



Sexual fluidity and BMI, obesity, and physical activity

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ARTICLE INFO

Keywords:

Sexual identity
Fluidity
BMI
Obesity
Physical activity

ABSTRACT

Analyzing reported changes in sexual identity over time is necessary for understanding young adult health risks. Utilizing waves 3 and 4 of the *National Longitudinal Study of Adolescent to Adult Health*, this paper studies the relationships between sexual identity changes and BMI, obesity, and physical activity among young adults in the U.S (N = 11,349). The results show that men who report a change toward a more homosexual identity have a significantly lower BMI and participate in more physical activity, while men who report a change toward a more heterosexual identity participate in less physical activity and have a higher BMI compared to those who did not report a change. For women, a change toward a more homosexual identity is significantly associated with more physical activity and lower odds of being obese compared to no change. The results suggest that specific sexual identity changes may also be linked to improvements in health.

1. Introduction

It is well established in the literature that sexual minorities report poorer health than their heterosexual counterparts, which encompasses increased rates of negative health behaviors, such as smoking and binge-drinking (Lindley, Walsemann, & Carter, 2012), mental health outcomes, such as depression and anxiety (Plöderl & Tremblay, 2015), and even certain physical health outcomes, such as heightened risk of cancer and cardiovascular disease (Lick, Durso, & Johnson, 2013). These disparities are commonly explained by the minority stress model by Meyer (Meyer, 2003), which proposes that sexual minorities experience unique and chronic stressors related to their disadvantaged status in society, which negatively influences their health. The model suggests that general stressors, distal minority stress processes, and proximal minority stress processes interact to create a hostile and stressful social environment that may impact health (Meyer, 2003). However, as Meyer's model focuses on mental health outcomes, it is not adequate to explain disparities in health behaviors. In an effort to expand Meyer's minority stress framework to explain physical health disparities, Lick and colleagues (Lick et al., 2013) argue that sexual minority physical health disparities are related to minority stress processes that follow exposure to sociocultural challenges, like social stigma. Specifically, the authors argue that experiencing sociocultural stressors leads to appraising those stressors, which leads to either psychosocial or physiological stress responses, which results in health behaviors and health status. Indeed,

recent studies have connected minority stress to various physical health concerns (Denton, 2012; Frost, Lehavot, & Meyer, 2015; Woodford, Howell, Silverschanz, & Yu, 2012).

The relationship between sexual orientation and health is undoubtedly complex, particularly as sexual orientation can shift throughout the life course (Diamond, 2005; Mock & Eibach, 2012). Past research has shown that sexual fluidity – referred to as “situation-dependent flexibility in sexual responsiveness” (Diamond, 2015) and operationalized as identity in this study – in young adulthood is fairly common (M Rosario, Schrimshaw, Hunter, & Braun, 2006; Savin-Williams, Joyner, & Rieger, 2012); a certain degree of fluidity is even considered a general property of sexuality among young adults (Weinberg, Williams, & Pryor, 1994). For example, Diamond et al. conducted a 10 year longitudinal study and found that among 79 young adult women, 67% reported changing their sexual identity labels at least once, and 36% reported changing their labels two or more times (Diamond, 2008). Naturally, sexual fluidity is bi-directional, such that it can represent a change towards homosexuality or towards heterosexuality (Katz-Wise, 2015). A consistent theme from previous work on sexual fluidity is that women are more sexually fluid than men (Diamond, 2008; Dickson, Paul, & Herbison, 2003; Ott, Corliss, Wypij, Rosario, & Austin, 2011). Suggested theoretical models for the hypothesized greater sexual fluidity in women than men span from biologically based sex differences to factors such as constraining self-concept and expression (Baumeister, 2000; Savin-Williams & Cohen, 2004). Both retrospective and prospective studies have been

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<https://doi.org/10.1016/j.ssmph.2020.100620>

Received 28 April 2020; Received in revised form 2 June 2020; Accepted 21 June 2020

Available online 27 June 2020

2352-8273/© 2020 The Author(s).

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conducted, and sexual minority women and bisexual men appear to report the most change in sexual identity, followed by gay men, with heterosexual men and women reporting the least (Diamond, 2015; Kinnish, Strassberg, & Turner, 2005; Manley, Diamond, & Van Anders, 2015; Mock & Eibach, 2012; M; Rosario et al., 2006). Notably, heterosexuality is the predominant sexual orientation identity and least likely to change overtime (Kinnish et al., 2005).

It has been theorized, albeit with mixed evidence, that the time surrounding sexual identity change consists of elevated levels of cognitive dissonance (between thoughts and attitudes regarding identity) and increased risk of poor mental health functioning (Coleman, 1982), as disturbances in conceptions of the self and disruptions in the identity process are known to create significant strain (Burke, 1991; Cass, 1979; Coleman, 1982). A change in sexual identity can also result in loss of community, loss of social status, and decreased access to social or emotional resources (e.g. from family members) (Ott et al., 2011). Young adults with a sexual orientation that is fluid are vulnerable to negative social reactions (M Rosario et al., 2006). Notably, young adults in general often lack adequate coping resources; thus, they may be more inept at dealing with stressful events, resulting in enhanced strain (Biggart, A., & Walther, 2006). As an additional explanation, individuals who experience changes in sexual identity often express that such changes are unexpected and beyond their control (Diamond, 2015). A lack of choice in sexual fluidity, and sexual identity in general, is theorized to cause greater confusion and psychological unrest (Diamond, 2015).

These challenges may be exacerbated for individuals changing toward more homosexual identities, possibly due to incongruence with societal norms and the potential for rejection and isolation (D'Augelli & Grossman, 2001; Margaret; Rosario, Schrimshaw, & Hunter, 2009). In fact, changes in sexual orientation identity toward more homosexual identities have been found to be associated with increases in depressive symptoms (B. Everett, 2015; B. G. Everett, Talley, Hughes, Wilsnack, & Johnson, 2016). However, it must also be acknowledged that a change in sexual identity, if assumed to come after a period of uncertainty and dissonance, may also result in less depression. Similarly, it may also result in gaining a community and resources (depending on the social context and direction of the change).

Of the past research that has examined the health-related consequences of this fluidity, findings argue that sexual fluidity is associated with depression, suicidal thoughts and behaviors, marijuana use, tobacco use, and binge drinking in young adults (B. Everett, 2015; Fish & Pasley, 2015; Ott et al., 2013). Further research of other potential health risks of this fluidity is necessary and important for public health, as changes in reported sexual identity over time may be as important as current sexual orientation for understanding young adult health risks (Ott et al., 2013). To address this gap in the literature, we examine the potential associations that sexual fluidity has with body mass index (BMI), obesity, and physical activity using. These outcomes are important indicators of overall health and are of particular issue among Americans, as only 1 in 5 American adults meet the recommended guidelines of physical activity and one-third are obese (Centers for Disease Control and Prevention, 2014; U.S. Department of Health and Human Services, 2008). Further, these indicators are agreed to vary by sexual orientation, such that sexual minorities are at increased risk of obesity and low physical activity (Bowen, Balsam, & Ender, 2008; Calzo et al., 2014; Deputy & Boehmer, 2010, 2014; Mereish & Poteat, 2015).

Sexual fluidity may influence BMI, obesity, and physical activity indirectly and directly. Indirectly, this work conceptualizes sexual identity change as a stressful life event that can influence BMI, obesity, and physical activity through its impact on mental health. These indicators are undoubtedly influenced by one's mental state. More specifically, individuals with depression tend to be less physically active than non-depressed individuals (Paluska & Schwenk, 2000; Vancampfort et al., 2015) and depression significantly increases the odds for developing obesity and reporting a higher BMI (albeit differentiated by

gender) (Dragan & Akhtar-Danesh, 2007; Luppino et al., 2010). Empirical support exists for depression acting as a mediator between sexual orientation identities and various health behaviors, such as sleep, smoking, suicidality, and risky sex practices (Blosnich, Lee, & Horn, 2013; Fricke & Sironi, 2017; Frost, Parsons, & Nanín, 2007; Russell & Joyner, 2001); however, to our knowledge, this is the first work to assess whether the proposed associations between sexual fluidity and weight and physical activity are (partially) explained by mental health. As described here, past research has linked to sexual fluidity, weight, and physical activity separately.

In addition to an indirect effect, sexual fluidity may also impact BMI, obesity, and physical activity directly; the explanation for this differs depending on the direction of the change. For those who change toward a homosexual identity, experiences of minority stress may influence these outcomes. Explained by the minority stress framework proposed by Lick and colleagues (Lick et al., 2013), potential minority stressors, such as heightened stigma, harassment, and discrimination, particularly in physical activity settings (Gill, Morrow, Collins, Lucey, & Schultz, 2010), those who change toward a more homosexual identity may report greater BMI, higher prevalence of obesity, and lower levels of physical activity. However, for individuals that change toward more a more heterosexual identity, the minority stress framework is not sufficient for explaining variations in BMI, obesity, and physical activity, as minority stressors may no longer be pertinent. These variations may be explained by cultural and gender norms and experiences of internalizing ideals of femininity and masculinity, which include ideas about appearance and body image (Calzo, Corliss, Blood, Field, & Austin, 2013; Katz-Wise et al., 2014). For instance, although evidence is mixed, a more muscular body type and physical activity participation may be more of a means to define masculinity for heterosexual males (Adams, Anderson, & McCormack, 2010), as compared to sexual minority males. Further, heterosexual women have smaller ideal body shapes and higher weight control motives than sexual minority women (Conner, Johnson, & Grogan, 2004). Lesbian women, in particular, have traditionally rejected unhealthily thin body images and are less preoccupied with their weight in general (Swami & Tovée, 2006), which may stem from a collective criticism of patriarchal edicts of beauty (McPhail & Bombak, 2015).

Although much less research has been conducted on bisexual/plurisexual identities, studies suggest that there is a "cultural conflation" of femininity/masculinity and homosexuality for both bisexual men and women (Filiault, Drummond, & Anderson, 2012; Huxley, Clarke, & Halliwell, 2014). Even so, their chosen social environments may drive their internalized body ideals; for example, empirical work with bisexual women suggests that those who integrate into lesbian communities are less receptive to mainstream body ideals of thinness (Johns, 2016). However, as this work dichotomizes sexual fluidity (towards more heterosexual or more homosexual identities), we are unable to evaluate more nuanced changes of sexual identity, such as a change from mostly heterosexual to bisexual.

Utilizing wave 3 and 4 of *The National Longitudinal Study of Adolescent to Adult Health (Add Health)*, this study aims to answer the question, "Does sexual fluidity influence BMI, obesity, and physical activity among young adults?" In coordination with the theoretical underpinnings outlined above, we hypothesize that compared to those who do not change their sexual identity, individuals who change toward a more homosexual identity report a higher BMI, higher prevalence of obesity, and/or less physical activity based on both the direct and indirect effects discussed above, while individuals who change toward a more heterosexual identity may be more likely to report a lower BMI, lower prevalence of obesity, and/or more physical activity based on the direct effect, but opposite outcomes for the indirect effect. Further, consistent with the minority stress framework and theories regarding identity change, we hypothesize that individuals who report a change toward a more homosexual identity report a higher BMI, higher prevalence of obesity, and/or less physical activity than those who report a

change toward a more heterosexual identity. Finally, we hypothesize that the associations between sexual identity change and BMI, obesity, and physical activity are affected by the inclusion of depression in the models.

2. Material and methods

This research utilizes wave 3 and 4 [restricted use] of *Add Health*. *Add Health* is a longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States during the 1994–1995 school year. The *Add Health* cohort has been followed into young adulthood with four in-home interviews. The third wave has been collected in 2001–2002 when the sample was aged 18–26, and the most recent wave in 2008, when the sample was aged 24–32. *Add Health* combines longitudinal survey data on respondents' social, economic, psychological, and physical well-being with contextual data on the family, neighborhood, community, school, friendships, peer groups, and romantic relationships.

The analyses were restricted to respondents that were interviewed both in Wave 3 and Wave 4 and were assigned a probability weight at wave 4 ($N = 12,288$). Further, 204 individuals were excluded who did not answer the sexual identity question in wave 3 and wave 4 (or answered that they were “not sexually attracted to either males or females,” given that it would be problematic to recode a change of identity for this group) and 735 individuals were excluded who did not have information on the other variables included either in wave 3 or wave 4 (physical activity, BMI, obesity, depression and the other confounders). The final sample consisted of 11,349 respondents: 5949 women and 5400 men.

2.1. Outcome variables

Three different dependent variables from Wave 4 are used in this analysis regarding physical activity, obesity, and BMI. The level of physical activity is measured through a variable that counts the *number of physical activities in the past seven days*. Respondents are asked the question, “In the past seven days, how many times did you ...” seven different times, with each question referencing specific activities: (1) bicycle, skateboard, dance, hike, hunt, or do yard work; (2) rollerblade, roller skate, downhill ski, snowboard, play racquet sports, or do aerobics; (3) participate in strenuous team sports such as football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey; (4) participate in individual sports such as running, wrestling, swimming, cross-country skiing, cycle racing, or martial arts; (5) participate in gymnastics, weight lifting, or strength training; (6) play golf, go fishing or bowling, or play softball or baseball; (7) walk for exercise. By summing the answers to these seven questions, a variable is built that goes from 0 to 49 (where 49 means 7 or more times a week for all of the activities). Obesity is measured with a dichotomous variable equal to 1 if the respondent reports to be obese (BMI equal or greater than 30), and 0 otherwise (Centers for Disease Control and Prevention, 2012, pp. 8–9). Women who are pregnant in Wave 4 are excluded from the analysis. Including BMI, in addition to obesity, enables us to take into account the full distribution and evaluate more nuanced changes. BMI is measured using a continuous variable that ranges from 14.4 to 80.4 and is based on self-reported height (inches) and weight (pounds).

2.2. Independent variable

In both wave 3 and wave 4, individuals in the sample are asked about their sexual identity, the predictor variable in the analysis. Sexual identity in this case refers to sexual orientation identity, which is when individuals identify with a sexual orientation or choose not to identify with a sexual orientation (American Psychological Association, 2009, pp. 1–138). The sexual identity variable is a categorical variable based on the question, “Please choose the description that best fits how you

think about yourself.” The categories given are “100% heterosexual (straight),” “mostly heterosexual (straight), but somewhat attracted to people of your own sex,” “bisexual that is, attracted to men and women equally,” “mostly homosexual (gay), but somewhat attracted to people of the opposite sex,” “100% homosexual (gay),” “not sexually attracted to either males or females,” “refused,” and “don't know”; respondents in this last three categories have been excluded from the analysis. A categorical variable is created that looks at the direction of the change between waves: no change, a change toward more homosexual identities, and a change toward more heterosexual identities. More detailed changes in sexual identity between waves could be identified, but the sample size of the subgroups that experienced specific changes would have been too small to allow for a robust analysis.

2.3. Confounders

Depression at Wave 4 is used as a control variable in the analysis. It is a previously constructed variable based on the well-validated CES-D scale (Irwin, Artin, & Oxman, 1999), and ranges from 0–15: the higher the score, the higher the level of reported depression. The variables used to build this measure are: “During the past seven days: You were bothered by things that usually don't bother you,” “During the past seven days: You could not shake off the blues, even with help from your family and your friends,” “During the past seven days: You had trouble keeping your mind on what you were doing,” “During the past seven days: You felt depressed,” “During the past seven days: You felt sad.” The respondents could choose between the following answers: “never or rarely,” “sometimes,” “a lot of the time,” or “most of the time or all the time.” Control variables included are number of kids (continuous: number of biological children ever had), age (continuous: takes into account both year and month of birth), education level (categorical: less than high school, high school, some college/vocational training, or college degree or more), in-school (dichotomous: equal to 1 if enrolled in school, 0 otherwise), current living arrangements (categorical: living with parents, living on their own, or other) relationship status (categorical: married, cohabiting, single/dating, or separated/divorced/widowed), race/ethnicity (categorical: non-Hispanic White, non-Hispanic Black, Asian/Pacific Islander, Hispanic (any race), or other), obesity at Wave 3 (dichotomous: equal to 1 if BMI is greater or equal to 30, 0 otherwise) and physical inactivity (dichotomous: equal to 1 if answered ‘yes’ to participating in any physical activity, 0 otherwise) at Wave 3.

2.4. Statistical analysis

Because of the documented gender differences in BMI, obesity prevalence, physical activity behavior, and depression, we performed all of the analyses separately for men and women. Following descriptive statistics of the included variables using probability weights to adjust for *Add Health's* sampling design, we ran multivariate regressions to estimate the association between sexual fluidity and the outcome variables of physical activity (poisson regression), obesity (logistic regression), and BMI (linear regression) at Wave 4. Stata was used for all of the analyses.

First, we estimated the models examining changes in sexual identity (towards more heterosexual or homosexual identities) and physical activity, obesity, and BMI with all of the controls included; second, we estimated the models with the depression variable included (together with the controls) to determine if depression could partially explain the relationship between specific sexual identity changes and physical activity, obesity, and/or BMI. Since our reference group in the regression models is the group that did not change sexual identity between Wave 3 and Wave 4, we would not be able to tell from these results whether there is a significant difference between those who changed toward more homosexual identities and those who changed toward more heterosexual identities. Hence, based on the regressions that include

depression as a control variable, we ran post hoc tests (using the *lincom* command in Stata) to evaluate whether the coefficients (or odds ratios and incidence rate ratios) for each outcome (respondents who changed toward more homosexual identities compared to those who changed toward more heterosexual identities) were significantly different from each other.

3. Results

3.1. Descriptive statistics

As Table 1 shows, the respondents are quite active at Wave 4, with an average of 7.1 and 5.7 activities per week for men and women, respectively. However, the average BMI is 28.9 for men and 29.0 for women, and 35.8% of men and 37.0% of women is found to be obese. In terms of sexual identity, 93.6% of men and 79.9% of women identified as ‘100% heterosexual’ in wave 4. 3.5% of men and 16.0% of women identify as ‘mostly heterosexual,’ 0.5% of men and 2.4% of women identify as ‘bisexual,’ 0.7% of men and 0.8% of women identify as ‘mostly homosexual,’ and 1.7% of men and 0.9% of women identify as ‘100% homosexual.’ A breakdown of physical activity, BMI and obesity by sexual identity is reported in Table A1 in the Appendix. Six point two

Table 1
Descriptive statistics.

Main Variables	Men	Women
Physical Activity		
Avg. # times per week	7.1	5.7*
BMI & Obesity		
Avg. BMI	28.9	29.0
% Obese	35.8	37.0
Sexual Identity (%)		
100% Heterosexual	93.6	79.9*
Mostly Heterosexual	3.5	16.0*
Bisexual	0.5	2.4*
Mostly Homosexual	0.7	0.8
100% Homosexual	1.7	0.9
% Change Sexual Identity W3-W4	6.2	18.0*
% Change toward more homosexual identity	3.5	11.8*
% Change toward more heterosexual identity	2.7	6.2*
Mental Health		
Avg. CESD Scale	2.3	2.8*
Control Variables	Men	Women
Avg. Age	28.9	28.6*
Race-Ethnicity (%)		
White	66.5	67.3
Hispanic	12.0	10.9
Black	13.8	15.0
Asian	3.8	3.6
Other	3.9	3.3
% in School	13.0	19.1*
Education Level (%)		
Less than HS	9.6	6.7
High School	20.5	13.1*
Some College/Vocational Training	41.6	44.7
College Degree or more	28.4	35.5*
Living with (%)		
Parents	17.0	14.5
On my own	73.9	79.9*
Other	9.1	5.6*
Relationship Status (%)		
Married	36.9	41.8*
Cohabiting	18.3	19.8
Separated-Divorced-Widow	5.8	7.5
Single or Dating	39.0	30.9*
Avg. # of children	0.8	1.1*
% Obese (Wave 3)	22.2	26.4*
% NO Physical Activity (Wave 3)	15.6	22.9*
N	5400	5949

*Results are significantly different between men and women ($p < 0.05$).
Note: The data refer to Wave 4, unless stated otherwise.

percent of men and 18.0% of women report a change in sexual identity between wave 3 and wave 4: 3.5% of men and 11.8% of women changed towards a more homosexual identity, while 2.7% of men and 6.2% of women changed towards a more heterosexual identity.

To examine in greater detail specific sexual identity trajectories between wave 3 and wave 4, the change for each sexual identity category is decomposed in Table 2. The proportion of individuals who identify as ‘100% heterosexual’ goes down (from 10,195 to 9808), as well as the proportion of individuals who identify as ‘bisexual’ (190 to 166). The category of reported sexual identity that sees the largest increase in identifications is ‘mostly heterosexual’ (791 to 1118) followed by ‘100% homosexual’ (101 to 161). And as already seen in Table 1, most of the documented change goes in the direction of homosexual identity.

3.2. Multivariate regression analyses

Starting from BMI, Table 3 shows that changing toward a more homosexual identity for men is associated with a lower BMI ($\beta = -0.715, p < 0.10$) on average compared to those who do not report a change; the coefficient remains significant at 10% level ($\beta = -0.695, p < 0.10$) when depression is included. Further, changing toward a more heterosexual identity for men is associated with a higher BMI ($\beta = 0.827, p < 0.10$) on average compared to those who do not report a change; the coefficient remains significant ($p < 0.10$) and increases to 0.846 when depression is added. For women, the association between a change in either direction and BMI is not significant.

In regards to obesity, Table 3 shows that women who report a change toward a more homosexual identity are less likely to be obese compared to those who do not report a change ($OR = 0.819, p < 0.10$); the odds ratio stays significant when depression is added ($OR = 0.802, p < 0.10$). Further, women who report a change toward a more heterosexual identity are also less likely to be obese (with and without taking into account depression), but the odds ratios are not statistically significant. For men, the association between a change in either direction and obesity is not significant.

For the number of physical activities per week, Table 3 shows that a change toward a more heterosexual identity is associated with a 7% ($p < 0.05$) and 5.4% ($p < 0.01$) increase in the number of physical activities, for men and women respectively, compared to those who do not report a change. Both incidence rate ratios increase and stay significant also when depression is included ($IRR = 1.074, p < 0.01$ for men, $IRR = 1.059, p < 0.01$ for women). Moreover, the number of physical activities is predicted to be 14.7% ($p < 0.01$) lower for men who report a change toward a more heterosexual identity compared to those who do not report a change. The incidence rate ratios for men who report a change toward a more homosexual identity changes to 0.857 (i.e. the number of physical activities is 14.3% lower) and remains significant when depression is included ($p < 0.01$).

Finally, the number of physical activities for women who report a change toward a more heterosexual identity is not significantly different from those who do not report a change. The results of the models including confounders and depression are reported in the Appendix.

3.3. Post hoc analyses

To evaluate whether changes toward a more heterosexual identity are significantly different from changes toward a more homosexual identity, we conducted post hoc analyses based on the regression models that include depression as a control variable, presented in Table 4. For men, when the coefficients for BMI are compared, a change toward a more homosexual identity is significantly different than a change toward a more heterosexual identity (Coeff. Difference = $-1.542, p = 0.012$), indicating that men who report a change toward a more homosexual identity have a significantly lower BMI than those who report a change toward a more heterosexual identity. For women, the coefficients for BMI are not significantly different (Coeff. Difference = $-0.005, p =$

Table 2
Sexual identity changes between wave 3 and wave 4.

Whole Sample		Sexual Identity Age 24–32 (Wave 4)				
Sexual Identity Age 18–26 (Wave 3)	100% Heterosexual	Mostly Heterosexual	Bisexual	Mostly Homosexual	100% Homosexual	Total
100% Heterosexual	9433	648	67	22	25	10,195
Mostly Heterosexual	326	397	41	14	13	791
Bisexual	34	69	51	22	14	190
Mostly Homosexual	10	3	5	24	30	72
100% Homosexual	5	1	2	14	79	101
Total	9808	1118	166	96	161	11,349
Men		Sexual Identity Age 24–32 (Wave 4)				
Sexual Identity Age 18–26 (Wave 3)	100% Heterosexual	Mostly Heterosexual	Bisexual	Mostly Homosexual	100% Homosexual	Total
100% Heterosexual	4951	103	11	8	16	5089
Mostly Heterosexual	76	70	6	8	7	167
Bisexual	5	8	10	7	4	34
Mostly Homosexual	5	0	0	17	17	39
100% Homosexual	3	0	2	9	57	71
Total	5040	181	29	49	101	5400
Women		Sexual Identity Age 24–32 (Wave 4)				
Sexual Identity Age 18–26 (Wave 3)	100% Heterosexual	Mostly Heterosexual	Bisexual	Mostly Homosexual	100% Homosexual	Total
100% Heterosexual	4482	545	56	14	9	5106
Mostly Heterosexual	250	327	35	6	6	624
Bisexual	29	61	41	15	10	156
Mostly Homosexual	5	3	5	7	13	33
100% Homosexual	2	1	0	5	22	30
Total	4768	937	137	47	60	5949

Note: numbers on the main diagonal (grey cells) refer to respondents who did not change their sexual identity between Wave 3 and Wave 4; Those above the main diagonal (in bold) changed towards more homosexual identities between Wave 3 and Wave 4; Those below the main diagonal (in italic) changed towards more heterosexual identities between Wave 3 and Wave 4.

Table 3
Regressions results - sexual identity change direction.

	Men		Women	
	With Controls	+ Depression	With Controls	+ Depression
Y = BMI	b/St. Err	b/St. Err	b/St. Err	b/St. Err
Toward homosexual	-0.715* (0.381)	-0.695* (0.382)	-0.3 (0.236)	-0.347 (0.238)
Toward heterosexual	0.827* (0.494)	0.846* (0.494)	-0.317 (0.318)	-0.342 (0.319)
Y = Obese	OR/C.I.	OR/C.I.	OR/C.I.	OR/C.I.
Toward homosexual	0.799 0.53,1.21	0.806 0.53,1.22	0.819* 0.66,1.02	0.802* 0.64,1.00
Toward heterosexual	1.43 0.90,2.27	1.445 0.91,2.29	0.799 0.59,1.08	0.791 0.58,1.07
Y = # Physical Activities per week	IRR/C.I.	IRR/C.I.	IRR/C.I.	IRR/C.I.
Toward homosexual	1.070** 1.02,1.13	1.074*** 1.02,1.13	1.054*** 1.02,1.09	1.059*** 1.02,1.10
Toward heterosexual	0.853*** 0.79,0.92	0.857*** 0.79,0.92	1.017 0.97,1.06	1.02 0.98,1.07
N	5400	5400	5949	5949

*p < 0.10, **p < 0.05, ***p < 0.01.

0.989).

For men, when the odds ratios for obesity are compared, a change toward a more homosexual identity is significantly different than a change toward a more heterosexual identity (OR Difference = 0.558, p = 0.061). This specifies that men who report a change toward a more homosexual identity are less likely to be obese than those who report a change toward a more heterosexual identity. For women, the odds ratios for obesity are not significantly different (OR Difference = 1.014, p = 0.940).

For men, when the incidence rate ratios for physical activity are

Table 4
Post hoc analyses - direction of change comparisons.

Y = BMI	Men		Women	
	Coeff. Difference	p-value	Coeff. Difference	p-value
Y = Obese	-1.542** OR Difference	0.012 p-value	-0.005 OR Difference	0.989 p-value
Y = Physical Activity	0.558* IRR Difference	0.061 p-value	1.014 IRR Difference	0.940 p-value
N	5400	5400	5949	5949

Note: The tests have been performed based on the regression models that include depression.

compared, a change toward a more homosexual identity is significantly different than a change toward a more heterosexual identity (IRR Difference = 1.254; p = 0.000), indicating that men who report a change toward a more homosexual identity report a significantly greater average number of physical activities per week compared those who report a change toward a more heterosexual identity. For women, the incidence rate ratios for physical activity are not significantly different (IRR Difference = 1.038, p = 0.163).

4. Discussion

Analyzing reported changes in sexual identity over time is necessary for understanding young adult health risks, as sexual fluidity has been associated with various health-related consequences (B. Everett, 2015; Fish & Pasley, 2015; Ott et al., 2013). This work extends that current body of literature by arguing that specific sexual identity trajectories are associated with a lower BMI and obesity prevalence and increases in physical activity, which provides evidence that sexual fluidity may also

be linked to improvements in health, in addition to the documented consequences. As such, particular findings of this work contradict our proposed hypothesis that characterize sexual identity change as a stressful life event that may negatively influence weight and physical activity for those who change toward more homosexual identities.

More specifically, results indicate that men who report a change toward a more homosexual identity have a significantly lower BMI on average compared to those who report no change and to those who report a change toward a more heterosexual identity. And post hoc analyses revealed that they are also less likely to be obese than those who report a change toward a more heterosexual identity. This is coherent with previous findings that sexual minority males are less likely to be overweight than heterosexual males (Conron, Mimiaga, & Landers, 2010). Similarly, men who report a change toward a more homosexual identity have a significantly greater average number of physical activities per week compared to those who do not report a change. While in contrast, men who report a change toward a more heterosexual identity report a significantly lower average number of physical activities per week than those who do not report a change.

These findings suggest that the direction of sexual identity change matters for men in regards to BMI and physical activity behavior, such that a change toward a more homosexual identity may be beneficial, while a change toward a more heterosexual identity may be harmful. This implies that body size and shape are at least as important to sexual minority men as compared to heterosexual men, which points to a growing body of literature that describes gay men as followers of the traditional masculinity ideology (Wade & Donis, 2007). It has been argued that sexual minority men aim to develop a muscular body to counteract memories of having a less athletic, or feminine, appearance during their childhood and adolescence (Rubinstein, 2003), or even to avoid harassment for violating masculine appearance norms (Watson & Dispenza, 2015). These results contradict our proposed hypothesis that a change toward a more homosexual identity has negative implications for BMI and physical activity. Further, these results for men partially confirm our hypothesis that a change in sexual identity is a stressful life event that adversely influences BMI, obesity, and physical activity. Future research should investigate why sexual identity change may present more of a challenge for men who change toward a more heterosexual identity.

For women, results indicate that those who report a change toward a more homosexual identity report a significantly greater average number of physical activities per week compared to those who do not report a change. Further, women who report a change toward a more homosexual identity are less likely to be obese, which is inconsistent with previous literature that repeatedly argues that sexual minority women are more likely to be obese than heterosexual women (Bowen, Balsam, Diergaarde, Russo, & Escamilla, 2006). However, post hoc analyses revealed that there is no difference among women who report a change toward a more heterosexual identity and those who report a change toward a more homosexual identity.

Results for women contradict our hypothesis that a change toward a more homosexual identity is a stressful life event that adversely influences obesity and physical activity. It may be the case that such a change is indeed a stressful life event, but the experienced mental health challenges do not impede physical activity behavior or actions to prevent obesity among women. Instead, they may motivate individuals to exercise, whereby exercise acts as a type of coping mechanism (Fredrick & Ryan, 1993). Alternatively, as women are more likely than men to change their sexual identity (Diamond, 2015; Dickson et al., 2003; Ott et al., 2011) and are argued to be more comfortable with their self-concept and related expression (Baumeister, 2000; Savin-Williams & Cohen, 2004), a change in sexual identity may be considered "liberating" as opposed to stressful, thereby encouraging women to engage in positive health behaviors. Further, it may result in gaining community, social status, and social or emotional resources, as opposed to losing them. An additional explanation could be that sexual minority women in

this sample may not have experienced minority stress (e.g. discrimination and harassment) in physical activity settings, thus encouraging them to exercise (the same can be said for men who change toward a more homosexual orientation).

The inclusion of depression as a control variable did not change our results in any of the regression analyses, which indicates that depression does not explain the negative associations between changing toward a more heterosexual identity and BMI and physical activity for men. This suggests that a different mental health mechanism (or different mechanism altogether) may be at work that accounts for the undesirable BMI and physical activity results. Possible other mechanisms may focus on social factors (e.g. social support), as changes in sexual identity are associated with loss of community, loss of social status, and decreased access to social or emotional resources (Ott et al., 2011). Future research should aim to identify these other mechanisms.

In regards to limitations, this analysis relies purely on self-reported sexual identity and physical activity, BMI, and obesity information, and self-report measures have limitations in accuracy and can be prone to certain biases, such as social-desirability bias (Wolfson et al., 2003). But *Add Health* respondents answer sensitive questions by computer (computer-assisted personal interviewing, 'CAPI'), which may limit this. *Add Health* is one of the few datasets that allows for an analysis of sexual identity change, as it asks about sexual identity at multiple time points. However, as of now, the data only allows for the consideration of one change. If possible, future research should investigate whether results vary when more than one change in identity occurs. Additionally, due to the small sample sizes of the subgroups that experienced specific changes, we settled for a dichotomous conceptualization of fluidity, which disregards the starting point from which the change originated and the health implications for non-sexual individuals (e.g. those who move from mostly straight to bisexual). However, future research (if feasible) should take into account the more nuanced categories of sexual orientation, including bisexuality, because recent work recognizes that it is often those categories that have worse health outcomes (Lindley et al., 2012; Mereish, Katz-Wise, & Woulfe, 2017).

5. Conclusions

The results of this study suggest that specific sexual identity changes are associated with increases in physical activity, a lower BMI, and lower obesity prevalence, which provides evidence that sexual fluidity may also be linked to improvements in health, in addition to the documented consequences. The findings of this study not only shed light on gender differences in sexual fluidity and resulting health outcomes, but also show potential benefits of an otherwise characteristically negative event. Ultimately, the results reiterate the necessity to focus on changes in sexual identity in addition to current sexual identity when examining young adult health risks. And in order for more practical applications of this work to be considered, individuals who experience sexual fluidity must first be identified. As such, it is necessary for future longitudinal surveys to not only incorporate questions regarding sexual orientation at each wave to identify fluid individuals, but also more nuanced categories of sexual orientation to better capture experiences. Further, qualitative work would give valuable insight into fluidity and its related benefits and challenges, which would better inform potential prevention and education efforts. This is important as sexual orientation fluidity is thought to be common, especially among women.

Author statement

Both authors, Julie Fricke and Maria Sironi, contributed equally to all parts of the published work.

Compliance with ethical standards

The authors declare no conflict of interest.

Secondary data have been used for this research.

Declaration of competing interest

None.

Appendix

Table A1
Key Outcome Variables and Sexual Identity at Wave 4.

Main Variables	Men (N = 5400)				Women (N = 5949)			
Sexual Identity W4	Physical Activity (Avg. # times p/week)	Avg. BMI	% Obese	N	Physical Activity (Avg. # times p/week)	Avg. BMI	% Obese	N
100% Heterosexual	7.1	29.0	36.5	5040	5.5	28.9	36.8	4768
Mostly Heterosexual	7.0	26.9	23.5	181	6.1	28.6	35.4	937
Bisexual	7.2	27.0	24.7	29	5.6	30.9	46.3	137
Mostly Homosexual	8.6	29.3	34.7	49	6.8	30.8	44.0	47
100% Homosexual	7.1	27.3	26.5	101	6.3	31.0	49.4	60

Table A2
OLS Regressions for 'BMI'.

Y = BMI	Men		Women	
	b/St. Err	b/St. Err	b/St. Err	b/St. Err
Change in Sex Id (Ref: No Change)				
Toward homosexual	-0.715* (0.381)	-0.695* (0.382)	-0.3 (0.236)	-0.347 (0.238)
Toward heterosexual	0.827* (0.494)	0.846* (0.494)	-0.317 (0.318)	-0.342 (0.319)
Age	-0.054 (0.041)	-0.053 (0.041)	0.025 (0.045)	0.024 (0.045)
Race/Ethnicity (Ref: Hispanic)				
white	-1.305*** (0.198)	-1.304*** (0.198)	-0.548** (0.225)	-0.544** (0.224)
black	-0.840*** (0.239)	-0.830*** (0.239)	1.574*** (0.261)	1.571*** (0.261)
asian	-1.208*** (0.310)	-1.201*** (0.310)	-1.512*** (0.365)	-1.516*** (0.364)
other	-0.713* (0.401)	-0.709* (0.401)	1.142*** (0.443)	1.130** (0.443)
Level of Education (Ref: less than HS)				
high school	0.447 (0.286)	0.436 (0.287)	1.019*** (0.383)	1.057*** (0.384)
some college or vocational training	0.433 (0.264)	0.415 (0.264)	0.764** (0.345)	0.828** (0.347)
college degree or more	-0.067 (0.285)	-0.096 (0.286)	-0.790** (0.366)	-0.702* (0.370)
Enrolled in school	0.057 (0.205)	0.058 (0.205)	-0.349* (0.195)	-0.358* (0.195)
Living with (Ref: Parents)				
on my own	-0.132 (0.205)	-0.141 (0.205)	-0.400* (0.234)	-0.392* (0.234)
other	-0.339 (0.291)	-0.328 (0.291)	-0.702* (0.373)	-0.717* (0.373)
Relationship Status (Ref: Single or Dating)				
married	0.994*** (0.193)	0.975*** (0.194)	0.407* (0.208)	0.434** (0.209)
cohabiting	0.213 (0.213)	0.208 (0.213)	0.098 (0.233)	0.114 (0.233)
divorced, separated, widow	-0.125 (0.314)	-0.116 (0.314)	-0.329 (0.311)	-0.345 (0.311)
Number of children	-0.071 (0.076)	-0.066 (0.076)	-0.091 (0.076)	-0.098 (0.076)
Physically Inactive Wave 3	-0.483** (0.194)	-0.485** (0.194)	-0.687*** (0.181)	-0.687*** (0.181)
Obese in Wave 3	10.380*** (0.167)	10.377*** (0.167)	12.340*** (0.176)	12.331*** (0.176)
CESD Depression Scale		-0.034 (0.031)		0.048* (0.029)
Constant	28.877*** (1.230)	28.956*** (1.232)	25.587*** (1.346)	25.401*** (1.350)
N	5400	5400	5949	5949

*p < 0.10, **p < 0.05, ***p < 0.01.

Table A3
Logistic Regressions for ‘Obesity’.

Y = Obese	Men		Women	
	OR/C.I.	OR/C.I.	OR/C.I.	OR/C.I.
Change in Sex Id (Ref: No Change)				
Toward homosexual	0.799 0.53,1.21	0.806 0.53,1.22	0.819* 0.66,1.02	0.802* 0.64,1.00
Toward heterosexual	1.43 0.90,2.27	1.445 0.91,2.29	0.799 0.59,1.08	0.791 0.58,1.07
Age	0.969 0.93,1.01	0.97 0.93,1.01	0.998 0.96,1.04	0.998 0.96,1.04
Race/Ethnicity (Ref: Hispanic)				
white	0.630*** 0.52,0.76	0.630*** 0.52,0.76	0.816** 0.67,1.00	0.816** 0.67,1.00
black	0.732*** 0.58,0.93	0.736** 0.58,0.93	1.528*** 1.21,1.93	1.526*** 1.21,1.92
asian	0.453*** 0.33,0.63	0.455*** 0.33,0.63	0.593*** 0.41,0.85	0.592*** 0.41,0.85
other	0.578*** 0.38,0.88	0.579*** 0.38,0.88	0.914 0.61,1.38	0.909 0.60,1.37
Level of Education (Ref: less than HS)				
high school	1.005 0.75,1.34	1 0.75,1.33	1.619*** 1.14,2.30	1.646*** 1.16,2.34
some college or vocational training	1.063 0.82,1.38	1.054 0.81,1.37	1.354* 0.98,1.87	1.392** 1.01,1.92
college degree or more	0.815 0.61,1.09	0.803 0.60,1.07	0.81 0.58,1.14	0.841 0.60,1.19
Enrolled in school	1.143 0.93,1.41	1.144 0.93,1.41	0.878 0.73,1.05	0.875 0.73,1.05
Living with (Ref: Parents)				
on my own	0.989 0.80,1.22	0.985 0.80,1.22	0.805** 0.65,1.00	0.807** 0.65,1.00
other	0.942 0.70,1.27	0.946 0.70,1.28	0.751 0.53,1.06	0.745* 0.53,1.05
Relationship Status (Ref: Single or Dating)				
married	1.565*** 1.29,1.90	1.550*** 1.27,1.89	1.097 0.91,1.33	1.112 0.92,1.35
cohabiting	1.164 0.94,1.45	1.161 0.93,1.44	1.046 0.84,1.30	1.055 0.85,1.31
divorced, separated, widow	0.858 0.61,1.20	0.862 0.62,1.21	0.977 0.74,1.30	0.972 0.73,1.29
Number of children	0.992 0.92,1.07	0.994 0.92,1.07	1.052 0.98,1.13	1.048 0.98,1.12
Physically Inactive Wave 3	0.951 0.78,1.16	0.95 0.78,1.16	0.823** 0.70,0.97	0.822** 0.70,0.97
Obese in Wave 3	35.404*** 28.82,43.49	35.385*** 28.81,43.47	33.158*** 27.69,39.71	33.107*** 27.64,39.65
CESD Depression Scale		0.984 0.95,1.02		1.021 0.99,1.05
Constant	0.813 0.23,2.82	0.845 0.24,2.93	0.277** 0.08,0.95	0.256** 0.07,0.88
N	5400	5400	5949	5949

*p < 0.10, **p < 0.05, ***p < 0.01.

Table A4
Poisson Regressions for ‘Number of physical activities per week’.

Y = # Physical Activities per week	Men		Women	
	IRR/C.I.	IRR/C.I.	IRR/C.I.	IRR/C.I.
Change in Sex Id (Ref: No Change)				
Toward homosexual	1.070** 1.02,1.13	1.074*** 1.02,1.13	1.054*** 1.02,1.09	1.059*** 1.02,1.10
Toward heterosexual	0.853*** 0.79,0.92	0.857*** 0.79,0.92	1.017 0.97,1.06	1.02 0.98,1.07
Age	1.009*** 1.00,1.02	1.009*** 1.00,1.02	1.011*** 1.00,1.02	1.011*** 1.00,1.02
Race/Ethnicity (Ref: Hispanic)				
white	0.961*** 0.93,0.99	0.961*** 0.93,0.99	1.106*** 1.07,1.14	1.106*** 1.07,1.14
black	0.969* 0.94,1.00	0.971* 0.94,1.01	0.901*** 0.87,0.94	0.901*** 0.87,0.94
asian	1.047** 1.00,1.09	1.048** 1.00,1.09	0.981 0.93,1.03	0.982 0.93,1.03

(continued on next page)

Table A4 (continued)

Y = # Physical Activities per week	Men		Women	
	IRR/C.I.	IRR/C.I.	IRR/C.I.	IRR/C.I.
other	0.987 0.93,1.05	0.988 0.93,1.05	1.167*** 1.10,1.24	1.169*** 1.10,1.24
Level of Education (Ref: less than HS)				
high school	1.061*** 1.02,1.11	1.059** 1.01,1.11	0.859*** 0.81,0.91	0.855*** 0.81,0.91
some college or vocational training	1.111*** 1.07,1.16	1.107*** 1.06,1.15	0.922*** 0.88,0.97	0.915*** 0.87,0.96
college degree or more	1.154*** 1.11,1.20	1.147*** 1.10,1.20	0.999 0.95,1.05	0.988 0.94,1.04
Enrolled in school	1.161*** 1.13,1.19	1.162*** 1.13,1.19	1.121*** 1.09,1.15	1.122*** 1.09,1.15
Living with (Ref: Parents)				
on my own	1.017 0.99,1.05	1.015 0.99,1.05	1.116*** 1.08,1.16	1.115*** 1.08,1.15
other	1.017 0.98,1.06	1.019 0.98,1.06	1.106*** 1.05,1.17	1.108*** 1.05,1.17
Relationship Status (Ref: Single or Dating)				
married	0.849*** 0.83,0.87	0.846*** 0.82,0.87	0.969** 0.94,1.00	0.966** 0.94,0.99
cohabiting	0.867*** 0.84,0.89	0.866*** 0.84,0.89	0.941*** 0.91,0.97	0.939*** 0.91,0.97
divorced, separated, widow	0.959* 0.92,1.00	0.960* 0.92,1.00	0.916*** 0.87,0.96	0.918*** 0.88,0.96
Number of children	0.988** 0.98,1.00	0.989* 0.98,1.00	0.988** 0.98,1.00	0.989** 0.98,1.00
Physically Inactive Wave 3	0.602*** 0.58,0.62	0.601*** 0.58,0.62	0.703*** 0.68,0.72	0.703*** 0.68,0.72
Obese in Wave 3	0.980* 0.96,1.00	0.979* 0.96,1.00	0.942*** 0.92,0.97	0.942*** 0.92,0.97
CESD Depression Scale		0.993*** 0.99,1.00	0.993*** 0.99,1.00	0.994*** 0.99,1.00
Constant	5.751*** 4.81,6.87	5.843*** 4.89,6.98	4.216*** 3.48,5.11	4.310*** 3.55,5.23
N	5400	5400	5949	5949

*p < 0.10, **p < 0.05, ***p < 0.01.

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