



Transgender identity and mental health functional impairment: analysis of the 2016 Behavioral Risk Factor Surveillance System

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Background: Transgender people have a gender identity or gender expression that differs from their sex assigned at birth. However, the data on mental health function disparities among transgender persons are not well-documented and data on the proportion of transgender subpopulations in the USA population are very limited. By using 2016 USA CDC Behavioral Risk Factor Surveillance System (BRFSS), this study focuses on the characteristics of transgender persons to evaluate whether transgender identity is independently associated with mental health functional impairments.

Methods: We used the 2016 BRFSS publicly available data to assess social economic status, behavioral health-related factors, medical care access, co-morbidities, and mental health functional impairments among three transgender subpopulations. We employed bivariate chi-square test, Pearson correlation, multivariable logistic regression, and multivariable ordinal regression to determine whether transgender identity is independently associated with mental health functional impairments.

Results: Information from a total of 198,060 respondents with valid answers were collected and used in this study. After controlling for socioeconomic, education, and other factors, we found that compared to non-transgender individuals, male to female transgender persons were at increased risk of depression or dysthymia by 43.1%. Female to male transgender persons showed increased risk of depression or dysthymia by 81.54% and of serious difficulty concentrating, remembering, or making decisions by 83.5%. Non-conforming transgender status, but not male to female transgender or female to male transgender status, was independently associated with 57.9% increased risk of self-reported mentally health complain severity.

Conclusions: Transgender persons are more likely to be diagnosed with depression and to have poor self-reported mental wellbeing than non-transgender persons. A similar finding was seen among non-conforming transgender persons. Our results will be useful in planning mental health services for this unique subpopulation.

Keywords: Gender identity; transgender; LGBT; mental health; depression

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Introduction

Transgender people have a gender identity, behavioral, or gender expression that do not conform to the biological sex the person had or was identified as having at birth (1). They may identify themselves as heterosexual, homosexual, bisexual, asexual, or may decline to label their sexual orientation. The Institute of Medicine [2011] recognized that not only are lesbians, gay men, bisexual men and women, and transgender people all separate groups, but each of these groups encompasses subpopulations with their own unique health needs (2). However, data on the proportion of transgender subpopulations in the USA population are lacking and information on the mental health needs of transgender subpopulations is limited (2-4). The transgender population bears a disproportionate burden of mental health issues relative to the general population (5-11), and emerging evidence suggests that within the LGBT population, the odds of depression symptoms are higher among transgender individuals compared to non-transgender individuals (12-14).

In a heteronormative society, nontraditional gender identity and sexuality influence self-esteem and causes internalized transphobia, a discomfort with one's own transgenderism as a result of internalizing society's normative gender expectations. This can negatively affect physical and mental health outcomes among transgender people (15,16). Reports show that transgender individuals have a high prevalence of clinical depression (44.1%), anxiety (33.2%), and somatization disorders (27.5%) (16). After controlling for potential confounders, transgender identity was associated with higher odds of self-reported discrimination (OR: 2.63, $P < 0.01$), depression (OR: 2.33, $P < 0.05$), and suicide attempts (OR: 2.59, $P < 0.01$) when compared with non-transgender individuals (1).

However, the data on mental health function disparities among transgender persons are not well-documented. Conron *et al.* [2012] found that 14.3% of transgender individuals reported more than 15 days of poor mental health in the past 30 days *vs.* 9.8% (95% CI: 9.2 to 10.4) of non-transgender individuals, although the difference was not statistically significant ($P = 0.54$) (3).

We used CDC Behavioral Risk Factor Surveillance System (BRFSS) publicly available data to assess the socioeconomic status, behavioral factors, medical care access, comorbidities, and mental health functional impairments among transgender subpopulations (male to female, female to male, and non-conforming). We also tried

to evaluate whether transgender status is independently associated with mental health functional impairments.

Methods

Sample and measures

We analyzed data from the 2016 BRFSS telephone survey for this study. The BRFSS is the largest continuously conducted health survey system in the world, with more than 400,000 adult interviews each year (17). In 2016, a total of 26 states participated in the optional Sexual Orientation and Gender Identity survey. The BRFSS collects data on USA residents regarding their demographic information, social economic status, chronic health conditions, including physical and mental dysfunction, use of preventive services, and health-related risk behaviors. Information from a total of 198,060 respondents with valid answers were collected and used in this study.

Statistical analysis

We used IBM Statistical Package for the Social Sciences (SPSS) version 22 to analyze the data. We restricted the analytic sample to 198,060 participants with valid responses to both sex orientation and transgender questionnaires. We employed chi-square test for bivariate analysis to assess the association of transgender subpopulations with background characteristics, and Pearson correlation to examine the correlation between mental health functional impairments and background characteristics. Variables with chi-square test $P < 0.05$ and Pearson correlation $R < 0.5$ were included in the regression models. Logistic and ordinal regression analyses controlling for demographic information, socioeconomic status, comorbidities, medical care access, and health-related risk behaviors were employed to test the association of transgender status and individual mental health morbidity.

Results

Frequency of self-reported sex orientation and transgender status

Table 1 presents the frequency of self-reported sex orientation and transgender status among 198,060 valid respondents. A total of 3,404 respondents (1.72%) self-reported as bisexual and 3,047 self-reported as either lesbian or gay (1.54%). Self-reported male-to-female transgender,

Table 1 Frequency of self-reported sex orientation and transgender status, the BRFSS, 2016

Sex orientation and transgender status	Frequency	Percent
Sex orientation (P=0.000)		
Bisexual	3,404	1.72
Lesbian or gay	3,047	1.54
Straight	191,609	96.74
Total	198,060	100.00
Transgender		
Yes, male to female	324	0.16
Yes, female to male	237	0.12
Yes, non-conforming	147	0.07
Non-transgender	197,352	99.65
Total	198,060	100.00

BAFSS, Behavioral Risk Factor Surveillance System.

female to male transgender, and non-conforming only count for 0.16%, 0.12%, and 0.07% of the total participants respectively.

Socioeconomic and demographic status

Sociodemographic characteristics of male-to-female, female to male, and non-conforming transgender respondents, and no transgender population are shown in *Table 2*. Among 196,436 non-transgender respondents, half of them were married and more than two-thirds own their own home. Percentages of marriage and home ownership were significantly lower among transgender subpopulation compared to non-transgender people. Less than half of non-conforming transgender persons own their house. Transgender persons were more likely to be young minorities, especially non-conforming transgender persons. Transgender participants were also significantly more likely to be less educated and to have less annual household income.

Comorbidities

Compared to no-transgender respondents, transgender individuals were more likely to suffer from increased comorbidities (see *Table 3*), such as cardiovascular accidents (stroke or heart attack), diabetes, chronic obstructive pulmonary disease (COPD), and arthritis. The only exception is that the non-conforming transgender

respondents report less arthritis (21.9%) and fewer strokes (2.7%) compared to other transgender subpopulations and non-transgender participants. Compared to non-conforming subpopulations, male to female and female to male transgender had significantly increased risk for myocardial infarction (MI) (by 26.4% and 16.8% respectively), stroke (by 151.8% and 181.5% respectively) and diabetes (by 48.6% and 59.0%).

Behavioral factors

As shown in *Table 4*, 21.5 % of transgender persons are current smokers and only 14.9% of non-transgender individuals are current smokers. Non-conforming transgender persons had a significantly higher risk of risky drinking behaviors (binge drinking or/and heavy drinking) compared to non-transgender, male to female, and female to male transgender individuals. Bisexual sex behavior was common among transgender population: 10.8% of male to female transgender persons, 14.3% of female to male transgender persons, and 32.0% of non-conforming transgender persons self-reported being bisexual, compared to only 1.7% of non-transgender persons. Approximately 10% of transgender persons self-reported being lesbian or gay compared to 1.5% of non-transgender persons.

Medical care access

As shown in *Table 5*, only 9.2% of non-transgender persons

Table 2 Socioeconomic status of transgender and no-transgender respondents, the BRFSS, 2016

Socioeconomic status	Yes, male to female (%)	Yes, female to male (%)	Yes, non-conforming (%)	Non-transgender (%)
Marital status (P=0.000)				
Married	131 (40.4)	83 (35.3)	52 (35.6)	103,232 (52.6)
Not married	193 (59.6)	152 (64.7)	94 (64.4)	93,204 (47.4)
Total	324 (100.0)	235 (100.0)	146 (100.0)	196,436 (100.0)
Home owner (P=0.000)				
Yes	192 (59.4)	135 (57.0)	72 (49.0)	141,912 (72.2)
No	131 (40.6)	102 (43.0)	75 (51.0)	54,682 (27.8)
Total	323 (100.0)	237 (100.0)	147 (100.0)	196,594 (100.0)
Respondent race (P=0.000)				
Non-Hispanic white	224 (70.2)	161 (68.6)	98 (67.6)	154,072 (79.2)
Non-white or Hispanic	95 (29.8)	73 (31.2)	47 (32.4)	40,491 (20.8)
Total	319 (100.0)	234 (100.0)	145 (100.0)	94,563 (100.0)
Age categories (P=0.000)				
Age 18 to 34	64 (19.8)	59 (24.9)	55 (37.4)	28,745 (14.6)
Age 35 to 44	28 (8.6)	18 (7.6)	13 (8.8)	22,063 (11.2)
Age 45 to 54	55 (17.0)	39 (16.5)	20 (13.6)	32,274 (16.4)
Age 55 to 64	86 (26.5)	41 (17.3)	26 (17.7)	45,203 (22.9)
Age 65 or order	91 (28.1)	80 (33.8)	33 (22.4)	69,067 (35.0)
Total	324 (100.0)	237 (100.0)	147 (100.0)	197,352 (100.0)
Level of education completed (P=0.000)				
Did not graduate high school	57 (17.8)	33 (13.9)	14 (9.5)	13,433 (6.8)
Graduated high school	127 (39.6)	94 (39.7)	48 (32.7)	54,628 (27.2)
Attended college or tech school	76 (23.7)	63 (26.6)	51 (34.7)	53,466 (27.2)
Graduated from college or tech school	61 (19.0)	47 (19.8)	34 (23.1)	75,391 (38.3)
Total	321 (100.0)	237 (100.0)	147 (100.0)	196,918(100.0)
Annual household income (P=0.000)				
Less than \$20,000	89 (31.4)	75 (36.9)	35 (28.2)	28,052 (16.5)
\$20,000 to less than \$35,000	66 (23.3)	50 (24.6)	33 (26.6)	32,480 (19.1)
\$35,000 to less than \$50,000	41 (14.5)	25 (12.3)	19 (15.3)	24,537 (14.4)
\$50,000 to less than \$75,000	36 (12.7)	25 (12.3)	8 (6.5)	28,093 (16.5)
\$75,000 or more	51 (18.0)	28 (13.8)	29 (23.4)	57,222 (33.6)
Total	283 (100.0)	203 (100.0)	124 (100.0)	170,384(100.0)

BAFSS, Behavioral Risk Factor Surveillance System.

Table 3 Comorbidities among transgender and non-transgender respondents, the BRFSS, 2016

Comorbidities	Yes, male to female (%)	Yes, female to male (%)	Yes, non-conforming (%)	Non-transgender (%)
Ever told have CHD or MI (P=0.000)				
Yes	50 (15.8)	34 (14.6)	18 (12.5)	18,053 (9.2)
No	266 (84.2)	199 (85.4)	126 (87.5)	177,894 (90.8)
Total	316 (100.0)	233 (100.0)	144 (100.0)	195,947 (100.0)
Ever told have a stroke (P=0.004)				
Yes	22 (6.8)	18 (7.6)	4 (2.7)	8,257 (4.2)
No	300 (93.2)	219 (92.4)	143 (97.3)	188,639 (95.8)
Total	322 (100.0)	237 (100.0)	147 (100.0)	196,896 (100.0)
Ever told have COPD (P=0.006)				
Yes	41 (12.7)	26 (11.0)	17 (11.6)	16,313 (8.3)
No	282 (87.3)	210 (89.0)	129 (88.4)	180,280 (91.7)
Total	323 (100.0)	236 (100.0)	146 (100.0)	196,593 (100.0)
Ever told have arthritis (P=0.003)				
Yes	125 (38.9)	89 (37.9)	32 (21.9)	69,766 (35.5)
No	196 (61.1)	146 (62.1)	114 (78.1)	126,676 (64.5)
Total	321 (100.0)	235 (100.0)	146 (100.0)	196,442 (100.0)
Ever told have diabetes (P=0.000)				
Yes	69 (21.4)	52 (22.9)	21 (14.4)	2,667 (13.6)
No	253 (78.6)	175 (77.1)	125 (85.6)	168,889 (86.4)
Total	322 (100.0)	227 (100.0)	146 (100.0)	195,556 (100.0)

BAFSS, Behavioral Risk Factor Surveillance System; CHD, coronary heart disease; MI, myocardial infarction; COPD, chronic obstructive pulmonary disease.

reported difficulty in seeing a health care provider due to cost in the past 12 months. However, these figures were 15.7%, 17.3%, and 16.3% for male to female, female to male, and non-conforming transgender persons, respectively. There were no statistically significant differences in yearly routine primary care visits and access to preventive medical services, such as yearly flu vaccination between the four groups (transgender subpopulations and non-transgender persons).

Functional impairments

Table 6 presents the functional impairments among three different transgender subpopulations and the non-transgender population. Physical health complaints were more common among three different transgender

subpopulations compared to non-transgender population, especially for more serious physical health complain among male to female transgender persons and female to male transgender persons. Approximately, one in five male to female transgender persons or female to male transgender persons reported more serious physical dysfunction compared to one in six of non-conforming transgender persons and one in seven non-transgender persons. The patterns of mental health complain followed the same trend of physical health complain. Transgender persons were much more likely to report more serious mental distress compared to non-transgender persons. Only one in ten non-transgender individuals self-reported more serious mental distress in the past 30 days compared to one of three among non-conforming transgender persons and one in five among male to female and female to male transgender

Table 4 Behavioral factors among transgender and non-transgender respondents, BRFSS, 2016

Behavioral factors	Yes, male to female (%)	Yes, female to male (%)	Yes, non-conforming (%)	Non-transgender (%)
Current smokers (P=0.000)				
No	250 (77.6)	184 (78.3)	116 (80.6)	166,467 (85.1)
Yes	72 (22.4)	51 (21.7)	28 (19.4)	19,183 (14.9)
Total	322 (100.0)	235 (100.0)	144 (100.0)	195,650 (100.0)
Binge drinkers (P=0.001)				
No	264 (84.1)	207 (88.8)	108 (75.5)	167,452 (86.5)
Yes	50 (15.9)	26 (11.2)	35 (24.5)	26,158 (13.5)
Total	314 (100.0)	233 (100.0)	143 (100.0)	193,610 (100.0)
Heavy drinkers (P=0.000)				
No	290 (92.9)	218 (93.6)	122 (84.7)	181,355 (93.8)
Yes	22 (7.1)	15 (6.4)	22 (15.3)	12,044 (6.2)
Total	312 (100.0)	233 (100.0)	144 (100.0)	193,399 (100.0)
Sex orientation (P=0.000)				
Bisexual	35 (10.8)	34 (14.3)	47 (32.0)	3,288 (1.7)
Lesbian or gay	28 (8.6)	24 (10.1)	19 (12.9)	2,976 (1.5)
Straight	261 (80.6)	179 (75.5)	81 (55.1)	191,088 (96.8)
Total	324 (100.0)	237 (100.0)	147 (100.0)	197,352 (100.0)

BAFSS, Behavioral Risk Factor Surveillance System.

Table 5 Medical care access among transgender and non-transgender respondents, BRFSS, 2016

Medical care access	Yes, male to female (%)	Yes, female to male (%)	Yes, non-conforming (%)	Non-transgender (%)
Difficulty to see doctor due to cost in the past 12 months (P=0.000)				
Yes	50 (15.7)	41 (17.3)	24 (16.3)	18,085 (9.2)
No	269 (84.3)	196 (82.7)	123 (83.7)	178,898 (90.8)
Total	319 (100.0)	237 (100.0)	147 (100.0)	196,983 (100.0)
Visited a doctor for a routine checkup (P=0.505)				
Within past year	242 (76.1)	172 (75.1)	105 (71.9)	150,057 (76.8)
More than 1 year ago	76 (23.9)	57 (24.9)	41 (28.1)	45,436 (23.2)
Total	318 (100.0)	229 (100.0)	146 (100.0)	195,493 (100.0)
Had flu shot or vaccine in 12 months (P=0.087)				
Yes	129 (40.2)	96 (41.4)	60 (41.4)	89,323 (45.6)
No	192 (59.8)	136 (58.6)	85 (58.6)	106,393 (54.4)
Total	321 (100.0)	232 (100.0)	145 (100.0)	195,716 (100.0)

BAFSS, Behavioral Risk Factor Surveillance System.

Table 6 Functional impairments among transgender and non-transgender respondents, BRFSS, 2016

Functional impairments	Yes, male to female (%)	Yes, female to male (%)	Yes, non-conforming (%)	Non-transgender (%)
3 level not good physical health status (P=0.000)				
Zero day not good in 30 days	175 (56.3)	122 (53.0)	79 (54.1)	122,125 (63.0)
1–13 days not good in 30 days	75 (24.1)	57 (24.8)	43 (29.5)	45,457 (23.5)
14 to 30 days not good in 30 days	61 (19.6)	51 (22.2)	24 (16.4)	26,248 (13.5)
Total	311 (100.0)	230 (100.0)	146 (100.0)	194,517 (100.0)
3 level not good mental health status				
Zero day not good in 30 days	200 (63.3)	128 (56.6)	63 (43.8)	132,809 (68.2)
1–13 days not good in 30 days	57 (18.0)	45 (19.9)	39 (27.1)	41,603 (21.4)
14 to 30 days not good in 30 days	59 (18.7)	53 (23.5)	42 (29.2)	20,199 (10.4)
Total	316 (100.0)	226 (100.0)	144 (100.0)	194,611 (100.0)
Depressive disorder or dysthymia (P=0.000)				
Yes	84 (26.3)	79 (33.5)	54 (36.7)	34,096 (17.3)
No	235 (73.7)	157 (66.5)	93 (63.3)	162,598 (82.7)
Total	319 (100.0)	236 (100.0)	147 (100.0)	196,694 (100.0)
Serious difficulty concentrating or make decision (P=0.000)				
Yes	63 (19.6)	57 (24.4)	43 (29.7)	19,044 (9.7)
No	259 (80.4)	177 (75.6)	102 (70.3)	196,953 (90.3)
Total	322 (100.0)	234 (100.0)	145 (100.0)	195,997 (100.0)
Difficulty doing errands alone such as visiting a doctor (P=0.000)				
Yes	46 (14.3)	39 (16.7)	24 (16.4)	14253 (7.3)
No	276 (85.7)	195 (83.3)	122 (83.6)	182093 (92.7)
Total	322 (100.0)	234 (100.0)	146 (100.0)	196346 (100.0)
Sleep pattern (P=0.000)				
Adequate sleep	273 (85.6)	186 (80.2)	114 (77.6)	174835 (89.3)
Not adequate sleep	46 (14.4)	46 (19.8)	33 (22.4)	20912 (10.7)
Total	319 (100.0)	232 (100.0)	147 (100.0)	195747 (100.0)

BAFSS, Behavioral Risk Factor Surveillance System.

persons.

Of 196,694 non-transgender individuals, 17.3% were diagnosed with a depressive disorder or dysthymia in the past, significantly less than the corresponding figures of 26.3%, 33.5%, and 36.7% of male to female, female to male, and non-conforming transgender persons, respectively. Transgender individuals were more likely to have mental health-related functional dysfunction as well.

Approximately one out of five male to female transgender

persons, one out of four female to male transgender persons, and one out of three non-conforming transgender persons reported serious difficulty concentrating, remembering, or making decisions due to physical and emotional distress. However, only one out of ten non-transgender persons self-reported these problems. Similar disparities were observed for difficulty attending to minor social obligation (such as visiting doctor's office or shopping) and poor sleep, with transgender persons having more disruption in the

Table 7 Ordinal regression and logistic regression among different transgender population groups (non-transgender as reference group), BRFSS, 2016

Independent correlates	Male to female transgender	Female to male transgender	Non-conforming transgender
Mentally not good days in the past 30 days (0 days, 1 to 13 days, 14 to 30 days)			
Estimate (P value)	0.155 (P=0.271)	-0.006 (P=0.970)	0.579 (P=0.003)
95% CI	-0.121 to 0.431	-0.342 to 0.329	0.191 to 0.966
Have a depressive disorder, including dysthymia			
OR (P value)	1.431 (P=0.026)	1.815 (P=0.001)	2.488 (P=0.000)
95% CI	1.043 to 1.965	1.263 to 2.611	1.597 to 3.876
Serious difficulty concentrating, remembering, or make decision			
OR (P value)	1.089 (P=0.665)	1.835 (P=0.004)	3.049 (P=0.000)
95% CI	0.739 to 1.608	1.212 to 2.770	1.852 to 5.025
Difficulty doing errands alone such as visiting a doctor or shopping			
OR (P value)	1.383 (P=0.128)	1.555 (P=0.073)	1.570 (P=0.201)
95% CI	0.912 to 2.096	0.960 to 2.525	0.786 to 3.135

BAFSS, Behavioral Risk Factor Surveillance System.

functional areas compared to non-transgender persons. An estimated 19.8% of female to male transgender persons and 22.4% of non-conforming transgender individuals reported poor sleep, compared to only 10.7% of non-transgender persons.

The independent effects of transgender on mental health dysfunction

After controlling for socioeconomic and demographic status, co-morbidities, behavioral factors, and medical care access, we found non-conforming transgender status to be independently associated with increased risk of self-reported mentally not good severity to the next higher level by 57.9% (parameter estimate: 0.579, 95% CI: 0.191, 0.966, P=0.003). However, compared to non-transgender individuals, all three transgender subpopulations were at increased risk of being diagnosed with depressive disorder or dysthymia compared to non-transgender persons (Table 7). Female to male transgender persons and non-conforming transgender persons had greater odds of having serious difficulty concentrating, remembering, or making decisions than non-transgender persons. No statistically significant differences in difficulty running errands alone were found between the 3 transgender groups and non-transgender respondents.

Discussion

The BRFSS is the nation's premier and largest system of health-related telephone surveys with a total 26 states participating in optional Sexual Orientation and Gender Identity survey in 2016 (17). Among 198,060 respondents, 0.35% self-identified as transgender persons, which is consistent with prior studies. Hafeez and Gates [2017] for example reported that about 0.3% of USA persons self-identify as transgender (18,19). Based on 12 USA surveys conducted between 2007 and 2015, Esther *et al.* [2017] reported that 0.4% of the USA population self-identified themselves as transgender (4). Our estimates are however, less than those reported by Crissman *et al.* [2017] (20,21). By using CDC 2014 BRFSS data, Crissman found that transgender individuals were found to comprise 0.53% of the total population. However, Crissman used weighted percentage, which increases the chances of having estimates that are greater than the raw data analysis.

Our findings regarding other sociodemographic characteristics are also consistent with other research findings (3,12,22). Transgender adults are more likely to be younger, homeless or live in shelters, Caucasian, and earn less household income. Findings regarding educational levels are more varied. Whereas our study indicated transgender persons are more likely to be less educated

compared to non-transgender persons, others report that transgender adults are less educated or do not differ (1,3,12,22).

Researchers have found that risky health behaviors, such as smoking and substance abuse, may affect transgender population general health (3,21,23-25). However, little is known about other key health-related behaviors, such as risky drinking behaviors (binge drinking or heavy drinking), obesity, and lack of physical exercise (12). Although our study did not find either physical activities or obesity to be associated with transgender subpopulations, it confirms higher rates of current smoking among all three transgender subpopulations, which may contribute to the comorbidity disparities among these minority population [higher prevalence of coronary heart disease (CHD), MI, stroke, and COPD]. We also found only non-conforming transgender individuals to be more likely to engage in risky drinking behaviors (either binge drinking or heavy drinking), which may in part due to more serious mental health dysfunction among this transgender subpopulation because non-conforming transgender individuals may use alcohol to compensate their mental health dysfunction (26-28).

With an increased risk of physical and psychiatric or mental comorbidities, transgender people may not be able to access the care they need because they may avoid medical care for fear of being prejudged or due to financial difficulty. Our findings indicated that all three transgender subpopulations are at least 70% less likely to see health care provider due to financial costs in the past 12 months. At the same time, medical insurance may not cover needed transgender health services and some of the transgender people actually have been turned by health care providers (29). More importantly, transgender individuals share some of the risk factors, such as hormone replacement therapy, silicone injection, smoking, risky drinking behavioral, and mental health complaints. Transgender men who still have a uterus or breasts are at risk for cancer in these organs. However, they may unwilling to received cervical cancer or breast cancer screening. Our study also indicated that transgender persons are often at higher risk for heart disease, stroke, and diabetes which may also associated with some of these risk factors. However, the primary care may lack of the training on how to deal with specialized transgender health care issues.

We found important disparities in physical and mental functioning among transgender subpopulations and non-transgender persons. Compared to the gender non-conforming subpopulation and non-transgender

individuals, male to female transgender and female to male transgender persons had greater prevalence of diabetes and cardiovascular disease, especially stroke. Importantly, these disparities exist cross all age groups (data not shown). The exact reasons for these disparities are not clear, however, some researchers hypothesize that exogenous hormone replacement may increase the risk for MI and stroke due to blood pressure elevation, insulin resistance, and lipid derangements (30). Transgender people have extremely high rates of smoking and drinking which also increase the risks for developing cardiovascular diseases (31). Researchers also reported that cross-sex hormone therapy is associated with increased risk of venous thrombosis, MI, cardiovascular disease, and diabetes (32-35). Prior to exogenous systemic hormone replacement therapy for transgender persons, the provider should therefore discuss the side effects of hormone therapy with patients, based on patient baseline risk factors.

We found that among all three transgender populations, non-conforming transgender adults were more likely to report poor mental health and functional impairment compared to male to female transgender and female to male transgender individuals. Sandfort *et al.* [2007] reported that compared with gender conforming gay and bisexual Latino men, gender non-conforming gay and bisexual Latinos were more likely to experience childhood sexual abuse, verbal/physical abuse, and rape by lovers or relatives (36). Being non-conforming transgender can be socially challenging. In addition, health care providers may not have adequate knowledge and capacity to provide unique care to this disadvantaged and underserved transgender population. Transgender persons have been turned away by health care providers or had other negative experiences. Some of them may avoid medical care because of these negative experiences. Transgender health services also currently are not covered by insurance, and some of the providers do not have the tools or skills to appropriately serve transgender persons. These challenges raise important legal, ethical, and medical considerations that are worthy of future study (37-39).

Our study is not without limitations. The BRFSS study is a telephone survey, and there is a risk of selection bias for persons with secure housing arrangements. It is estimated that 1 in 5 transgender people have unstable housing, or are at risk or in need of shelter services (3,12,38,39). Our respondent sample however, indicates that almost half of our transgender respondents own a home. There is also a chance that some of the information collected may not be accurate due to social desirability bias. For instance,

respondents may deny transgender identity because of concerns about stigma, safety, privacy, or transphobia. Strengths of this study include the large sample size and our use of the largest continuously conducted health survey system in the world, in addition to robust statistical analytic approaches.

Conclusions

In summary, we found higher rates of self-reported physical/mental functional impairments, including depression and poor mental wellbeing among transgender groups compared to non-transgender persons. Our results will be useful in planning mental health services for this unique subpopulation.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/jphe.2019.12.02>). XC serves as an unpaid editorial board member of *Journal of Public Health and Emergency* from Jan 2017 to Dec 2022. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. We only used the 2016 CDC BRFSS publicly available data to assess social economic status, behavioral health-related factors, medical care access, co-morbidities, and mental health functional impairments among three transgender subpopulations. Ethics approval was not required.

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