) were used most frequently. The pooled score was 38.1 on the Loneliness and Social Dissatisfaction Questionnaire, 33.1 on the Liebowitz Social Anxiety Scale (avoidance subscale), and 21.1 on the Social Avoidance and Distress Scale.
Conclusions: Social isolation is common in social anxiety disorder but assessed by a heterogeneous mix of measures.

Contents

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1. Introduction

Social relationships are a critical element in people's lives. The quantity and quality of social relationships have been associated with mortality. Both narrative (House, Landis, & Umberson, 1988) and systematic reviews (Holt-Lunstad, Smith, & Layton, 2010) of the literature support the finding that "social isolation kills (House, 2001)." The magnitude of effect from social isolation is on par with, and in many larger, than deleterious behaviors such as excessive drinking, smoking, and obesity (Holt-Lunstad et al., 2010). In tragedies such as school shootings, social isolation has been identified as a risk factor for violence against others (American Psychological Association; Verlinden, Hersen, & Thomas, 2000). Further, epidemiological data indicate that social isolation is common in the community (Hawthorne, 2008). Thus, it is unsurprising that the general public is concerned about growing disconnection and loneliness in society (Olds & Schwartz, 2009). Leaders in health care have also shown increasing awareness of social relationships as a key component of health, as reflected by inclusion of it in the recovery model (New Freedom Commission on Mental Health, 2003) and in quality of life measures (Hays, Sherbourne, & Mazel, 1993). Social isolation is also of great relevance to mental illness, including social anxiety disorder (Meltzer et al., 2013). A core feature of the disorder, also referred to as social phobia, is avoidance of social situations. Those who socially isolate or withdraw have more severe illness and may require a different treatment strategy (Nagata et al., 2013).

Researchers have not come to a consensus about a language for social isolation, leading to the disparate use of terms such as loneliness (Cacioppo, Hawkley, & Thisted, 2010), lack of social contact (Chou, Liang, & Sareen, 2011), low perceived social support (Berkman et al., 2003), and low strength of social relationships (Holt-Lunstad et al., 2010). We have attempted to capture these many ways the term has been used in this review. In this review, we construe "social isolation" as an umbrella term that describes a lack of social relationships, contact, or interaction, derived from a variety of underlying causes. Causes of social isolation may be myriad, either internal or external to the individual, as leading experts in the field have argued (Rubin, Coplan, & Bowker, 2009). Like another recent systematic review, we use a multidimensional definition of social isolation that incorporates both "structural" and "functional" components (Dickens, Richards, Greaves, & Campbell, 2011). The structural dimension of social isolation is an objective, quantitative assessment of the frequency or size of one's social contacts or social interaction (e.g., talking with family members less than once a month). In contrast, the functional dimension addresses subjective perceptions of the quality or value of social relationships.

There are important gaps in our understanding of social isolation. First, while topics such as depression (Brugha et al., 1987; George, Blazer, Hughes, & Fowler, 1989; Schuster, Kessler, & Aseltine, 1990), cognition and dementia (Cacioppo & Hawkley, 2009; Fratiglioni, Wang, Ericsson, Maytan, & Winblad, 2000), and elderly mental health (Cacioppo et al., 2010; Cornwell & Waite, 2009; Fiori, Antonucci, & Cortina, 2006) have been frequently examined, social anxiety disorder has rarely been an area of focus. Social anxiety disorder itself has long been an underappreciated condition, less studied and frequently undiagnosed (Weiller, Bisserbe, Boyer, Lepine, & Lecrubier, 1996), despite being the most common anxiety disorder (Stein & Stein, 2008). Second, though mortality associated with social isolation has been studied for decades (Berkman & Syme, 1979; Perissinotto, Stijacic Cenzer, & Covinsky, 2012), morbidity effects are less understood. Third, there has not been a concerted effort to quantify the impact of social isolation in social anxiety disorder. Finally, researchers have not come to a consensus about a language for social isolation, leading to the disparate use of terms such as loneliness (Cacioppo et al., 2010), lack of social contact (Chou et al., 2011), low perceived social support (Berkman et al., 2003), and low strength of social relationships (Holt-Lunstad et al., 2010).

Thus, we conducted a systematic review and meta-analysis with three aims: first, to describe and quantify the morbidity associated with social isolation in those with social anxiety disorder; second, to comprehensively identify and characterize measures of social isolation in studies of social anxiety disorder; and third, to assess the quality of measures of social isolation. We hypothesized that level of social isolation would be high in people with social anxiety disorder, disparate measures of social isolation would exist, and few quality measures of social isolation would be routinely used.

2. Methods

For this systematic review, we followed a prospectively prepared protocol and used the guidelines as recommended by Meta-analysis Of Observational Studies in Epidemiology (MOOSE) (Stroup et al., 2000).

2.1. Search strategy

We conducted a systematic literature search of articles published in PubMed, PsycINFO, PsycArticles, and Sociological Abstracts from January 1, 1980 to February 1, 2011. A master's level medical librarian assisted with construction of the search strategy. We searched for the terms (*social isolation* OR *social relation** OR *social ties* OR *social withdrawal* OR *lonel** OR "*social network*") AND (*social phobia* OR *social anxiety disorder*) in March 2011. Additionally, we conducted two supplemental hand searches. First, using Web of Science, we reviewed articles that had cited publications from the database search and second, we reviewed the reference lists of all publications meeting criteria. We applied these search strategies to titles and abstracts (when available), restricting to those published in English. Missing data essential for this investigation were identified by contacting authors directly.

2.2. Study selection

We applied a priori-defined inclusion criteria when selecting publications. Fig. 1 summarizes the selection process. We included studies where: (1) subjects were diagnosed with social anxiety disorder; (2) social anxiety disorder was a focus of the study; (3) some assessment, either quantitative or qualitative, of social isolation was made; and (4) human subjects were adolescents or adults (at least some subjects >13 years old). Diagnosis of social anxiety disorder was chosen as an inclusion criterion as we were most interested in clinically significant levels of social anxiety. We considered both clinician diagnosis and a cut-off score on an instrument as acceptable forms of diagnosis. We operationalized "social isolation" to include loneliness, social network, social relationships, ties or connections, social support, social withdrawal,

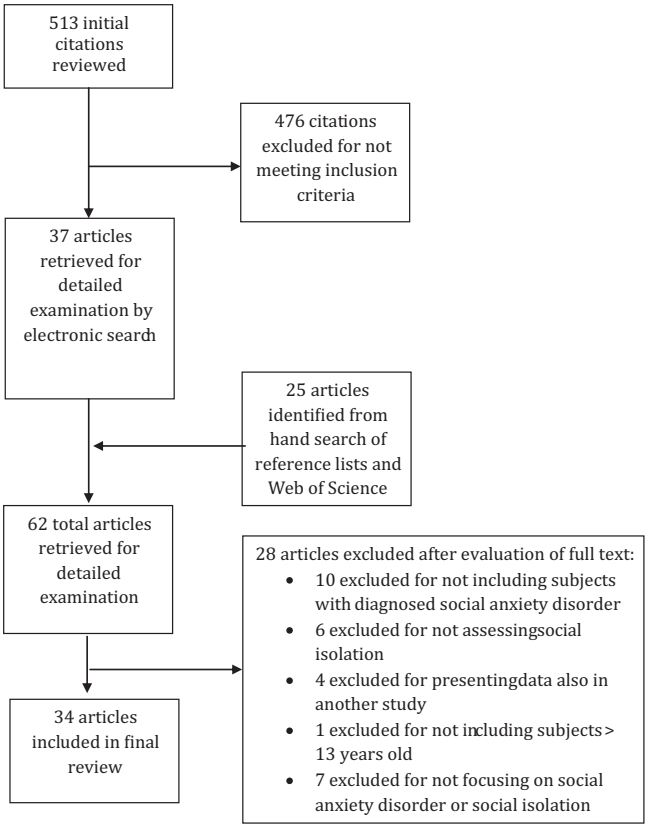

Fig. 1. Article selection process.

social avoidance, and relationship or living status. We operationalized "focus of the study" to be mentioning social anxiety disorder, social phobia, or phobias in the article title or abstract. Both adolescents and adults were included because onset of social anxiety disorder is known to typically occur by adolescence, and social isolation is a relatively persistent and stable behavior across development (Rubin et al., 2009; Stein & Stein, 2008; Walkup & Rubin, 2013). This systematic review included only original research studies; reviews were excluded. If the same study was the source of multiple publications, only the latest original research publication was included. Two reviewers independently examined all initial citations and confirmed that all extracted studies met the inclusion criteria. A third reviewer adjudicated any differences.

2.3. Data extraction and quality assessment

All reviewers followed a standardized protocol and entered data independently into an abstraction form. Extracted data included the study design, year of publication, setting (academic, community, public/government, other), the total number of subjects, location of study subjects, demographic information, and all relevant qualitative and quantitative data pertaining to social isolation as operationalized in Section 2.2. When examining treatment studies that included assessment at multiple time points, baseline values were used for analysis. To assess and rank the quality of individual publications meeting criteria, we examined key components contributing to internal validity as recommended in the MOOSE guidelines for observational studies (Stroup et al., 2000). These components included response rate, the metric used to diagnose social anxiety disorder, and measures of interrater agreement (Cohen's kappa). As with study selection, a third reviewer adjudicated any differences in the data collected by the two independent reviewers. The reviewers had a 68% rate of agreement across nine measures assessed for each study.

2.4. Statistical analysis

Meta-analyses were conducted using the DerSimonian–Laird random effects model (DerSimonian & Laird, 1986). Pooled estimates of effect and 95% confidence intervals (CI) were calculated. Heterogeneity was assessed using the Cochran Q test and Higgins and Thompson I^2 statistic which represents the percentage of total variation across studies that is due to heterogeneity (Higgins & Thompson, 2002). Evidence of publication bias was assessed using the Harbord test when cell counts were available (Harbord, Egger, & Sterne, 2006) and Eggers test when only study-specific odds ratios were available. There was one exception; Begg's test for publication bias was used for the "not married" subgroup. This was due to instability of standard error from small cell size (Begg & Mazumdar, 1994). Alpha was set at 0.05, 2-tailed. Analyses were conducted in STATA/MP (StataCorp).

3. Results

3.1. Descriptive data

3.1.1. Description of studies and population

Table 1 gives an overview of the 34 studies included in this systematic review. Years of publication ranged from 1990 through 2011. There were 21 studies conducted in North America, eight from Europe, three from Australia and two in other sites (Saudi Arabia and South Africa). There were three clinical trials, one of which was a randomized controlled trial. There were 11 population-based surveys, some national and others reflecting provinces or large sections of the country, with the remaining reflecting local regions (Acarturk, de Graaf, van Straten, Have, & Cuijpers, 2008; Chou et al., 2011; Davidson, Hughes, George, & Blazer, 1993; Essau, Conradt, & Petermann, 1999; Furmark et al., 1999; Hybels, Blazer, & Kaplan, 2000; Magee, Eaton, Wittchen, McGonagle, & Kessler, 1996; Stein & Kean, 2000; Stein, Torgrud, & Walker, 2000; Whisman, Sheldon, & Goering, 2000; Wittchen, Stein, & Kessler, 1999). Quality measures for each study are listed in Table 2. Response rates ranged from 41.1% to 96.9%, when reported. The diagnosis of social anxiety disorder was most frequently made through a structured diagnostic interview, although some investigators used a threshold score on a scale. Not all studies reported interrater agreement for the diagnosis of social anxiety disorder but, for those that did, seven reported kappa $\geq$ .80 and five reported values between 0.49 and 0.78.

3.1.2. Mean scores on formal instruments measuring social isolation

Pooled mean scores on various social isolation scales were calculated for individuals with social anxiety disorder. The forest plot summarizing these results is shown in Fig. 2. The mean score on the Loneliness and Social Dissatisfaction Questionnaire (Asher Loneliness Scale), used in two studies with two separate groups of participants (Alfano et al., 2009; Rao et al., 2007), was 38.1 (95% CI 33.5–42.7) among subjects with social anxiety disorder. In the three studies including the Avoidance Subscale of the Liebowitz Social Anxiety Scale (Heimberg et al., 1999; Holt, Heimberg, & Hope, 1992; Liebowitz et al., 2002), the mean score among subjects with social anxiety disorder was 33.1 (95% CI 28.3–37.8). The mean score on the Social Avoidance and Distress Scale among subjects with social anxiety disorder was 21.1 (95% CI 20.2–22.0) in three additional studies with four separate groups of participants (Holt et al., 1992; Leung, Heimberg, Holt, & Bruch, 1994; Liebowitz et al., 2002). Because of the lack of control subjects in these studies, direct comparison to those without social anxiety disorder was not possible. However,

Table 1
Basic study characteristics on included studies.

Citation	Year	Location of study	Study setting	Study type	Number of subjects	Age range, years (mean)	% female
Chaleby and Raslan (1990)	1990	Saudi Arabia	Community	Case series	80	NR	0
Holt et al. (1992)	1992	USA	Academic	Case control	33	NR (38)	45
Strauss and Last (1993)	1993	USA	Academic	Case control	111	4–17 (14)	57
Davidson et al. (1993)	1993	USA	Community	Population-based survey	3801	NR (42)	64
Leung et al. (1994)	1994	USA	Community	Case control	177	NR (34)	50
Schneier et al. (1994)	1994	USA	Academic, community	Case control	46	22–64 (34)	54
Stemberger, Turner, Beidel, and Calhoun (1995)	1995	USA	Academic	Case control	93	NR (40)	59
Norton et al. (1996)	1996	Canada	Academic	Case control	58	NR (38)	34
Magee et al. (1996)	1996	USA	National	Population-based survey	8098	15–54 (NR)	50
Weiller et al. (1996)	1996	France	Community	Cross sectional	44	NR (36)	59
Safren, Heimberg, Brown, and Holle (1996)	1997	USA	Academic	Uncontrolled trial (pre–post)	405	NR	NR
Antony et al. (1998)	1998	Canada	Academic	Case control	135	18–65 (36)	50
Hayward et al. (1998)	1998	USA	Community	Prospective cohort	2242	NR (15)	48
Spence, Donovan and Brechman-Toussaint (1999)	1999	Australia	Academic	Case control	27	7–14 (11)	56
Essau et al. (1999)	1999	Germany	Community	Population-based survey	1035	12–17 (14)	59
Furmark et al. (1999)	1999	Sweden	Community	Population-based survey	1202	18–70 (42)	55
Heimberg et al. (1999)	1999	USA	Academic	Cross sectional	382	18–61 (35)	43
Wittchen et al. (1999)	1999	Germany	Community	Population-based survey	3021	14–24 (NR)	NR
Wittchen et al. (2000)	2000	Germany	Community	Case control	215	18–60 (37)	62
Hybels et al. (2000)	2000	USA	Community	Population-based survey	2914	18+ (NR)	61
Stein and Kean (2000)	2000	Canada	Community	Population-based survey	8116	15–64 (NR)	52[a]
Stein et al. (2000)	2000	Canada	Community	Population-based survey	1956	18+ (NR)	54
Whisman et al. (2000)	2000	Canada	Community	Population-based survey	4933	18–64 (NR)	52
Liebowitz et al. (2002)	2002	USA and Canada	Academic, community	Randomized controlled trial	384	18–70 (37)	41
Lochner et al. (2003)	2003	South Africa	Academic	Case control	337	NR (34)	52
Eng et al. (2005)	2005	USA	Academic	Uncontrolled trial (pre–post)	138	NR (34)	42
Stangier, Esser, Leber, Risch, and Heidenreich (2006)	2006	Germany	Academic	Case control	100	NR (34)	53
Rao et al. (2007)	2007	USA	Academic	Cross-sectional	150	7–17 (12)	52
Hoge et al. (2008)	2008	Australia	Academic	Case control	46	NR (33)	46
Acarturk et al. (2008)	2008	Netherlands	Community	Population-based survey	7076	18–64 (41)	64
Sparrevohn and Rapee (2009)	2009	Australia	Academic, community	Case control	106	18–54 (33)	63
Alfano et al. (2009)	2009	USA	Academic	Uncontrolled trial (pre–post)	88	7–17 (11)	49
Dahl and Dahl (2010)	2010	Norway	Community	Case control	2676	30–45 (37)	58
Chou et al. (2011)	2011	USA	National	Population-based survey	33,368	20+ (NR)	50

NR, not reported.
[a] Data based on subsample of total subjects.

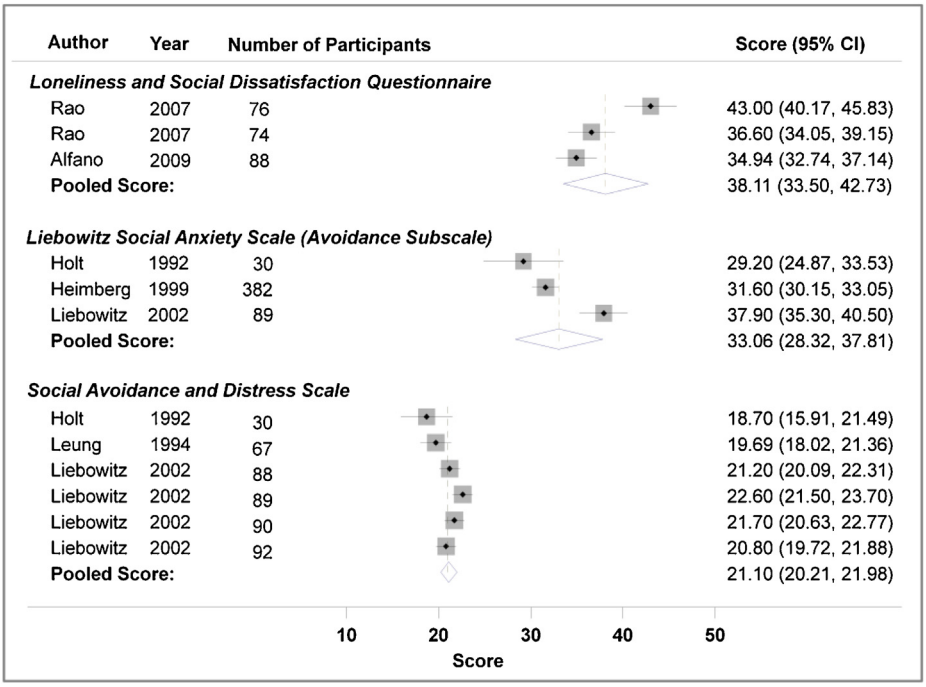

Fig. 2. Forest plot of social isolation scales.

Table 2
Quality assessment of studies.

Citation	Year	Response rate (%)	Diagnostic method for social anxiety disorder	Interrater agreement statistic
Chaleby and Raslan (1990)	1990	NR	No description	None
Holt et al. (1992)	1992	NR	Diagnostic interview	$K = 0.70$; diagnosis of SAD subtype
Davidson et al. (1993)	1993	96.9	Diagnostic interview	None
Strauss and Last (1993)	1993	48.6	Diagnostic interview	$K = 0.89$; diagnosis of SAD
Leung et al. (1994)	1994	NR	Diagnostic interview	None
Schneier et al. (1994)	1994	NR	Diagnostic interview	None
Stemberger et al. (1995)	1995	76.4	Diagnostic interview	$K = 0.87$; diagnosis of SAD
Magee et al. (1996)	1996	82.4	Structured diagnostic interview and clinical interview	$K = 0.64$; diagnosis of SAD (short-term, test-retest)
Norton et al. (1996)	1996	NR	Diagnostic interview	$K = 0.73$; diagnosis of SAD
Weiller et al. (1996)	1996	61.9	Diagnostic interview	None
Safren et al. (1996)	1997	NR	Diagnostic interview	"ratings between the two interviewers were significantly correlated ($p < .01$)"; diagnosis of SAD
Antony et al. (1998)	1998	NR	Diagnostic interview	Diagnosis by consensus if disagreement
Hayward et al. (1998)	1998	95.3	Diagnostic interview	$K = 0.49$; diagnosis of SAD (test–retest)
Essau et al. (1999)	1999	71.7	Diagnostic interview	None
Furmark et al. (1999)	1999	60.1	Threshold score on a scale	None
Heimberg et al. (1999)	1999	NR	Diagnostic interview	None
Spence et al. (1999)	1999	NR	Diagnostic interview	$K = 0.83$; diagnosis of SAD
Wittchen et al. (1999)	1999	70.9	Diagnostic interview	$K = 0.8$; diagnosis of SAD
Hybels et al. (2000)	2000	93.5	Diagnostic interview	None
Stein and Kean (2000)	2000	76.5	Diagnostic interview	None
Stein et al. (2000)	2000	66.1	Diagnostic interview	None
Whisman et al. (2000)	2000	49.6	Diagnostic interview	None
Wittchen et al. (2000)	2000	62.5	Diagnostic interview	None
Liebowitz et al. (2002)	2002	85.1	Diagnostic interview	None
Lochner et al. (2003)	2003	NR	Diagnostic interview	None
Eng et al. (2005)	2005	NR	Diagnostic interview	100% agreement between interviewer and independent assessor; diagnosis of SAD
Stangier et al. (2006)	2006	NR	Diagnostic interview	None
Rao et al. (2007)	2007	NR	Diagnostic interview	$K = 0.78$; diagnosis of SAD
Acarturk et al. (2008)	2008	69.7	Diagnostic interview	None
Hoge et al. (2008)	2008	NR	Diagnostic interview	None
Alfano et al. (2009)	2009	46.6	Diagnostic interview	$K = 0.85$, $K = 0.78$; diagnosis of SAD (subjects in study pooled from two treatment studies)
Sparrevohn and Rapee (2009)	2009	NR	Diagnostic interview	$K = 0.86$–0.89; diagnosis of SAD (by study staff in previous studies)
Dahl and Dahl (2010)	2010	41.1	Threshold score on a scale	None
Chou et al. (2011)	2011	86.7	Diagnostic interview	None

NR, not reported.

scores of normal controls for these measures are considerably lower in other studies (Asher, Hymel, & Renshaw, 1984; Fresco et al., 2001; Hofmann, DiBartolo, Holaway, & Heimberg, 2004).

The Liebowitz Self-rated Disability Scale contains three subscales (family relations, romantic relations, and social network) relevant to social isolation, and each subscale is rated according to current and worst lifetime disability. These were available from two studies (Lochner et al., 2003; Schneier et al., 1994). The pooled mean score for current and lifetime family relations was 0.80 (95% CI 0.48–1.11) and 1.63 (95% CI 1.33–1.93), respectively. The pooled mean score for current and lifetime romantic relationship was 1.35 (95% CI 1.03–1.66) and 2.05 (95% CI 1.78–2.33), respectively. The pooled mean score for current and lifetime social network was 1.30 (95% CI 1.02–1.58) and 2.01 (95% CI 1.74–1.29), respectively. For reference, in the study by Schneier and colleagues (Schneier et al., 1994), normal controls on the Liebowitz Self-rated Disability Scale had a mean score of 0 for both current and lifetime family relations, .1 and .3 for romantic relations, respectively, and .1 for both current and lifetime social network.

3.1.3. Prevalence of not being married in social anxiety disorder

Eleven studies of adults (mean subject age >30) contained sufficient information to enable meta-analysis to calculate a weighted pooled measure for the percentage of persons with social anxiety disorder who were either never married, not married, or single. In the three studies in which "never married" was assessed, 43.8% of people with social anxiety disorder were never married (95% CI 25.9–61.6%) (Antony, Roth, Swinson, Huta, & Devins, 1998; Davidson et al., 1993; Wittchen, Fuetsch, Sonntag, Muller, & Liebowitz, 2000). In the three studies in which "not married" was reported, 56.8% were not married or partnered (95% CI 43.8–69.8%) (Dahl & Dahl, 2010; Hoge, Pollack, Kaufman, Zak, & Simon, 2008; Sparrevohn & Rapee, 2009). By comparison, normative data from the U.S. population using similar definitions of marital/partnered status indicate that among those age 25–44, just 30.0% of women and 30.9% of men are not married or partnered (Goodwin, Mosher, & Chandra, 2010) and 37.1% of those with major depressive disorder are not married (Blazer, Kessler, McGonagle, & Swartz, 1994). In the five studies with data on "single" status, 48.0% of subjects were single (95% CI 32.9–63.1%) (Eng, Coles, Heimberg, & Safren, 2005; Furmark et al., 1999; Heimberg et al., 1999; Leung et al., 1994; Weiller et al., 1996). Overall, nearly half (49.3%) were either single, not married, or never married (95% CI 40.9–57.7%).

3.2. Assessment of the measures of social isolation

Studies that assessed social isolation among those with social anxiety used one of the five different modalities (see Table 3). The most common approach was inclusion as a sociodemographic characteristic. Other ways social isolation was evaluated included: self-perceptions (emotions and cognitions), behavior (typically avoidance), personality (particularly extraversion), and

Table 3
Types of measures of social isolation in studies of social anxiety disorder.

Type of measure	Example
Sociodemographic variable	Household composition
Perceived state	Loneliness and Social Dissatisfaction Questionnaire
Behavior	Liebowitz Social Anxiety Scale, avoidance subscale
Personality trait	Eysenck Personality Inventory
Functioning, quality of life, and disability	Sheehan Disability Scale, social item

social functioning. These five categories help provide a *conceptual understanding* of how social isolation has been considered in the mental health community. No one approach can fully capture the various facets of social isolation.

We next aimed to provide a comprehensive *practical list* of social isolation measures used in the included studies (Table 4). To that end, we first assembled all 20 measures that are either a component of, or completely comprise, a formal instrument. The reliability and validity of these instruments have typically been studied in clinical populations. No single instrument was used in more than four studies, and 12 of the 20 were only utilized in single studies. For all formal instruments, a higher score indicates greater impairment. Exceptions are the Empowerment Scale and Social Network Index in which a higher score indicates a better outcome. A supplemental (Table S1; Butcher, Graham, Ben-Porath, Tellegen, & Dahlstrom, 2001; Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997; Devins, 2010; Eysenck & Eysenck, 1975; Eysenck, 1965; Horowitz, Alden, Wiggins, & Pincus, 2000; Hughes, Blazer, & Hybels, 1990; La Greca & Stone, 1993; Liebowitz, 1987; Marks & Mathews, 1979; Reznick, Hegeman, Kaufman, Woods, & Jacobs, 1992; Rogers, Chamberlin, Ellison, & Crean, 1997; Sheehan, 1983; Silverman & Albano, 1996; Ware & Sherbourne, 1992; Watson & Friend, 1969; Weissman & Bothwell, 1976) provides information on how to obtain each formal instrument. The remaining social isolation measures were separated into two distinct categories called functional measures and structural measures. These two categories have long been used as an important distinction of the features of social networks and ties (Ikeda & Kawachi, 2010), akin to how a car has both a structure (engine, tires, etc.) and function (transportation, safety, etc.). Further, empirical data generally suggest functional measures are more strongly correlated with health outcomes (Holt-Lunstad et al., 2010). The seven identified *functional measures* address the perceived or provided function served by social relationships (e.g., the quality of a relationship), whereas the two identified *structural measures* examine concrete descriptive features of social ties (e.g., whether one lives alone).

Supplementary material related to this article found, in the online version, at http://dx.doi.org/10.1016/j.janxdis.2013.03.010.

3.3. Data on the statistical association between social isolation and social anxiety disorder

3.3.1. Social Isolation as a risk factor for social anxiety disorder

There was only one study in which social isolation was evaluated as a risk factor for the development of social anxiety disorder (Hayward, Killen, Kraemer, & Taylor, 1998), and therefore there were too few studies to make any conclusions.

3.3.2. Association between structural measures of social isolation and social anxiety disorder

Of the six studies that evaluated cohabitation or household composition, four contained information regarding living alone for those with social anxiety disorder compared to a control group of subjects without social anxiety disorder (Acarturk et al., 2008; Dahl & Dahl, 2010; Norton et al., 1996; Wittchen et al., 1999). Overall, the results indicated that the odds of living alone were 73% greater in persons with social anxiety disorder compared to persons without the disorder (95% CI 1.34–2.24, $p < 0.001$). Heterogeneity among the studies was not significant, with a Cochan Q statistic of 6.71 ($p = 0.082$) and $I^2 = 55.3\%$. No evidence of publication bias was found; Egger's test was not significant ($p = 0.579$). For the three population-based studies, the pooled odds ratio was 1.70 (95% CI 1.38–2.10, $p < .001$) with a Cochran Q statistic of 3.71 ($p = 0.157$) and $I^2 = 46.0\%$. These population-based studies indicate that the odds of having social anxiety disorder were 70% greater in individuals who were living alone versus not living alone.

A total of 13 studies assessed marital status, though there were some differences in how marital status was ascertained in each study. For purposes of our investigation, we considered those classified as "never being married," "not married," and "single" as indicative of social isolation. There were eight studies (Antony et al., 1998; Dahl & Dahl, 2010; Davidson et al., 1993; Furmark et al., 1999; Hoge et al., 2008; Leung et al., 1994; Weiller et al., 1996; Wittchen et al., 1999) in which marital status was compared between individuals with social anxiety disorder and those without (studies with children were excluded). The results from meta-analysis indicated that the odds of having social anxiety disorder were 65% greater in persons who were either never married, not married, or single (pooled OR = 1.65, 95% CI 1.43–1.91, $p < 0.001$). The test for heterogeneity was not significant (Cochan Q statistic = 6.75, $p = 0.455$, $I^2 = 0\%$). The odds of social anxiety disorder were 52% greater in people who were never married compared to those who were ever married (95% CI 1.11–2.07, $p = 0.009$); 93% greater in people who were not married compared to those who were married (95% CI 1.58–2.37, $p < 0.001$); and 34% greater in people who were currently single compared to those not single (95% CI 1.02–1.76, $p = 0.032$). Publication bias was not evident for never married versus ever married ($p = 0.904$), not married versus married ($p = 0.317$), or single versus not single ($p = 0.679$).

3.4. Moderators of social isolation

We conducted a meta-regression of the effect of age (mean age) and sex (percentage female) on the social isolation scores shown in Fig. 2. The results indicated a statistically significant association between the percentage female of the subjects and the Liebowitz Social Anxiety Scale for Avoidance ($p = 0.001$) and the Social Avoidance and Distress Scale ($p = 0.044$). In both instances, as the percentage of females in the sample increased, the mean social isolation scores decreased. The results were not significant for percentage female regressed on the Asher Loneliness Scale ($p = 0.376$). Mean age of the subjects was not significantly related to the scores on the Asher Loneliness Scale, the Liebowitz Social Anxiety Scale for Avoidance, or the Social Avoidance and Distress Scale.

4. Discussion

4.1. Association between social isolation and social anxiety disorder

Social isolation is closely associated with social anxiety disorder. Across a variety of measures – from simple structural measures such as being unmarried or living alone to more complex multi-item scales – social anxiety disorder was consistently associated with social isolation. Despite the evidence of a strong correlation between social isolation and social anxiety, the cross-sectional nature of many studies has left researchers unable to comment on cause and effect (Falk Dahl & Dahl, 2010). In our systematic review the sole prospective cohort study in adolescents (Hayward et al.,

Table 4
Instruments and measures used to assess social isolation.

Formal instruments							
Measure	Description						
	Scale scoring	Minimum score	Maximum score	Instrument item information	Administration	Notes	Studies using the measure
Anxiety Disorder Interview Schedule for DSM-IV – Child and Parent Version	Complex	0	8	The main quantitative aspect to the ADIS-C/P is the "clinician severity rating" which rates the severity of each diagnosis from 0 ("none") to 8 ("very severely disturbing/disabling").	By clinician	The section of the ADIS-C/P that is relevant to social isolation asks about the presence of avoidance in 20 social situations for which the response is "yes/no." This information is used to assist in diagnosis of anxiety disorders, not scored per se.	Rao et al. (2007)
Disability Profile (Social Phobia Disability Profile)	Complex	0	64	The Disability Profile has 8 domains, and for each domain items are scored from 0 ("no impairment") to 4 ("severe impairment"). Each domain has "current" and "lifetime" impairment.	By clinician	The sections of the Disability Profile that are relevant to social isolation are 3 domains: marriage/dating, family, and friendship. Total score ranges from 0 to 24.	Lochner et al. (2003) and Schneier et al. (1994)
Duke Social Support Index	Complex[a]	9	61	The DSSI has four scales with a total of 35 items: subjective social support (score range 9–28), social interaction (score range 0–13), social network (score range 0–17), and instrumental social support (score range 0–13).	By interviewer	Davidson selected 32 items from the Duke Social Support Index: 13 instrumental social support items; 5 social interaction items; 4 social network items; and 10 subjective social support items.	Davidson et al. (1993) and Hybels et al. (2000)
Empowerment Scale	Items summed and averaged	1	4	The Empowerment Scale has 28 items, each scored from 1 ("strongly agree") to 4 ("strongly Disagree").	By respondent	The section of the Empowerment Scale that is relevant to social isolation is the community activism subscale, which contains 6 items.	Dahl and Dahl (2010)
Eysenck Personality Inventory	Complex	NA	NA	All item choices are "yes" or "no" in response to a question (57 items in total). Subscale scores are used to determine a personality profile.	By respondent	The section of the EPI that is relevant to social isolation is the extraversion subscale. Total score ranges from 0 to 24.	Stemberger et al. (1995)
Eysenck Personality Questionnaire – Junior	Complex	NA	NA	All item choices are "yes" or "no" in response to a question (81 items in total). Subscale scores are used to determine a personality profile.	By respondent	The section of the EPQJ that is relevant to social isolation is the extraversion subscale. Total score ranges from 0 to 24.	Rao et al. (2007)
Fear Questionnaire	Complex	0	120	The FQ has 15 items; responses for all items range from 0 ("would not avoid it") to 8 ("always avoid it").	By respondent	The section of the FQ that is relevant to social isolation is the 5-item social phobia subscale. Total score ranges from 0 to 40.	Safren et al. (1996)
Illness Intrusive-ness Rating Scale	Summative	13	91	The IIRS has 13 items; responses for all items range from 1 ("not very much") to 7 ("very much").	By respondent	The sections of the IIRS that are relevant to social isolation are the subscales on relationship with spouse, family relations, other social relations and community and civic involvement. Total score ranges from 4 to 28.	Antony et al. (1998)

Table 4 (*Continued*)

Formal instruments							
Measure	Description						
	Scale scoring	Minimum score	Maximum score	Instrument item information	Administration	Notes	Studies using the measure
Inventory of Interpersonal Problems	Complex	35	99	The IIP has 64 items. A 32-item version is also available.	By respondent	The section of the IIP that is relevant to social isolation is the socially avoidant subscale. Total raw score ranges from 0 to 32.	Stangier et al. (2006)
Liebowitz Self-rated Disability Scale	Summative	0	66	The LSRDS has 11 items, each of which is rated during the past 2 weeks and lifetime/when at worst. All item responses range from 0 ("problem does not limit me at all") to 3 ("problem limits me severely").	By respondent	The sections of the LSRDS that are relevant to social isolation are the subscales on family relations, social network, and romantic relations. Total score ranges from 0 to 18.	Lochner et al. (2003), Schneier et al. (1994) and Wittchen et al. (2000)
Liebowitz Social Anxiety Scale	Summative	0	144	The LSAS has 24 items, each of which is rated on level of fear or anxiety (from 0 = "none" to 3 = "severe"), and avoidance (from 0 = "never [0%]" to 3 = "usually [67–100%]."	By clinician	The section of the LSAS that is relevant to social isolation is the avoidance subscale. Total score ranges from 0 to 72.	Heimberg et al. (1999), Holt et al. (1992), Liebowitz et al. (2002) and Schneier et al. (1994)
Loneliness and Social Dissatisfaction Questionnaire (Asher Loneliness Scale)	Summative	16	80	The LSDQ has 16 primary items (with 8 filler items), with all items responses ranging from 1 ("that's always true about me") to 5 ("that's not true at all about me").	By respondent	None.	Alfano et al. (2009), Rao et al. (2007) and Strauss and Last (1993)
Minnesota Multiphasic Personality Inventory-2 (MMPI-2)	Complex	NA	NA	The MMPI-2 has 567 true-false items. There is no overall score, instead clinical interpretations are made from patterns of scale scores. Scores are presented as *T*-scores for each scale.	By clinician	The section of the MMPI that is relevant to social isolation is the social introversion scale (69 items). *T*-score of 75 and above is "Very High" and below 45 is "Low". Higher scores indicate more introversion. The included study referred to "social withdrawal scale"; however, this does not exist and is likely a translation error. The MMPI is no longer in production, having been replaced by the MMPI-2.	Chaleby and Raslan (1990)
Retrospective Self-report of Inhibition	Items summed and averaged	1	5	The RSRI has 30 items with each item response ranging from 1 ("never") to 5 ("always") or comparable terms appropriate for the questions.	By respondent	None.	Hayward et al. (1998)
SF-36 (Social functioning subscale)	Complex	0	100	The SF-36 has 36 items that assess 8 health concepts.	By respondent or interviewer	The section of the SF-36 that is relevant to social isolation is the social functioning scale, which contains two items. Scoring information may be obtained at http://www.qualitymetric.com/whatwedo/certifiedscoringservices/tabid/207/default.aspx. In 1996, a revised version (SF-36v2) was released.	Acarturk et al. (2008), and Wittchen et al. (2000)

Table 4 (*Continued*)

Formal instruments							
Measure	Description						
	Scale scoring	Minimum score	Maximum score	Instrument item information	Administration	Notes	Studies using the measure
Sheehan Disability Scale (Social Item)	Summative	0	30	The SDS has 3 primary items with each response ranging from 0 ("not at all") to 10 ("extremely") and 2 items about number of days lost and days unproductive in the last week. Scoring is typically applied to the 3 primary items only.	By respondent	The section of the SDS that is relevant to social isolation is the social item. Total score ranges from 0 to 10.	Liebowitz et al. (2002) and Lochner et al. (2003)
Social Adjustment Scale Self Rating	Items summed and averaged	1	5	The SAS-SR has 54 items measuring role performance in 6 domains of functioning, with each item rated on a 5-point scale, which varies by item.	By respondent	None.	Lochner et al. (2003)
Social Anxiety Scale for Children – Revised	Summative	18	90	The SASC-R has 18 items (plus 4 filler items) with each response ranging from 1 ("Not at all [true]") to 2 ("[true] all the time").	By respondent	The sections of the SASC-R that are relevant to social isolation are the subscales on social avoidance and distress in new situations (SAD-New) (6 items), and generalized social avoidance and distress (SAD-Generalized) (4 items). Total scores range from 6 to 30 and 4 to 20 for the SAD-New and SAD-Generalized subscales, respectively.	Spence et al. (1999)
Social Avoidance and Distress Scale	Summative	0	28	The SAD has 28 true-false items.	By respondent	None.	Heimberg et al. (1999), Holt et al. (1992), Leung et al. (1994) and Liebowitz et al. (2002)
Social Network Index	Complex	0	21	The SNI includes 22 items and 1 item listing groups the subject talks to at least every 2 weeks. The SNI contains 3 measures: network diversity (score range 0–12); number of people in social network (score range 0–74); and number of embedded networks (score range 0–8).	By respondent	Chou used just 4 of the items from the Social Network Index: "How many close friends do you have?"; "How many of these close friends do you see or talk to at least once every 2 weeks?"; "How often do you attend religious services at church, synagogue, mosque, or other place of worship?"; and "How many members of your church or religious group do you talk to at least once every 2 weeks?" 3 of the 4 items included here may be scored on a scale from 0 people to 7 or more people, for a score range of 0–21.	Chou et al. (2011)

Table 4 (*Continued*)

Functional measures

Measure	Description	Studies using the measure
Interference in personal life	Self-reported interference of personal life by social fear	Stein et al. (2000)
"Small social network" scale	Hybrid functional–structural measure of eight variables: (1) living alone, (2) number of good friends, (3) do not have enough good friends, (4) no club/association memberships, (5) frequency of club/association activities, (6) feeling lonely, (7) never goes to church/sermons, and (8) community activism.	Hayward et al. (1998)
Current social role impairment	Impairment in social contacts or partner relationships measured in days impaired in past month.	Wittchen et al. (1999)
Impairment of social contact	Impairment of social contact in last 4 weeks.	Essau et al. (1999)
Quality and satisfaction of relationships	Self-perception of quality of relationships (e.g., family, friends, or co-workers) in the last six months, reported satisfaction in family relationships and friendships	Stein and Kean (2000)
Quality of social relationships	Perception of quality of relationship with spouse/close relative/close friends in past six months.	Whisman et al. (2000)
Presence of confidant	Presence of someone to talk to when facing personal problems.	Furmark et al. (1999)

Structural measures

Measure	Description	Studies using the measure
Living situation	Living alone versus living with others	Acarturk et al. (2008), Eng et al. (2005), Magee et al. (1996), Norton et al. (1996), Wittchen et al. (1999)
Marital status	Married versus other	Antony et al. (1998), Chaleby and Raslan (1990), Davidson et al. (1993), Eng et al. (2005), Furmark et al. (1999), Heimberg et al. (1999), Hoge et al. (2008), Hybels et al. (2000), Leung et al. (1994), Magee et al. (1996), Sparrevohn and Rapee (2009), Weiller et al. (1996) and Wittchen et al. (2000)

[a] Although Duke Social Support Index items can be summed into a total score, the authors recommend against using this approach.

1998) provides intriguing evidence that social isolation may lead to the onset of social anxiety disorder, a potential risk factor that future studies should confirm.

4.2. Quality of studies and social isolation measures

This causality dilemma relates to the more general concern about the quality of available studies on this subject: there is a dearth of rigorous studies that examine the intersection of social anxiety disorder and social isolation. Although there were some large datasets available, these epidemiological studies were mostly cross sectional and did not contain control groups. Studies that did contain a control group tended to use more crude measures of social isolation.

The complexity, or quality, of a social isolation measure appeared inversely related with the frequency of its use in the literature. As is evident in Table 4, structural measures were few but commonly used, whereas formal instruments were many in number but no particular instrument was used often. This is noteworthy because not all measures of social isolation are created equal. For instance, the structural measure of marital status is very weak. Limitations abound, including restricted application among younger people or same-sex couples who may not be expected or able to marry. Complex measures of social isolation are more relevant to health. For instance, measures of social integration or multifaceted measures are more predictive of mortality risk compared to simple structural measures of cohabitation and marital status (Holt-Lunstad et al., 2010).

Also, though there are a plethora of established social support measures that have been used in research on other areas of mental health (Handley et al., 2012), these measures did not turn up in our systematic review. The only social support measure was the Duke Social Support Index, and this was utilized solely by researchers with the same institutional affiliation (Davidson et al., 1993; Hybels et al., 2000).

4.3. Limitations

Relative limitations for this study are ones common to any systematic review and meta-analysis. Our search strategy limited results to studies in English, which could partially account for the predominance of Western studies. We limited our evaluation to studies published since 1980, supported by the rationale that methodologically sound research on the interaction between social relationships and health were not emerging until approximately 1980 (Berkman & Syme, 1979; House et al., 1988). Similar to reviews of other heterogeneously defined concepts (Williams et al., 2012), "social isolation" carries many meanings and interpretations. For all these reasons, relevant studies may have been missed. In addition, a systematic review and meta-analysis can only be as good as the underlying data. As we pointed out, many known measures of social isolation simply have not been employed in the social anxiety disorder literature.

4.4. Implications for future work

Based on the current state of the literature summarized in this paper, we suggest two implications to help guide future research.

First, our results found that formal instruments that measure social isolation have seldom been used in multiple studies. We suggest future studies of social anxiety disorder include a formal, quantitative instrument of social isolation such as the Duke Social Support Index. Doing so would allow researchers get provide a more nuanced characterization of social isolation in those with social anxiety disorder than whether patients live alone or are unmarried. Second, future studies should take on the challenge of characterizing the direction of the relationship between social isolation and social anxiety disorder. Given how few clinical trials and prospective studies were found in our review of the literature, we especially encourage this type of study design. Though data in this review point to a correlation between the two, their questions, however, remain unclear. Does social isolation – in its emotional, cognitive, behavioral, or personality trait form – place a person at risk for developing social anxiety disorder, or is it a consequence of fear-based avoidance in the disorder? Would targeting social isolation for intervention or treatment prevent cases of social anxiety disorder? Is social isolation a prognostic indicator in social anxiety disorder? Many questions remain to be answered. This systematic review and meta-analysis provides an informed basis from which to move forward.

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