Mental Health of Sexual Minorities. A Systematic Review

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Abstract

Many studies, reviews, and meta-analyses reported elevated mental health problems for sexual minority (SM) individuals. This systematic review provides an update by including numerous recent studies and also explores if SM individuals are at increased risk across selected mental health problems as per dimensions of sexual orientation (SO), genders, life-stages, geographic regions, and in higher-quality studies. A systematic search in PubMed produced 199 studies appropriate for review. A clear majority of studies reported elevated risks for depression, anxiety, suicide attempts or suicides, and substance related problems for SM males and females, as adolescents or adults from many geographic regions and with varied SO dimensions (behavior, attraction, identity) especially in more recent and higher quality studies. One notable exception is alcohol related problems, where many studies reported zero or reversed effects, especially for SM males. All SM subgroups were at increased risk, but bisexual individuals were at highest risk in the majority of studies. Other subgroup and gender differences are more complex and are discussed. The review supports the longstanding mental health risk proposition for SM individuals, overall and as subgroups.

Keywords: mental health disorders, suicide, depression, anxiety, alcohol, substance, drug, sexual orientation, homosexuality, bisexuality, sexual minority, systematic review
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Introduction

Many studies have reported elevated mental health problems for sexual minority (SM) individuals, including lesbian, gay, bisexual (LGB), mostly heterosexual, or questioning individuals, compared to heterosexual counterparts. These findings have been replicated, but it is only since the 1990s that SM individuals were sampled within the general population as opposed to LGB communities, the latter possibly producing biased results (Kuyper, Fernee, & Keuzenkamp, 2015).

A few meta-analyses reported statistically significant disparities for SM compared to heterosexual individuals for most assessed mental health disorders, substance use problems, and suicidality (King et al., 2008; Marshal et al., 2011; Marshal et al., 2008; Plöderl, Sauer, & Fartacek, 2006). However, these meta-analyses often collapsed SM into one group because older studies did not report results for SM subgroups, or to increase statistical power, nonetheless blurring the differences between subgroups (Savin-Williams, 2008). For example, bisexual individuals commonly have higher levels of mental health problems than homosexual individuals (Marshal, et al., 2011; Marshal, et al., 2008) and this could distort estimations of other SM subgroups. Studies have often also used different dimensions of sexual orientation (SO) (identification, behavior, attraction) that impacts the SO differences (Bostwick, Boyd, Hughes, & McCabe, 2010). Moreover, SO differences have varied with gender and type of mental health problem (Marshal, et al., 2008; Plöderl, et al., 2006).

Most importantly, a substantial number of studies were published since the mentioned analyses, thus necessitating an update. Because of the studies’ methodological diversity, we opted for a systematic review without meta-analytic aggregation. The review is organized
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according to these questions: Is the often reported increased risk for mental health problems of SM individuals apparent

- in light of recent studies?
- within subgroups of SM (e.g., gay, lesbian, bisexual, questioning)?
- for males and females?
- for adolescents and adults?
- across dimensions of SO?
- for different types of mental health problems?
- in higher quality studies?

Method

PubMed was searched with two sets of keywords combined with the AND operator. The first set included SO key words (gay, lesbian, homosexual, homosexuality, sexual orientation, same-sex sexual) and the second set had mental health key words (suicide, self-harm, mental health, mental disorders, depression, anxiety, drug use, alcohol use, drug abuse, alcohol abuse, drinking problems), all separate by OR. We used the results of an existing search (Plöderl, et al., 2006) with publications to August 31, 2005, producing 2508 hits. We complemented this with a publication search from September 1, 2005, to December 2014, producing 1942 hits, for a total of 4450 results.

The study titles and abstracts were screened using a dual selection criteria: First, only studies that did not selectively recruit SM individuals but used pre-specified, defined populations such as countries, states, counties, districts, cities, regions, schools, universities, birth-cohorts, large occupational groups (nurses, veterans), and registers of general practitioners. Studies from social networking sites (facebook groups, online newspaper readers etc.) were excluded because
the sample was not pre-specified. Only studies with a comparison heterosexual group were included.

Second, we included studies reporting on depression or depressive mood, distress, anxiety and anxiety disorders, alcohol and substance use (and related disorders), suicide attempts and suicides. If other psychiatric disorders or indicators of mental distress were reported, results were only reported in the supplemental table. For the behavior dimension of SO, we did not report the results for sexually inactive individuals.

In the text and the table, “effects” refer to SO-differences, with heterosexuals always as the reference group. Similarly, for subgroups (e.g., males, older groups, etc.), the reference group is always the heterosexual counterpart within the subgroup (e.g., male heterosexual, older heterosexuals). For example, when we compare homosexual and bisexual SM subgroups, we compare the SO-differences of homosexual vs. heterosexual with the SO-difference bisexual vs. heterosexuals. Reported effect sizes (odd ratios, risk ratios, hazard ratios, Cohen’s d) were used when the control variables were not problematic (e.g., age, education). When variables were known to differ crucially by SO (partnership status, marriage, health related variables etc.), we either used the unadjusted effect sizes or, if possible, they were calculated (see the footnote to the table for details). We used the following interpretations of effect sizes for ORs and RRs:

Zero/close to zero difference (1.0-1.2), small (1.3-2.0), medium (2.1-3.5), and large (> 3.5). These interpretations follow conventions (Breaugh, 2003; Ferguson, 2009; Haddock, Rindskopf, & Shadish, 1998), except that we categorized very small effects as “zero or close to zero” difference (OR/RR ≤ 1.2, d ≤ 0.1). To formulate summarizing statements, we tabulated the effect sizes, avoiding using multiple studies on the same data-set (as marked in the supplementary table). This way we could calculate the fraction of the study findings with certain effect sizes, allowing an approximation of the overall effect size. One study could produce several entries in
the table, for example when results for different dimensions of SO or for SM subgroups were reported.

**Results**

A total of 199 studies fulfilled review-criteria, 95% published in the new millennium, 82% since 2006 and 53% since 2011. The tabulated study descriptions and outcomes are available as an online supplemental. Two longitudinal studies from adolescence to young adulthood are reported separately. The results for different assessment methods (clinical interview, questionnaire, single items, diagnosis/treatment by doctor) are separated.

**Description of the Studies**

Twenty-six studies (13%) are of higher quality, defined as representative national studies using clinical interviews. Twenty-seven percent of studies are of special importance because results were separated by sex and by homosexual/LG and bisexual status. Only one study provided separate analyses for transgender individuals (Rath, Villanti, Rubenstein, & Vallone, 2013), but small sample size precluded reliable results only reported in the online supplemental. Most studies (76%) were from the US or Canada, 15% from Europe, 6% from Australia or New Zealand, and 2% from Asia or Mexico.

**Depression**

**Adults:** A clear majority of study results (89%) indicated elevated levels/rates of depression in general or across SM subgroups in all dimensions of SO (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies. These findings were replicated using varied assessment methods: structured clinical interviews or medical chart (Booth et al., 2012; Chakraborty, McManus, Brugha, Bebbington, & King, 2011; Cochran & Mays, 2000a, 2000b; Cochran, Sullivan, & Mays, 2003; Fergusson, Horwood, & Beautrais, 1999;
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Fergusson, Horwood, Ridder, & Beautrais, 2005; Frisell, Lichtenstein, Rahman, & Langstrom, 2010; Gattis, Sacco, & Cunningham-Williams, 2012; Gilman et al., 2001; Hatzenbuehler, Keyes, & Hasin, 2009; Mattocks et al., 2013; Said, Kypri, & Bowman, 2013; Sandfort, de Graaf, Bijl, & Schnabel, 2001), questionnaires (Bagley & Tremblay, 1997; Cochran & Mays, 2009; Frisell, et al., 2010; Grant et al., 2014; Grella, Cochran, Greenwell, & Mays, 2011; Jorm, Korten, Rodgers, Jacomb, & Christensen, 2002; McNair, Szalacha, & Hughes, 2011; Rath, et al., 2013; Said, et al., 2013; Schauer, Berg, & Bryant, 2013; Skegg, Nada-Raja, Dickson, Paul, & Williams, 2003; Wang et al., 2014; Wang, Hausermann, Wydler, Mohler-Kuo, & Weiss, 2012), single items (Diamant & Wold, 2003; Gruskin & Gordon, 2006; Kerr, Ding, Burke, & Ott-Walter, 2015; Kerr, Santurri, & Peters, 2013; Lhomond, Saurel-Cubizolles, & Michaels, 2014; Oswalt & Wyatt, 2011; Rothman, Sullivan, Keyes, & Boehmer, 2012; Sandfort, Bakker, Schellevis, & Vanwesenbeeck, 2009; Skegg, et al., 2003), and treatment/diagnosis by professionals, as reported by participants (Brennan, Ross, Dobinson, Veldhuizen, & Steele, 2010; Burgess, Tran, Lee, & van Ryn, 2007; Diamant & Wold, 2003; Grant, et al., 2014; Hughes, Szalacha, & McNair, 2010b; Lytle, De Luca, & Blosnich, 2014; Matthews & Lee, 2014; McNair, et al., 2011; Oswalt & Wyatt, 2011; Pakula & Shoveller, 2013; Pelts & Albright, 2014; Steele, Ross, Dobinson, Veldhuizen, & Tinmouth, 2009; Tjepkema, 2008).

Few study results (11%) indicated close to zero differences or reversed effects in specific subgroups, with no clear-cut pattern (see supplemental table) (Bostwick, et al., 2010; Cheng, Gipson, Perez, & Cochran, 2014; Cochran & Mays, 2009; Cochran, Mays, Alegria, Ortega, & Takeuchi, 2007; Gattis, et al., 2012; McNair, Kavanagh, Agius, & Tong, 2005; McNair, et al., 2011; Sandfort, et al., 2009; Schauer, et al., 2013; Skegg, et al., 2003). Overall, most of the effects were medium for men and small for women (39% and 50% of study results, respectively).
Adolescents. A clear majority of studies (97%) reported elevated levels of depression in general or across SM subgroups, and across dimensions of SO (identity, behavior, attraction). These findings were replicated using questionnaires (Almeida, Johnson, Corliss, Molnar, & Azrael, 2009; Bos, Sandfort, de Bruyn, & Hakvoort, 2008; Denny et al., 2014; Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008b; Johnson et al., 2011; Lucassen et al., 2014; Marshal et al., 2013a; Marshal et al., 2012b; Martin-Storey & Crosnoe, 2012; Pesola, Shelton, & van den Bree, 2014; Poteat, Aragon, Espelage, & Koenig, 2009), and single items (including items on core symptoms, i.e., sadness/hopelessness) (Birkett, Espelage, & Koenig, 2009; Hatzenbuehler, Pachankis, & Wolff, 2012; Jiang, Perry, & Hesser, 2010; Kann et al., 2011; Lampinen, McGhee, & Martin, 2006; Mustanski, Andrews, Herrick, Stall, & Schnarrs, 2014; Seil, Desai, & Smith, 2014; Shields, Whitaker, Glassman, Franks, & Howard, 2012; Zhao, Montoro, Igartua, & Thombs, 2010). Reversed or close to zero differences were reported only in specific subgroups in the Add Health/GUTS studies (see below) and for white LGB males in one study (Poteat, et al., 2009). Most of the effects were small (37%) or medium (40%).

Add Health and GUTS-Study. In the Add Health Study, elevated depression among SM adolescents was reported in Wave I (adolescence) across subgroups (Russell & Joyner, 2001; Ueno, 2010b; Williams & Chapman, 2011) and for all assessed subgroups (Marshal, et al., 2013a). No/reversed effects were reported for LG, mostly LG, bisexual individuals, but not for mostly heterosexuals (Cardom, Rostosky, & Danner, 2013). In Wave II (adolescence), significant effects were reported overall (Teasdale & Bradley-Engen, 2010; Ueno, 2010b) and for all assessed subgroups (Marshal, et al., 2013a). In Wave III (young adulthood), elevated depression levels were reported overall (Ueno, 2010b), and for all assessed subgroups (Marshal, et al., 2013a; McLaughlin, Hatzenbuehler, Xuan, & Conrond, 2012; Needham & Austin, 2010). In two
studies, there were only significant effects or effects with substantial evidence for bisexual and mostly heterosexual individuals (Loosier & Dittus, 2010; Savin-Williams, Cohen, Joyner, & Rieger, 2010). In Wave IV (young adulthood), elevated depression levels applied for all subgroups (Marshal, et al., 2013a; Strutz, Herring, & Halpern, 2015). No/reversed effects for LG and mostly LG but effects for bisexuals and mostly heterosexuals were reported in one study (Cardom, et al., 2013), and close to zero effect only for male youth with attraction and some other SO indicator (Strutz, et al., 2015). More complex patterns were reported in one study where significant effects applied only for women identified as mostly heterosexual, bisexual, and mostly lesbian, but not lesbians; for bisexual but not same-sex attracted, only for mostly heterosexual behavior and, among men, only for mostly heterosexual identity and behavior (Lindley, Walsemann, & Carter, 2012). In the GUTS study, elevated levels of depression applied for all identity subgroups (LG/mostly LG, bisexual, mostly heterosexual) except questioning individuals (Rosario et al., 2014a; Rosario et al., 2014b).

**Lifetime vs. past year.** The results are mixed: some studies had comparable effects for lifetime and past year depression (Frisell, et al., 2010; Gilman, et al., 2001; Sandfort, et al., 2001) while others reported larger lifetime effects (Barnes, Hatzenbuehler, Hamilton, & Keyes, 2014), with some having mixed results, depending on subgroups (Bostwick, et al., 2010; Cochran, et al., 2007).

(Hughes, McCabe, Wilsnack, West, & Boyd, 2010a; Hughes, et al., 2010b)

**Subgroup differences.** Bisexual individuals had larger effects than homosexual individuals in a slight majority of studies (Bagley & Tremblay, 1997; Bostwick, et al., 2010; Cardom, et al., 2013; Denny, et al., 2014; Hughes, et al., 2010b; Jorm, et al., 2002; Kerr, et al., 2013; Loosier & Dittus, 2010; Marshall, et al., 2013a; McLaughlin, et al., 2012; McNair, et al.,
Larger effects for bisexuals than homosexuals were sometimes reported only among women but not men (Cochran & Mays, 2009; Ziyadeh et al., 2007), or reversed (Needham & Austin, 2010). Bisexuals had comparable or smaller effects than homosexuals in several other studies (Brennan, et al., 2010; Cochran & Mays, 2000b; Diamant & Wold, 2003; Lhomond, et al., 2014; McNair, et al., 2005; Mustanski, et al., 2014; Rath, et al., 2013; Rosario, et al., 2014a; Sandfort, et al., 2009; Skegg, et al., 2003; Wang, et al., 2014). In the adolescent YRBS, bisexuals had larger effects than homosexuals for the behavior dimension but not for the identity dimension (Kann, et al., 2011), noting that the risk may vary by SO for sexually inactive individuals.

Mostly heterosexuals had larger effects than homosexuals in some studies (Cardom, et al., 2013; Lindley, et al., 2012; Loosier & Dittus, 2010; Marshal, et al., 2013a), or only among women (Ziyadeh, et al., 2007), or only among men (Cochran & Mays, 2009). In contrast, more studies reported that mostly heterosexuals had comparable or smaller effects than homosexuals (Bloomfield, Wicki, Wilsnack, Hughes, & Gmel, 2011; Fergusson, et al., 2005; Lhomond, et al., 2014; McNair, et al., 2005; McNair, et al., 2011; Wang, et al., 2014; Zhao, et al., 2010).

Questioning individuals, compared to homosexuals, had larger SO differences in some studies (Birkett, et al., 2009; Poteat, et al., 2009; Rath, et al., 2013), but the reversed was reported in other studies (Kann, et al., 2011). Heterosexual identified individuals with same-sex attraction or behavior had somewhat smaller effects than gay/lesbian identified with concordant behavior/attraction (Gattis, et al., 2012).

**Gender.** A weak majority of studies reported larger effects for men then for women. Comparable effects for SM males and females were reported in some studies (Almeida, et al., 2009; Cheng, et al., 2014; Frisell, et al., 2010; Grella, et al., 2011; Lhomond, et al., 2014;

**Higher quality studies.** A clear majority of high quality studies reported elevated levels of depression (Chakraborty, et al., 2011; Cochran & Mays, 2000a, 2000b; Cochran, et al., 2003; Fergusson, et al., 1999; Frisell, et al., 2010; Gattis, et al., 2012; Gilman, et al., 2001; Hatzenbuehler, et al., 2009; Sandfort, et al., 2001), with only few exceptions among men (Cochran, et al., 2007) or women for past year depression (but not lifetime) (Sandfort, et al., 2001), or among heterosexual identified women with homosexual experience (Cochran & Mays, 2009).

**Other mood disorders.** The majority of studies reported elevated bipolar disorder incidences for SM individuals (Cochran & Mays, 2000a; Mattocks, et al., 2013; Pelts & Albright, 2014; Sandfort, et al., 2001) except Bipolar I in one study with all other mood disorders elevated – thus perhaps a false positive result (Cochran & Mays, 2000a); dysthymia (Bostwick, et al., 2010; Cochran & Mays, 2000a; Hatzenbuehler, et al., 2009; Sandfort, et al., 2001), or mania (Bostwick, et al., 2010; Hatzenbuehler, et al., 2009), and for any mood disorder (Barnes, et al., 2014; Bolton & Sareen, 2011; Hatzenbuehler, et al., 2009). However, a very complex pattern emerged where elevated levels were reported across SO dimensions among men and women.
except unsure identified women, and homosexually attracted or behaving women (Bostwick, et al., 2010).

**Summary.** A great majority of studies reported elevated levels of depression for all SM subgroups in all dimensions of sexual orientation (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies. Most effects were small or medium. Regarding subgroups, compared to homosexuals/LG individuals, the majority of studies reported the largest effects for bisexual individuals, whereas results for mostly heterosexual and questioning individuals are mixed. For SO identities, LG and bisexual individuals were comparable. More studies reported larger SO differences for males rather than the opposite, but several studies had comparable male and female effects. Studies of higher quality are in line with other studies. The few findings for other mood disorders (bipolar, dysthymia, etc.) are similar to depression.

**Attempting Suicide / Suicides**

**Adults.** Nearly all study results (98%) indicated elevated attempted suicide rates in general or across SM subgroups, genders, dimensions of SO (identity, behavior, attraction), regions, and in more recent studies. This outcome applied for lifetime suicide attempts (Bagley & Tremblay, 1997; Blosnich, Mays, & Cochran, 2014b; Chakraborty, et al., 2011; Cochran & Mays, 2000a; Cochran, et al., 2007; de Graaf, Sandfort, & ten Have, 2006; Fergusson, et al., 1999; Gilman, et al., 2001; Herrell et al., 1999; Husky, Guignard, Beck, & Michel, 2013; Lhomond & Saurel-Cubizolles, 2006; Oswalt & Wyatt, 2011; Pelts & Albright, 2014; Skegg, et al., 2003; Wang, et al., 2012; Wichstrom & Hegna, 2003), attempting suicide in the past 12 or 6 months (Blosnich & Bossarte, 2012; Cochran, et al., 2007; Gilman, et al., 2001; Hughes, et al., 2010b; Kerr, et al., 2013; Lhomond & Saurel-Cubizolles, 2006; Lian, Zuo, Lou, Gao, & Cheng,
2015; Lytle, et al., 2014; McNair, et al., 2005; Oswalt & Wyatt, 2011; Reed, Prado, Matsumoto, & Amaro, 2010; Wang, et al., 2014; Wang, et al., 2012), or in the past five years (Fergusson, et al., 2005). Most of the effects were large (58%).

**Adolescents.** Similarly, nearly all study results (98%) indicated elevated attempted suicide rates for SM adolescents for lifetime suicide attempts (Button, O’Connell, & Gealt, 2012; Eisenberg & Resnick, 2006; McMahon, Reulbach, Keeley, Perry, & Arensman, 2012; O’Connor, Rasmussen, & Hawton, 2014; O’Connor, Rasmussen, Miles, & Hawton, 2009b; Remafedi, et al., 1998; Wang, et al., 2012), past year attempts (Almeida, et al., 2009; Bostwick et al., 2014; Denny, et al., 2014; DuRant, Krowchuk, & Sinal, 1998; Faulkner & Cranston, 1998; Fleming, Merry, Robinson, Denny, & Watson, 2007; Garofalo, Wolf, Kessel, Palfrey, & DuRant, 1998; Hatzenbuehler, 2011; Hatzenbuehler, Birkett, Van Wagenen, & Meyer, 2014; Jiang, et al., 2010; Kann, et al., 2011; Lucassen, et al., 2014; Madge et al., 2011; Marshal et al., 2013b; Marshal, et al., 2012b; Mustanski, et al., 2014; Olshen, McVeigh, Wunsch-Hitzig, & Rickert, 2007; Pinhey & Millman, 2004; Robin et al., 2002; Saewyc et al., 2007; Seil, et al., 2014; Shields, et al., 2012; Stone, Luo, Lippy, & McIntosh, 2014a; Stone et al., 2014b; Taliaferro & Muehlenkamp, 2014; Wang, et al., 2012; Zhao, et al., 2010), in a 6 month follow up period (O’Connor, Rasmussen, & Hawton, 2009a), and in one study without a given timeframe (Lampinen, et al., 2006).

Reversed or close to zero differences were uncommon (2%) and only reported in specific subgroups (see supplemental table) (Olshen, et al., 2007; Saewyc, et al., 2007; Skegg, et al., 2003; Zhao, et al., 2010), and in the Add Health studies for certain waves and subgroups (see below). Overall, most of the effects were large (47%) or medium (33%).

**Add Health study.** In the Add Health Wave I study, SM youth had elevated rates of past year suicide attempts, overall (Russell & Joyner, 2001; Williams & Chapman, 2011), for all subgroups (mostly heterosexual, bisexual, mostly LG), except for LG depressed youth in one
study (Cardom, et al., 2013). Similar effects applied (no subgroup analysis) in Wave II (Fried, Williams, Cabral, & Hacker, 2013) and Wave III (Fried, et al., 2013; Silenzio, Pena, Duberstein, Cerel, & Knox, 2007). In Wave IV, elevated attempted suicide rates were reported for minority women but reversed effects existed for all dimensions among men (Almazan, Roettger, & Acosta, 2014). In one study of men and women combined, a negative effect was reported only for mostly LG, not for all other SM subgroups (mostly heterosexuals, bisexuals, LG) (Cardom, et al., 2013).

**Lifetime vs. Past Year.** There are mixed findings: larger effects for lifetime compared to past year attempts were reported in some studies, (Hidaka et al., 2008; Wang, et al., 2012), but not in others (Cochran, et al., 2007; Lhomond & Saurel-Cubizolles, 2006), with comparable effects sometimes reported (Gilman, et al., 2001; Oswalt & Wyatt, 2011).

**Subgroup Differences.** The majority of studies reported the largest effects for bisexual individuals, compared to homosexuals (Bagley & Tremblay, 1997; Blosnich & Bossarte, 2012; Denny, et al., 2014; Hatzenbuehler, 2011; Hatzenbuehler, et al., 2014; Hughes, et al., 2010b; Kerr, et al., 2013; Olshan, et al., 2007; Robin, et al., 2002; Wang, et al., 2014), with only a few studies reporting comparable or smaller effects among bisexual compared to homosexual individuals, sometimes only in subgroups (Button, et al., 2012; McNair, et al., 2005; Saewyc, et al., 2007). However, the dimension of SO is crucial, as bisexuals had elevated risk only for the behavioral dimension but not the identity dimensions in adolescents (Kann, et al., 2011; Stone, et al., 2014b), a detailed description being available elsewhere (Ramsay & Tremblay, 2015).

Many studies reported that mostly heterosexuals had comparable or smaller effects than homosexual individuals (Fergusson, et al., 2005; McNair, et al., 2005; Saewyc, et al., 2007; Wang, et al., 2014), and one study reported the opposite (Hughes, et al., 2010b). Those
questioning their identity had smaller effects than homosexuals (Hatzenbuehler, et al., 2014; Kann, et al., 2011; Stone, et al., 2014b; Zhao, et al., 2010)

**Gender.** A clear majority of studies reported larger effects among men, compared to women (Almeida, et al., 2009; Cochran, et al., 2007; de Graaf, et al., 2006; Hidaka, et al., 2008; Husky, et al., 2013; Lucassen, et al., 2014; O'Connor, et al., 2014; O'Connor, et al., 2009b; Olshen, et al., 2007; Pinhey & Millman, 2004; Remafedi, et al., 1998; Saewyc, et al., 2007; Skegg, et al., 2003); only one study reported an opposite effect (Almazan, et al., 2014).

Comparable effects among men and women were reported in a few studies (Bostwick, et al., 2014; Eisenberg & Resnick, 2006; Russell & Joyner, 2001; Stone, et al., 2014a; Stone, et al., 2014b)

**Higher quality studies.** All higher quality studies reported increased risks for attempting suicide among SM individuals, with exceptions for suicides.

**Suicides.** Only few studies about death by suicide are available. In the Danish registry data, same-sex-registered partners had higher rates of suicides compared with heterosexual married individuals. This difference was of medium size in the first study (men and women combined) (Qin, 2005). In a second study, the effect was large for men and small for women (Mathy, Cochran, Olsen, & Mays, 2011) but medium effect for men and large for women in a third study (Frisch & Simonsen, 2013). The latter study also reported higher suicide rates for long-term same-sex cohabiting compared to opposite-sex cohabiting individuals (medium effect among men, small for women). No suicide occurred in the male NHANES study among the 85 males who had sex with males at least once in life (Cochran & Mays, 2011) but the study is underpowered and thus highly inconclusive (Plöderl et al., 2013). Furthermore, the study sample is likely compromised given that 98% of homosexually oriented suicide attempters (lifetime) were in the 17-29 age group, and essentially none in the 30 to 39 age group, whereas the
heterosexual suicide attempter percentages were not significantly different in both age groups. Thus, a significant proportion of at-risk SM males may not have participated in the study (Tremblay, n.d.). In the General Social Survey, SM status was based on any lifetime sexual behavior and SM males had nonsignificant lower suicide rates (medium effect), SM women had significantly higher rates (large effect) (Cochran & Mays, 2015). In two psychological autopsy studies with living control groups, SM youth were overrepresented in deaths by suicide (Renaud, Berlim, Begolli, McGirr, & Turecki, 2010; Shaffer, Fisher, Hicks, Parides, & Gould, 1995). In the original study, a no-difference effect was reported, but this is incorrect, and the effect size is large (Plöderl, et al., 2013)

**Summary.** Nearly all studies reported elevated rates of suicide attempts in general or across SM subgroups in all dimensions of sexual orientation (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies. Most effects were large. Regarding subgroups, compared to homosexuals/LG individuals, the majority of studies produced larger effects for bisexuals, comparable or smaller effects for mostly heterosexuals and smaller effects for questioning individuals. With respect to SO identity, the differences between bisexual and LG individuals were less pronounced or absent. The majority of studies had larger SO differences for males than females. Studies of higher quality are in line with other studies. Only few studies of SM suicide exist. The youth autopsy studies had an SM overrepresentation and the Danish data produced elevated rates of suicide for same-sex registered partners or households with long-term cohabiting same-sex adults. Of two US follow-up studies, one is too underpowered and inconclusive, and the other reported an increase of suicide rates among same-sex active women but not men.

**Anxiety Disorders**
**Adults.** A majority of study results (83%) indicated elevated levels of anxiety or rates of anxiety disorders [panic attacks (PD), generalized anxiety disorders (GAD), phobias] in general or across SM subgroups in all dimensions of SO (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies.

These findings were replicated for varied assessment methods: structured clinical interviews or medical charts (Barnes, et al., 2014; Bolton & Sareen, 2011; Bostwick, et al., 2010; Chakraborty, et al., 2011; Cochran & Mays, 2000b, 2009; Cochran, et al., 2007; Cochran, et al., 2003; Fergusson, et al., 1999; Fergusson, et al., 2005; Frisell, et al., 2010; Gattis, et al., 2012; Gilman, et al., 2001; Hatzenbuehler, et al., 2009; Sandfort, et al., 2001), questionnaires (Jorm, et al., 2002; Rath, et al., 2013; Said, et al., 2013), single items (Kerr, et al., 2013; McNair, et al., 2005; Oswalt & Wyatt, 2011; Sandfort, et al., 2009), and treatment/diagnosis by professionals, as reported by participant (Brennan, et al., 2010; Burgess, et al., 2007; Grant, et al., 2014; Hughes, et al., 2010b; McNair, et al., 2005; McNair, et al., 2011; Oswalt & Wyatt, 2011; Pelts & Albright, 2014; Tjepkema, 2008).

Some study results (17%) indicated close to zero differences or reversed effects among women (Cochran, et al., 2007) or for more specific SM subgroups, anxiety disorders, age groups, or period or of assessment. However, no specific pattern emerged (see supplemental table) in these studies (Bolton & Sareen, 2011; Bostwick, et al., 2010; Cochran & Mays, 2009; Gilman, et al., 2001; McNair, et al., 2005; Oswalt & Wyatt, 2011; Sandfort, et al., 2009; Sandfort, et al., 2001). Most of the effects were small (35%) or medium (39%) sized.

**Adolescents.** All of the few studies reported elevated levels of anxiety among SM youth, either assessed by questionnaires (Hatzenbuehler, et al., 2008b; Marshal, et al., 2013b; Marshal, et al., 2012b; Williams & Chapman, 2011) or via diagnosis by health professionals, as reported by the youth (Strutz, et al., 2015). The effects were mostly medium sized.
**Lifetime vs. past year.** The results were comparable for lifetime and past year assessments (Barnes, et al., 2014; Bostwick, et al., 2010; Cochran, et al., 2007; Gilman, et al., 2001; Sandfort, et al., 2009; Sandfort, et al., 2001).

**Subgroup differences.** For bisexuals, the findings are mixed. Bisexuals had larger effects than homosexual/LG in several studies (Hughes, et al., 2010b; Jorm, et al., 2002; Kerr, et al., 2013; McNair, et al., 2005; McNair, et al., 2011; Said, et al., 2013; Tjepkema, 2008), or only among women (but reversed for men) (Bolton & Sareen, 2011; Bostwick, et al., 2010). In several other studies bisexuals had comparable or smaller effects than homosexual / LG individuals (Brennan, et al., 2010; Fergusson, et al., 2005; Oswalt & Wyatt, 2011; Rath, et al., 2013; Sandfort, et al., 2009) or only among the older women (McNair, et al., 2005). Mostly heterosexuals had comparable or smaller effects than homosexuals (Hughes, et al., 2010b; McNair, et al., 2005; McNair, et al., 2011) and there was a complex pattern in one study (Bostwick, et al., 2010). Questioning individuals had smaller or comparable effects than homosexuals (Bolton & Sareen, 2011; Bostwick, et al., 2010; McNair, et al., 2005; Oswalt & Wyatt, 2011; Rath, et al., 2013)

A complex pattern occurred for panic attacks and generalized anxiety disorder for LG, bisexual, and mostly heterosexual men and women (Cochran & Mays, 2009). In one study, men and women identified as heterosexual, but with some homosexual behavior or attraction, scored between behavior concordant heterosexuals and homosexuals for GAD, except for heterosexual women with homosexual behavior who had lower levels than concordant heterosexual women (Gattis, et al., 2012)

**Gender.** Most studies reported larger effects among men than women (Cochran & Mays, 2000b; Cochran, et al., 2007; Frisell, et al., 2010; Sandfort, et al., 2001), but this was only for homosexual and not bisexual men in one study (Bolton & Sareen, 2011). One study had
comparable effects for men and women (Strutz, et al., 2015) and some reported mixed findings, depending on SO subgroup (Bostwick, et al., 2010; Tjepkema, 2008) or type of anxiety disorder (Cochran, et al., 2003).

**Higher quality studies.** The results of high-quality studies are in line with the other studies. A majority reported elevated anxiety problems/disorders for SM men and women (Barnes, et al., 2014; Bolton & Sareen, 2011; Chakraborty, et al., 2011; Cochran & Mays, 2000a; Cochran, et al., 2003; Fergusson, et al., 1999; Fergusson, et al., 2005; Frisell, et al., 2010; Hatzenbuehler, et al., 2009), and many studies reported negative findings for women (Bostwick, et al., 2010; Cochran & Mays, 2009; Cochran, et al., 2007; Gattis, et al., 2012; Gilman, et al., 2001; Sandfort, et al., 2001) or men (Gilman, et al., 2001).

**Summary.** A clear majority studies on adults and all studies on adolescents reported elevated SM anxiety levels/rates in general or across different dimensions of SO (identity, behavior, attraction), genders, age groups, regions, and in more recent studies. Zero or reversed effects were reported in some studies, mostly for female adults, and for some subgroups of SM. Most effects were small or medium. Regarding subgroups, compared to homosexuals/LG individuals, bisexuals had elevated levels/rates in several studies but comparable in others. Mostly heterosexual and questioning individuals had comparable or smaller differences than homosexuals. The majority of studies reported larger effects for males than females. Studies of higher quality are in line with other studies.

**Alcohol and Drug Use**

To reduce complexity, only recent binge/risky drinking, alcohol dependency (AD), drug dependency (DD) and recent use of illicit drugs (including marijuana) are summarized. For drug use/disorder, the majority of study results (93% for adults and 94% for adolescents) indicated an
increased risk among SM individuals in general or across SM subgroups in all dimensions of SO (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies. For alcohol abuse/disorder, the results were mixed, and the majority of study findings for adults indicated no/reversed effects (31%) or small effects (32%) especially for males and certain SM subgroups (for adolescents, 35% of effects were zero/reversed and 52% were small, respectively).

Przedworski, McAlpine, Karaca-Mandic, & VanKim, 2014; Reczek, Liu, & Spiker, 2014; Reed, et al., 2010; Rhodes, McCoy, Wilkin, & Wolfson, 2009; Rothman, et al., 2012; Sandfort, Bakker, Schellevis, & Vanwesenbeeck, 2006; Schauer, et al., 2013; Steele, et al., 2009; Talley, Hughes, Aranda, Birkett, & Marshal, 2014) and drugs (Bowring, et al., 2015; Cochran, et al., 2012; Conron, Mimiaga, & Landers, 2010; Hughes, et al., 2010b; Julien, et al., 2008; Kerr, et al., 2015; Lhomond, et al., 2014; McCabe, Boyd, Hughes, & d'Arcy, 2003; McCabe, Hughes, Bostwick, & Boyd, 2005; McCabe, Hughes, Bostwick, Morales, & Boyd, 2012; Mercer, et al., 2007; Pope, et al., 2001; Reed, et al., 2010; Rhodes, et al., 2009; Ridner, Frost, & LaJoie, 2006; Rothman, et al., 2012; Skegg, et al., 2003; Ueno, 2010a) and with treatment/diagnosis by professionals, as reported by participants for drugs (Pelts & Albright, 2014).

For alcohol, close to zero differences or reversed effects were reported overall (Bloomfield, 1993; Blosnich & Silenzio, 2013; McCabe, et al., 2003; McCabe, et al., 2012; Reed, et al., 2010; Rhodes, et al., 2009) or for specific subgroups, but without a clear-cut pattern (see supplemental table) (Bloomfield, et al., 2011; Boehmer, et al., 2012; Brennan, et al., 2010; Cochran & Mays, 2000a; Cochran, et al., 2007; Conron, et al., 2010; Dilley, et al., 2010; Eisenberg & Wechsler, 2003; Ericksen & Trocki, 1994; Farmer, Bucholz, Flick, Burroughs, & Bowen, 2013a; Farmer, et al., 2013b; Gilman, et al., 2001; Jorm, et al., 2002; Kerr, et al., 2015; Kerr, Ding, & Chaya, 2014; King & Nazareth, 2006; Lhomond, et al., 2014; Matthews & Lee, 2014; McCabe, et al., 2005; McCabe, et al., 2009; Midanik, et al., 2007; Ridner, et al., 2006; Sandfort, et al., 2001; Schauer, et al., 2013; Talley, et al., 2014).

Zero/negative effects for drugs were reported in certain subgroups, and again, no specific pattern emerged (see supplemental table) (Cochran & Mays, 2000b; Eisenberg & Wechsler, 2003; Ford & Jasinski, 2006; Gattis, et al., 2012; Hughes, et al., 2010a; Hughes, et al., 2010b;

The effect sizes for alcohol were mostly near zero or reversed for men (53%) and small (30%) or medium (33%) for women. For drugs, most effects were small (39%) or medium (39%) for men and medium (31%) or large (45%) for women. Generally, it seemed that the effects sizes for marijuana were generally smaller than for other illicit drugs and especially harder drugs.


For alcohol, zero/reversed effects were reported overall (Hatzenbuehler, et al., 2012; Lucassen, et al., 2014), or for certain subgroups: gay/homosexuals but not bisexuals (Mustanski, et al., 2014; Robin, et al., 2002); bisexual men but not gay men and lesbian or bisexual women (Hagger-Johnson, et al., 2013), questioning individuals (Button, et al., 2012), or for less severe alcohol problems (Faulkner & Cranston, 1998; Tucker, et al., 2008). Some studies reported complex patterns, depending on gender/SM subgroup and SO dimension, with lacking/reversed effects especially for the behavioral dimension (Hatzenbuehler, Corbin, & Fromme, 2008a; Kann,
et al., 2011; Matthews, Blosnich, Farmer, & Adams, 2014; Ortiz-Hernandez, et al., 2009; Talley, et al., 2014), and, prospectively, for older youth (Pesola, et al., 2014).

For drug use/disorders, only few studies reported negative/reversed effects, and only in certain subgroups: gay/homosexual but not bisexual individuals (Robin, et al., 2002), questioning individuals (Button, et al., 2012), or for marijuana (at least for certain subgroups) but not for harder drugs (Faulkner & Cranston, 1998; Kann, et al., 2011; Mustanski, et al., 2014; Orenstein, 2001).

The effect sizes for alcohol were mostly near zero or reversed for males (50%) and mostly small for females (55%), whereas for drug related problems, most effects were small (29%) to medium (43%) for men and medium (50%) for women.

**Add-Health and GUTS studies.** Similar patterns appeared in the two longitudinal studies. Add Health study: Wave I studies reported elevated levels of alcohol use/abuse among girls (Marshal et al., 2012a) and overall (Russell & Joyner, 2001). Wave II studies reported no/reversed effect for binge drinking for both SM males and females (Hahm, Wong, Huang, Ozonoff, & Lee, 2008). For Wave I and II combined, binge drinking was elevated among SM girls but not SM boys, illicit drug use was significantly elevated for SM girls and boys but with near-zero magnitude for boys (Pearson & Wilkinson, 2013). In studies on Wave III, binge drinking was elevated among LG but not B participants, but drug use was elevated in all groups (McLaughlin, et al., 2012). Another study using identity reported elevated binge drinking rates for lesbian and bisexual females but not among their male counterparts, whereas hard-drug use was elevated among all subgroups (Needham & Austin, 2010). In Wave IV, close to zero effects were reported for binge drinking among gay men but not for bisexual men/women and lesbian women, whereas for drug use, there were elevated levels in all subgroups (Almazan, et al., 2014; Marshal, et al., 2008).
In the GUTS Wave I study, binge drinking effects were reported for LGB adolescents, but there were reversed effects for questioning adolescents (Ziyadeh, et al., 2007). In waves I-III, complex alcohol abuse patterns appeared, depending on variables, gender, and SM subgroups, and some close to zero effects were reported for gay and lesbian adolescents (Corliss, Rosario, Wypij, Fisher, & Austin, 2008). Binge drinking was elevated in lesbian/gay and mostly heterosexual but not in bisexual participants (Rosario, et al., 2014a). In contrast, for marijuana and other illicit drugs, there were SO differences in all subgroups (Corliss et al., 2010; Rosario, et al., 2014a).

**Lifetime vs. past year.** Studies reporting lifetime vs. current problems had comparable effects (Gilman, et al., 2001; Kerr, et al., 2014; Sandfort, et al., 2001)

**Subgroup differences.** In contrast to other mental health problems, there was not a clear majority of studies reporting elevated levels of alcohol/drug abuse/dependency for bisexuals compared to homosexuals (Balsam, et al., 2012; Brennan, et al., 2010; Burgard, et al., 2005; Button, et al., 2012; Dilley, et al., 2010; Ford & Jasinski, 2006; Jorm, et al., 2002; Kerr, et al., 2015; Kerr, et al., 2014; Loosier & Dittus, 2010; Mercer, et al., 2007; Mustanski, et al., 2014; Newcomb, et al., 2014; Robin, et al., 2002). Sometimes this was only among women but not men (Conron, et al., 2010; McCabe, et al., 2009). Several studies reported that bisexuals had comparable or smaller risk than homosexual individuals (Blosnich, et al., 2014a; Boehmer, et al., 2012; Bolton & Sareen, 2011; Cochran & Mays, 2009; Diamant, et al., 2000; Drabble, et al., 2005; Hughes, et al., 2010a; McLaughlin, et al., 2012; Przedworski, et al., 2014; Rosario, et al., 2014a; Said, et al., 2013; Schauer, et al., 2013; Steele, et al., 2009), and there were mixed findings depending on the substance (Corliss, et al., 2010; Hughes, et al., 2010b) or on SM subgroups (Hagger-Johnson, et al., 2013; Kann, et al., 2011; Matthews, et al., 2014; McCabe, et al., 2012; Midanik, et al., 2007; Needham & Austin, 2010).
Mostly heterosexuals had comparable or smaller effects compared to homosexuals in the majority of studies (Corliss, et al., 2010; Hughes, et al., 2010b; Rosario, et al., 2014a; Ziyadeh, et al., 2007) and larger effects in one study (Cochran & Mays, 2009). Questioning individuals were, compared to homosexuals, at lower risk in the majority of studies (Bolton & Sareen, 2011; Button, et al., 2012; Hughes, et al., 2010a; Kann, et al., 2011; McCabe, et al., 2009; Zhao, et al., 2010; Ziyadeh, et al., 2007). They had comparable risk (Newcomb, et al., 2014), higher risk (Birkett, et al., 2009), or comparable risk only among women but higher risk among men (Poteat, et al., 2009), always compared to homosexual individuals.

**Gender.** Larger effects among women than men were reported in the majority of studies (Bloomfield, et al., 2011; Boehmer, et al., 2012; Bolton & Sareen, 2011; Cochran, et al., 2007; Cochran, et al., 2003; Corliss, et al., 2010; Dilley, et al., 2010; Drabble, et al., 2005; Eisenberg & Wechsler, 2003; Farmer, et al., 2013a; Farmer, et al., 2013b; Frisell, et al., 2010; Grella, et al., 2011; Gruskin & Gordon, 2006; Hughes, et al., 2010a; Kerr, et al., 2014; King & Nazareth, 2006; McCabe, et al., 2003; Needham & Austin, 2010; Ortiz-Hernandez, et al., 2009; Pearson & Wilkinson, 2013; Ridner, et al., 2006; Sandfort, et al., 2001; Schauer, et al., 2013). Comparable effects among men and women were reported in fewer studies (Balsam, et al., 2012; Blosnich, et al., 2014a; Cochran & Mays, 2009; Fredriksen-Goldsen, et al., 2013; Hagger-Johnson, et al., 2013; Lucassen, et al., 2014; Pesola, et al., 2014; Skegg, et al., 2003) and some reported mixed findings, depending on SO subgroups (Conron, et al., 2010; Ford & Jasinski, 2006; Matthews, et al., 2014; McCabe, et al., 2012; Midanik, et al., 2007; Poteat, et al., 2009) or changing effects over time (Hatzenbuehler, et al., 2008a), or type of dependency or drug (Gilman, et al., 2001; Orenstein, 2001). Only one study reported larger effect for men (Ericksen & Trocki, 1994).

**Higher quality studies.** By our definition, studies with higher quality are those using clinical interviews that assess disorders of substance abuse or dependency. For alcohol, the
majority of studies (83%) reported increased levels/rates of alcohol disorders for SM individuals (Bolton & Sareen, 2011; Chakraborty, et al., 2011; Cochran & Mays, 2000b, 2009; Cochran, et al., 2003; Fergusson, et al., 2005; Frisell, et al., 2010; McCabe, et al., 2009). Few studies reported reversed effects in some subgroups, for example in bisexual men (Drabble, et al., 2005), among men but not/less among women (Cochran, et al., 2007; Gilman, et al., 2001; Sandfort, et al., 2001) (but effect for lifetime in the Gilman study), or no effects only among bisexual identified men and for behavior (but not identity) among HO women (Midanik, et al., 2007).


**Summary.** For alcohol related problems, a majority of studies reported small, near zero, or reversed effects, whereas for drug related problems most studies reported elevated SM levels in general or across dimensions of SO (identity, behavior, attraction), genders, age groups, regions, and in more recent studies. The absent/reversed effects for alcohol were mostly reported for SM males, whereas for females, there were mostly small SO differences for alcohol related problems. For drugs, the effect sizes were small or medium for males and medium or large for females, and they were larger for other illicit drugs than marijuana, especially hard drugs. Regarding subgroups, compared to homosexual/LG individuals, bisexuals did not have larger effects in the majority of studies, but mostly heterosexual and questioning individuals had comparable or smaller effects. The majority of studies reported larger effects among females than males. In contrast to lower quality studies, studies with higher quality reported elevated levels of alcohol and drug problems among all SM subgroups.
Other Disorders

For other mental disorders, increased levels/rates also applied for SM individuals: for bulimia/anorexia higher for gay and bisexual males, less so for bisexual women, and not for lesbian women (Matthews-Ewald, Zullig, & Ward, 2014; Pelts & Albright, 2014), eating disorders for women but not men (Cochran, et al., 2007), OCD for SM veterans (Pelts & Albright, 2014), PTSD, with some subgroup exceptions (Gattis, et al., 2012; Gilman, et al., 2001; Grella, et al., 2011; Hatzenbuehler, et al., 2009), ADHD (Frisell, et al., 2010; Pelts & Albright, 2014; Strutz, et al., 2015; Wang, et al., 2014), schizophrenia or psychotic symptoms (Bolton & Sareen, 2011; Chakraborty, et al., 2011; Pelts & Albright, 2014), personality disorders, with scattered zero/reversed effects in some subgroups (Bolton & Sareen, 2011), oppositional defiant disorder and borderline personality in LB identified girls (Marshal, et al., 2012b). Antisocial Personality Disorder was not elevated among young mostly gay or bisexual men in Switzerland, but elevated levels (small effect) existed for mostly heterosexuals and mostly gay individuals (Wang, et al., 2014).

Older Versus Newer Studies.

Recently published studies are in line with older studies. Of importance are the YRBS, which have been replicated often and continue reporting elevated mental health risks among SM adolescents. A related replication study from New Zealand had comparable or even increasing effects from 2001 to 2012 for adolescent suicide attempters (Lucassen, et al., 2014), and a replication study from the Netherlands (not in this review) reported results similar to those in 1996 (Sandfort, de Graaf, ten Have, Ransome, & Schnabel, 2014).
Discussion

A majority of reviewed studies reported elevated levels/rates of mental health problems for SM individuals, including depression, anxiety, suicide attempts/suicides, and drug related mental health problems, compared to heterosexuals. The only exception was alcohol related mental health problems, where the majority of studies reported negative or near zero effect for males. However, in the majority of higher quality studies that used clinical diagnoses of alcohol dependency, SM individuals again had increased rates. SO differences were largest for attempting suicides/suicides, where most of the effect sizes were large, and they were smallest for alcohol related mental health problems. The increase of risk varied in magnitude and existed across SM subgroups in all dimensions of sexual orientation (behavior, attraction, identity), for both genders, age groups, regions, and in more recent studies. Thus, the main results of this review that included more recent studies are in line with older meta-analytic reports and reviews. However, given that most studies appeared only recently, there is now much more weight of evidence supporting the conclusions. Older studies and reviews have been criticized because they ignored result differences for gender or SO subgroups and dimensions, which could lead to distorted views about mental health problems for subgroups, for example overestimations among gay-identified individuals (Savin-Williams, 2008) Our review included several recent studies that used different dimensions of SO and with separate SO subgroup analysis. Indeed, there are differences, such that in the majority of studies, effects are larger for bisexuals and comparable or smaller for mostly heterosexuals and questioning individuals compared to homosexual individuals for most mental health problems. However, our review concludes that elevated risk, with varying degree, exists within all SM subgroups in the majority of studies. For example, among gay identified or homosexual attracted/behaving males, most studies nonetheless reported elevated rates/levels of depression and anxiety (mostly medium effects), suicide attempts (mostly
large effects), and drug abuse/disorder (mostly small effects). Only for alcohol abuse were there many studies reporting lower levels of alcohol abuse disorder, but not in the majority of higher quality studies. Thus, the assumption that certain SM subgroups are not at increased risk for mental health problems is not supported by the available data.

The review also supports the previously reported larger effects for males than females for all disorders except substance related disorders, where the majority of studies reported larger effects for females.

**Methodological Considerations**

Only studies that did not recruit SM individuals from gay/lesbian organizations were chosen for this review, based on the common assumption that this avoids biases inherent in convenience samples. Only one meta-analysis reported that SO differences are comparable or even smaller in random samples than in convenience samples (Meyer, 2003), but a recent single study found small opposite effects (Kuyper, et al., 2015). Both sampling approaches have their strengths and weaknesses (Meyer & Wilson, 2009), and an updated meta-analytical comparison would be fruitful. Until then, results from convenience samples - not included in our analysis - should be taken seriously.

Another critical issue in several studies is adjustment and weighing procedures. It is standard practice to adjust for sociodemographic variables to increase the validity of group differences. However, in several studies, this included variables such as marriage status, which is known to be associated with better mental health but only few SM individuals are married. Adjustment for such a variable may thus be inappropriate. In the same line, several studies used sampling weights to achieve representativeness. However, it remains an open issue if it is appropriate to use similar sampling weights for SM and heterosexual individuals given different population distributions. Furthermore, the number of SM individuals in the studies is rather
small and weighing may lead to grossly different percentage of SM individuals (Grella, et al., 2011) or SO differences (Husky, et al., 2013). The Cochran et al. 2000 NHANES study results were likely compromised given that the homosexually oriented small subsample of 108 males became 78 males (weighted, a 28% reduction), while the large sample of 3,208 heterosexual men became 3,212 (little change). For this reason, the CDC warned against using weighing procedures for small samples (CDC, 2015).

There is an ongoing debate about the validity of studies, especially for suicides and suicide attempts as outcomes (Plöderl, et al., 2013). Some SM individuals may refuse to participate, as in one study where three times (16.8 vs. 5.1%) more SM men were among those who initially refused to participate in a household survey (CDC, 1991). The associated bias remains unknown. A gold standard to assess mental health disorders are clinical interviews. However, fewer SM members disclose their homosexual behavior to interviewers compared with computer based methods (Villarroel et al., 2006). It is possible that non-disclosed SM individuals or those who refuse study participation may be at increased risk for mental health problems, a reasonable hypothesis given the negative psychological impact of a concealed stigma (Pachankis, 2007). On the other hand, those who report their SM status may also be more willing to report mental health problems than those not disclosing their SM status, leading to inflated estimation of SO differences. Furthermore, for suicidality, one study reported that gays and lesbians over-report mental health problems due to a suffering script (Savin-Williams, 2001) but other studies did not replicate these findings (Plöderl, Kralovec, & Fartacek, 2010; Plöderl, et al., 2013). Similarly, SO differences may be inflated by mischievous responses. However, as demonstrated in a study on adolescents SO disparities remained significantly after controlling for biases (Robinson-Cimpian, 2014) and it seems unlikely that such biases are influential in the studies on adults or when using clinical interviews.
These methodological caveats could lead to overestimations or underestimations of the actual SO differences and more research on biases would be helpful. However, by nature, research on hidden populations will never achieve top quality level. Unfortunately, this will leave room for those wanting to downplay or overstate the problem for other than scientific reasons. Following the principle of Ockham’s razor, we recommend not including additional unproven assumptions but to let the data speak for itself.

Despite the increase of mental health risk for SM people, it is important to acknowledge that the majority of SM individuals do not have a mental health problem. Furthermore, SO differences may be explained, in great part, by increased minority stressors (Hatzenbuehler, 2009; Meyer, 2003; Stall, Friedman, & Catania, 2008).

Limitations

As with all restricted search strategies, some studies are missed, for example, probability samples without a control group (Catania et al., 2001), unpublished data, studies in other databases, or those where the SO results are given as aside results. Given that PubMed covers a wide range of studies, similar conclusions would apply. For attempting suicide, we are certain about it, because the most exhaustive collection of international studies (Ramsay & Tremblay, 2015) is in line with our findings. In addition, the weight of the evidence in our review is strong, and it would take many studies with opposite findings to undermine the conclusions.

We tried to summarize subgroup and gender differences. However, only a meta-analysis could precisely quantify the differences but, as most studies vary in methodology, it will take more studies to accomplish this. In addition, there are certainly some more or less strong effects of race, education, or age that may have gone unnoticed in our review.

Conclusion
Our review includes more recent studies and supports the proposition that SM individuals are at increased risk for mental health problems. The risks vary within SM subgroups and gender and they are, as a rule, elevated in all subgroups.

**Disclosure of Commercial Interests**

**Declaration of interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.
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