Size and Distribution of Transgender and Gender Nonconforming Populations

A Narrative Review

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KEYWORDS

• Transgender • Gender nonconforming • Epidemiology • Population

KEY POINTS

- Accurate estimates of the number and the proportion of transgender and gender nonconforming (TGNC) people in a population are necessary for developing data-based policy and for planning and funding of health care delivery and research.
- The literature addressing this topic spans five decades and presents data from 17 countries.
- On balance, the data indicate that people who self-identify as TGNC represent a sizable proportion of the general population with realistic estimates ranging from 0.1% to 2%, depending on the inclusion criteria and geographic location.
- Clinic-based studies seem to capture only a small subset of the TGNC population.
- Temporal trends show that TGNC population is undergoing rapid changes in terms of its size and in terms of its demographic characteristics.

INTRODUCTION

Accurate estimates of the number and the proportion of transgender and gender nonconforming (TGNC) people in a population are necessary for developing data-based recommendations and for planning and funding of health care delivery and

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research.[1] In addition, accurate estimates of the TGNC population size allow developing social policy that protects against stigma and discrimination, inform effective transgender health care programs, and educate insurance companies on how to provide coverage for such care.[2]

In 2012, the Standards of Care for the Health of Transsexual, Transgender, and Gender Nonconforming People identified only a small number of articles attempting to estimate the size of the TGNC population, and characterized the state-of-the-science as at a "starting point" requiring further systematic study.[3] In recent years, several reviews sought to synthesize the available information regarding this issue[4–6]; however, the rapidly expanding literature warrants reevaluation of all available data.

In reviewing epidemiologic considerations related the size of TGNC population it is best to avoid the terms "incidence" and "prevalence" because these terms can lead to inappropriate "pathologizing" of TGNC people.[7,8] Moreover, the term "incidence" may not be applicable in this situation because it assumes that TGNC status has an easily identifiable time of onset, a prerequisite for calculating incidence estimates.[9] For all of these reasons we use the terms "number" and "proportion," which more precisely signify the absolute and the relative size of the TGNC population, respectively.

A total of 43 publications estimating the number and the proportion of TGNC people are available to date (**Fig. 1**). Of those 22 studies were conducted in Europe, 12 were based in the United States, two were from Japan, two from Taiwan, and two from New Zealand. Iran, Australia, and Singapore each contributed a single study. The years of publication ranged from 1968 to 2018.

The main findings from the available studies are summarized next. We discuss the evidence according to the definition of TGNC, which is divided into four main categories. The first category includes individuals who received or requested surgical or hormonal gender-affirmation therapy. The second category is limited to TGNC people who received transgender-related diagnoses, such as "transsexualism," "gender dysphoria," or "gender identity disorder." The third category defines the population of interest based on self-reported TGNC status. The fourth category is based on legal or administrative name or gender changes. The reported ranges for each category are

Fig. 1. Geographic distribution of 41 studies estimating the number and population proportion of TGNC individuals (*circle* corresponds to the number of studies from each country).

evaluated overall and separately for persons assigned male and female at birth (AMAB and AFAB, respectively).

In addition to summarizing reported ranges of TGNC numbers and proportions, we also discuss additional epidemiologic considerations that may contribute to better understanding of the characteristics and distribution of this population. Additional considerations include a need to distinguish between studies that were conducted in a clinical setting from those that were population-based, important differences in geographic distributions, and notable time trends.

PROPORTIONS OF INDIVIDUALS RECEIVING OR REFERRED FOR GENDER-AFFIRMATION THERAPY

Nine studies focused on individuals who received or requested gender-affirming treatment (**Table 1**). Of those, seven publications have estimated the proportions of TGNC people by considering only those who received or were referred for gender-affirming surgery.[10–16] The numerators for most of these estimates were based on clinical case series or surveys of practitioners providing transgender care, whereas the denominators were typically approximated from demographic data for a particular geographic area of interest. The estimated proportions of TGNC in general population in this category of studies ranged between 1 and 35 per 100,000 individuals. Note that these ranges cover a period of nearly 50 years, and come from studies conducted in a variety of settings and based on data of variable quality and completeness.

The corresponding data pertaining to the proportion of individuals who received hormone therapy are limited to two studies conducted in the Netherlands. In 1976, the Free Amsterdam University clinic established a gender team. Based on data collected through 1986, a total of 538 individuals began hormone therapy at that facility.[17] Of those, 399 were AMAB and 139 AFAB. Using the Dutch Bureau of Statistics data for denominator estimates, the proportion of TGNC in the Dutch population was calculated as 5.6 per 100,000 for AMAB and 1.9 per 100,000 for AFAB. In a subsequent study based at the same clinic, the analysis was extended through the end of 1990.[18] By that time, the clinic was providing hormone therapy to 713 transgender patients older than age 15 years, 507 AMAB and 206 AFAB. The total population of the Netherlands in 1990 was used to determine prevalence estimates of 8.4/100,000 AMAB and 3.3/100,000 AFAB.

PROPORTIONS OF INDIVIDUALS WHO MET THE CRITERIA FOR TRANSGENDER AND GENDER NONCONFORMING–RELATED DIAGNOSES

Of the 18 publications listed in **Table 2**, 13 studies calculated the proportions of TGNC people using diagnostic codes for “transsexualism,” “gender dysphoria,” or “gender identity disorder”.[19–31] Methodologically, most studies that relied on TGNC diagnoses are similar to those that defined TGNC as having received gender-affirming therapy. Most used general demographic information to define the denominator and relied on clinical case series or survey of practitioners to determine the size of the TGNC population. The reported proportions of individuals with TGNC-specific diagnoses across populations in these studies ranged from 0.7 to 28 per 100,000. The corresponding estimates for AMAB and AFAB individuals ranged from 0.7 to 36 and from 0.7 to 19, respectively.

The numerators in the clinic- or physician interview-based studies are most likely underestimates because they primarily capture subjects who receive care at specialized facilities. Two studies (one in Taiwan and one in Iceland) addressed this limitation by using diagnostic interviews of the general population cohorts.[32,33] Both studies

Table 1
Number and population proportion of individuals who received or requested to receive surgical or hormonal gender-affirmation therapy

Reference	Location; Time Period	Case Definition	Source of Numerator	Numerator			Source and Size of Denominator	Proportion (per 100,000)			Ratio AMAB/ AFAB
				Total	AMAB	AFAB		Total	AMAB	AFAB	
Bakker et al,[18] 1993	Netherlands, 1976–1990	Receipt of HT	Free University of Amsterdam (AZVU) clinic records	713	507	206	Center of Statistics: 6,019,546 males and 6,252,566 females		8.4	3.3	2.5:1
Caldarera & Pfäfflin,[10] 2011	Italy, 1992–2008	GAS receipt	Surgical clinics	549	424	125	National Institute of Statistics 2009: total 59,619,290 (28,949,747 males and 30,669,543 females)	0.9	1.5	0.4	3.39:1
De Cuypere et al,[11] 2007	Belgium, 1985–2003	GAS receipt	Questionnaires sent to "gender teams" and plastic surgeons	412	292	120	January 2003 population: 3,758,969 males and 4,048,095 females		7.7	3.0	2.43:1
Dhejne et al,[15] 2014	Sweden, 1960–2010	Request (receipt) of GAS	National Board of Health and Welfare Statistics	767 (681)	478 (429)	289 (252)	December 2010 population: 3,704,685 males and 3,791,791 females	10.2 (9.1)	12.9 (11.6)	7.5 (6.6)	1.7:1
Eklund et al,[17] 1988	Netherlands, 1976–1986	Receipt of HT	Free University of Amsterdam (AZVU) clinic records	538	399	159	Dutch census data: 7,125,000 males and 8,368,421 females[a]		1980: 2.2 1983: 3.8 1986: 5.6	1980: 0.5 1983: 1.0 1986: 1.9	3:1
Esteva de Antonio et al,[16] 2012	Spain, 1999–2011	Request for GAS	Questionnaires sent to gender identity units	3303			Spanish population 15–64 years old, 33,030,000[a]	10.0			1.9:1

Pauly,[14] 1968	United States, dates not specified	Request for GAS	Author's communication with specialized centers		2000	500	200,000 total US population used for both AMAB and AFAB calculations		1.0	0.25	4:1
Tsoi,[12] 1988	Singapore, until 1986	Request for GAS	Documented diagnosis of transsexualism as part of pre-GCS evaluation	458	343	115	Population June 1986: 979,300 males and 954,900 females		35.0	12.0	3:1
Vujovic et al,[13] 2009	Serbia, 1987–2006	Receipt of GAS	Informed written consent to undergo treatment	147	71	76	7,500,000 (World Bank data)	1.96	1.89	2.0	1:1

Abbreviations: GAS, gender-affirming surgery; HT, hormone therapy.
[a] Denominator calculated from the numerator and the reported proportion.

Table 2
Number and population proportion of individuals who received a transgender-specific diagnosis

Reference	Location; Time Period	Case Definition	Source of Numerator	Numerator			Source and Size of Denominator	Proportion (per 100,000)			Ratio AMAB/AFAB
				Total	AMAB	AFAB		Total	AMAB	AFAB	
Ahmadzad-Asl, et al,[24] 2010	Iran, 2002–2009	GID diagnosis DSM-IV-TR	Tehran Psychiatric Institute	281	138	143	Center of Statistics of Iran, population aged 15–44: 39,526,948	0.7	0.69	0.74	0.96:1
Baba et al,[23] 2011	Hokkaido, Japan, December 2003–January 2010	GID diagnosis ICD-10 and DSM-IV	Sapporo Medical University Hospital	342	104	238	Native Japanese Hokkaido residents: 5,500,000		3.97	8.2	1:2
Becerra-Fernández et al,[29] 2017	Autonomous Region of Madrid (Spain), 2007–2015	ICD-10 and/or gender identity disorder based on the DSM-IV-TR	Patients referred to the GIU at the Hospital Universitario Ramon y Cajal (Madrid)	1171	803	368	Official population in the autonomous region of Madrid >15 year old in 2015: 5,310,409 (2,516,147 males and 2,794,262 females)	22.1	31.2	12.9	2.2:1
Blosnich et al,[34] 2013	VA system, United States, 2002–2011	GID diagnosis ICD-9 codes 302.85 (GID) or 302.6 (GID NOS)	Confirmed GID diagnosis in VHA, FY 2000–2011	2002: 569 2011: 1329			Total VHA patients: 4,544,353 (2002), 5,795,165 (2011)	2002: 12.5 2011: 22.9			
Esteva et al,[20] 2006	Andalucía, Spain, 1999–2004	GID diagnosis	Regional gender identity disorder unit		243	148	Regional Population: 2,359,223 males and 2,276,923 females[a]		10.3	6.5	1.64:1
Gómez Gil et al,[21] 2006	Catalonia, Spain, 1996–2004	ICD-10 F64.0 (transsexualism)	Psychiatric and Psychology Institute at the Barcelona Hospital, 1996–2004		Catalonia: 113 Barcelona: 100	Catalonia: 48 Barcelona: 45	Catalonia: 2,376,538 males 2,308,611 females Barcelona: 1,996,708 males 1,776,269 females		Catalonia: 4.8 Barcelona: 5.5	Catalonia: 2.1 Barcelona: 2.5	2.6:1
Hoenig & Kenna,[19] 1974	England and Wales, 1958–1968	GID	Royal Infirmary Manchester at the University Department of Psychiatry	66	49	17	Manchester population June 30, 1970: 3,498,700 (1,652,000 males 1,846,700 females)	1.9	2.9	0.9	3.25:1

Hwu et al,[32] 1989	Taiwan, 1982–1986	Diagnostic Interview Survey	Multistage random sampling method	Taipei: 3 Small towns: 6 Rural villages: 3			Taipei: 5000 Small towns: 3000 Rural villages; 3000	Taipei: 60 Small towns: 200 Rural villages: 30	Taipei: 40 Small towns: 0 Rural villages: 0	Taipei: 80 Small towns: 420 Rural villages: 70	Taipei: 1:2
Judge et al,[25] 2014	Ireland, 2005–2014	GID, DSM-IV/V	GD clinic referrals 2005–2014	218			2011 census reports: total 3,205,882[a]	6.8	9.88	3.6	2.7:1
Kauth et al,[35] 2014	VA system, US, 2006–2013	GID diagnosis ICD-9 codes 302.85, 302.6, 302.5	Confirmed GID diagnosis VHA, FY 2006–2013	2567			VHA enrollees: 7,809,269		32.9		
O'Gorman,[31] 1982	Northern Ireland, dates not specified	GID	Clinic based, >14 y	28	21	7	Northern Ireland population: 1,500,000	1.9			3:1
Okabe et al,[22] 2008	Japan, April 1997–October 2005	GID, DSM-IV	GID Clinic- Okayama University Hospital	579	349	230	Inhabitants of Western Japan, estimated at 40,000,000		0.9		1.5:1
Quinn et al,[36] 2017	Kaiser Permanente, United States, 2006–2014	Transgender-specific diagnoses and free-text keywords	Electronic medical records at Kaiser Permanente sites in Georgia, NoCal, and SoCal				All members enrolled in a given year	2006 GA: 3.5 SoCal: 5.5 NoCal: 17 2014 GA: 38 SoCal: 44 NoCal: 75			2006: 1.7:1 2014: 1.7:1
Ross et al,[27] 1981	Australia, 1976–1978	Transsexual	Questionnaires to registered psychiatrists	243	209	34	Australia's population on June 31, 1978: 10,616,188[a]	2.4	4.2	0.7	6.1:1
Stefansson et al,[33] 1991	Iceland, 1931–1986	"Transsexual" diagnosis	Diagnostic interview schedule	1			862 persons representing half of the 1931 birth cohort in Iceland (441 males, 421 females)	100			

(*continued on next page*)

Table 2
(*continued*)

Reference	Location; Time Period	Case Definition	Source of Numerator	Numerator			Source and Size of Denominator	Proportion (per 100,000)			Ratio AMAB/AFAB
				Total	AMAB	AFAB		Total	AMAB	AFAB	
Wålinder,[26] 1968	Sweden, as of 1965	GID	Survey of psychiatrists	110			Not stated, estimate: 6,272,886[a]	1.9	2.7	1.0	2.5:1
Wiepjes et al,[30] 2018	Amsterdam, 1972–2015	ICD-9 and ICD -10 codes	Medical files of all people who attended the gender identity clinic	6793	4432	2361	Total population of people at least 16 years old in the Netherlands in 2015: 13,870,426	27.7	36.4	19.3	1.9:1
Wilson et al,[28] 1999	Scotland, 1998	GD	Questionnaires to general medical practices	273	218	55	Registered patients >15 y of age: 3,336,261 (1,622,090 males 1,714,171 females)	8.2	13.4	3.2	4:1

Abbreviations: DSM, diagnostic and statistical manual of mental disorders; GD, gender dysphoria; GID, gender identity disorder; ICD, international classification of diseases; NoCal, Northern California; SoCal, Southern California; VHA, veterans health administration.

[a] Denominator calculated from the numerator and the reported proportion.

administered site-specific versions of the Diagnostic Interview Schedule by the US National Institute of Mental Health. Although these studies were conducted several decades ago and may no longer be applicable, both reported proportions (range, 30–100 per 100,000) that exceeded those obtained from clinics or from surveys of health care providers. Note, however, that the estimates in both studies were statistically imprecise because they were based on small sample sizes and identified few TGNC people.

Several studies estimated proportions of TGNC people among individuals enrolled in health care systems. Blosnich and colleagues[34] used Veterans Health Administration electronic medical records from 2000 through 2011. The numerator for the study included individuals that had received an International Classification of Diseases-9th edition diagnostic code of either 302.85 (gender identity disorder) or 302.6 (gender identity disorder not otherwise specified). Using the Veterans Health Administration data and electronic record database to define the denominator, the authors reported prevalence estimates for different years starting in 2002. The 2002 estimate was 12.5 per 100,000 and the proportion reported in 2011 was 22.9 per 100,000. In a more recent similarly designed VA-based study the numerator was expanded to include International Classification of Diseases-9th edition code 302.5 (transsexualism). The proportion of TGNC veterans in 2013 was 32.9 per 100,000.[35]

Another health systems–based study evaluated electronic medical records data at Kaiser Permanente sites in Georgia, Northern California, and Southern California.[36] The numerator was ascertained using step-wise methodology, which involved computerized searches of diagnostic codes supplemented by a review of free text to identify TGNC individuals. The proportions of TGNC Kaiser Permanente enrollees increased over time at each of the three participating sites. In 2006, the estimates per 100,000 enrollees were 3.5, 5.5, and 17 in Georgia, Southern California, and Northern California, respectively; however, by 2014, the corresponding estimates increased to 38, 44, and 75.

PROPORTIONS OF ADULTS WITH SELF-REPORTED TRANSGENDER AND GENDER NONCONFORMING IDENTITY

Nine studies listed in **Table 3** used survey-based data to estimate the proportion of adults (persons older than age 18 years) who self-identified as TGNC.[37–45] The use of self-report greatly increased the likelihood that an individual would meet the criteria for inclusion in the numerator. The resulting proportions were also orders of magnitude higher and thus could be expressed as percentages.

In the United States, several studies took advantage of the Behavioral Risk Factor Surveillance Study (BRFSS), an annual telephone survey conducted in all 50 states and US territories.[37–40] One of the earliest BRFSS-based studies analyzed data collected between 2007 and 2009 in the State of Massachusetts.[37] The survey was administered to 28,662 adults, and contained the following module: “Some people describe themselves as transgender when they experience a different gender identity from their sex at birth. For example, a person born into a male body, but who feels female or lives as a woman. Do you consider yourself to be transgender?” A total of 131 participants responded “yes” to that question, corresponding to a proportion of 0.5%.

In 2014, the same BRFSS question was adopted by 19 states and the territory of Guam. Across all participating sites, TGNC individuals made up 0.53%.[38] An additional analysis of the same data estimated the proportion of TGNC population for the entire US by extrapolating data from the 20 participating sites.[39] The missing information for states and territories that did not inquire about TGNC status was imputed

Table 3
Number and population proportion of adults who self-reported transgender identity and gender nonconformity

Reference	Location; Time Period	Case Definition	Source of Numerator	Numerator			Size of Denominator	Proportion (per 100,000)			Ratio AMAB/ AMAB
				Total	AMAB	AFAB		Total	AMAB	AFAB	
Ahs et al,[44] 2018	Stockholm County, Sweden, 2014	Desire to undergo treatment	Stockholm Public Health Cohort study questionnaire	121	60	61	50,157; 21,586 males and 28,571 females	500	600	400	1:1
		Feeling as person of different sex		770	309	461		2300	2100	2500	1:1.49
		Desire to be treated as person of different sex		779	218	561		2800	2000	3500	1:2.57
Conron et al,[37] 2012	Massachusetts, 2007–2009	Self-identity as transgender	Massachusetts BRFSS 2007–2009	131			28,176	500			
Crissman et al,[38] 2017	United States, 2014	Self-identity as transgender	Annual cross-sectional telephone survey in all US states and 3 territories	TGNC: 807 Trans: 691	Trans: 363	Trans: 212	151,456 (62,086 cis-males, 886,679 cis-females)	TGNC 530 Trans: 456	581	238	2.4:1
Flores et al,[39] 2016	United States, 2014	Self-identity as transgender	BRFSS, in all US states and 3 US territories	1,400,000			233,333,333[a]	600			

Gates,[40] 2011	California, 2003–2009	Self-identity as transgender	2009 California Health Interview Survey, 2003 CA LGBT Tobacco Survey	49			47,614 survey participants in the California Health Interview Survey	100			
Kuyper & Wijsen,[42] 2014	Netherlands, 2013	Incongruent gender identity	Sexual Health Survey		48	16	8064		600	200	3:1
Lai et al,[45] 2010	Taiwan, University, 2003–2004	Self-reported gender dysphoria	Adult Self-Report Inventory-4, DSM-IV referenced rating	225	49	176	5010 (2585 males, 2425 females) first-year college students	4500	1900	7300	1:3
Reisner et al,[41] 2014	United States, 2010	Self-identity as transgender	Growing Up Today Study	26	10	16	7831 (2605 males, and 5226 females)	330	380	310	
Van Caenegem et al,[43] 2015	Flanders, Belgium, 2011–2012	Incongruent gender identity	Sexual Health Survey	13	7	6	1799	722	783	662	1.2:1

Abbreviations: BRFSS, behavioral risk factor surveillance survey; DSM, diagnostic and statistical manual of mental disorders.

[a] Denominator calculated from the numerator and the reported proportion.

using multilevel statistical models. Based on these calculations, the estimated number of TGNC adults residing in the United States in 2014 was approximately 1.4 million, which constitutes 0.6% of the total population (or 600 per 100,000). The state-specific estimates ranged from 0.3% to 0.8% in North Dakota and Hawaii, respectively.

Using the Growing Up Today prospective cohort study of US young adults, a 2010 survey implemented a two-step approach by inquiring about sex assigned at birth, and asking about the participants' self-described gender identity.[41] The response options were "female," "male," "transgender, "and "do not identify as female, male or transgender." Of the 7831 survey respondents, 26 (0.33%) identified as having a gender identity that differed from the assigned (natal) sex. Of those, seven (0.09%) were cross-sex identified; five (0.06%) self-described as transgender; and 14 (0.18%) did not identify as female, male, or transgender. These data indicate that when assessing proportion of TGNC people it is important to include nonbinary measures especially among younger adults.

Kuyper and Wijsen[42] estimated the proportion of TGNC people among adolescent and adult residents of the Netherlands using Internet-based data collection. The study sample included 8064 participants who were asked questions regarding gender identity and gender dysphoric feelings (defined as ambivalent or incongruent gender identity, dislike of body characteristics, or wish to obtain treatment). The analysis of the data yielded proportions of 0.6% for AMAB and 0.2% among AFAB; however, the response rate was low (20%).

A similar study estimated proportion of TGNC people among residents of the Flanders region in Belgium.[43] Eligible participants were randomly selected from the Belgian National Register and 1799 (48%) completed the survey. Information pertaining to gender identity and gender expression was collected via a computer-assisted personal interview. Using a five-point Likert scale, the participants were asked to score the following statements: "I feel like a woman," and "I feel like a man." A person was considered gender ambivalent if the same answer (eg, a 1 or a 2) was given to both statements. Gender incongruence was defined as a lower score assigned to the natal sex than to the other sex. Using these definitions, the prevalence of gender incongruence was estimated to be 0.7% for AMAB and 0.6% for AFAB. The corresponding estimates for gender ambivalence among AMAB and AFAB were even higher: 2.2% and 1.9%, respectively.

A study of Taiwanese university students conducted interviews with 5010 participants using the Adult Self-Report Inventory-4 instrument.[45] Self-reported "gender dysphoria" was determined based on a response to the statement "I wish I was the opposite sex." Responses "often" and "very often" were interpreted as evidence of gender dysphoria. The use of this rather loose definition produced high estimated proportions of TGNC people: 7% for AFAB and 1.9% for AMAB.

A recent population-based study evaluated proportion of TGNC people among 50,157 adults residing in Stockholm County, Sweden.[44] The numerator was determined by asking "I would like hormones or surgery to be more like someone of a different sex." Two additional items were designed to identify individuals experiencing gender incongruence: "I feel like someone of a different sex," and "I would like to live as or be treated as someone of a different sex." Responses to each item followed a four-point Likert scale. Using weighting to account for stratified sampling design, the authors reported that the desire for hormone therapy or gender-affirming surgery was reported by 0.5% of participants. Participants who expressed feeling like someone of a different sex and those who wanted to live or be treated as a person of another sex constituted 2.3% and 2.8% of the total sample, respectively.

PROPORTIONS OF CHILDREN AND ADOLESCENTS WITH SELF-REPORTED TRANSGENDER AND GENDER NONCONFORMING IDENTITY

The literature on the proportion of TGNC youth (persons younger than 19 years of age) in the general population is sparse. Four recent studies examined this question by conducting surveys among school children (**Table 4**).[46–49]

Almeida and colleagues[46] used data from the 2006 survey of 9th to 12th grade students in Boston public schools. The survey participants were asked whether they considered themselves transgender (yes, no, do not know), although the precise definition of "transgender" is not given." Of the 1032 complete surveys administered at 18 schools, 17 (1.6%) indicated that the respondents self-identified as transgender. Eleven of the 17 transgender adolescents reported "female as their sex"; this presumably corresponds to the AMAB/AFAB ratio of 1.8:1.

A 2012 national cross-sectional survey in New Zealand collected information on TGNC status among 8166 high school students.[47] The numerator was based on the responses to the question "Do you think you are transgender? This is a girl who feels like she should have been a boy, or a boy who feels like he should have been a girl (eg, Trans, Queen, Fa'faffine, Whakawahine, Tangata ira Tane, Genderqueer)?" The question about TGNC status was preceded by the question "What sex are you?" (with binary response options). A total of 96 students (1.2%) self-identified as TGNC, and 202 (2.5%) reported they were not sure. The AMAB/AFAB ratio for TGNC participants was 1:1.2 and the corresponding estimates for those who responded not sure was 1:1.5. Only about one-third of TGNC participants reported having disclosed their TGNC status.

The most recent of the available publications reported the results of the 2016 survey conducted among 9th and 11th grade students in Minnesota.[48] The data included information on 80,929 survey respondents; of those 2198 students (2.7%) reported being TGNC with AMAB/AFAB ratio of 1:2. The proportions of TGNC adolescents were higher among racial/ethnic minorities, but similar in metropolitan and nonmetropolitan areas of the state.

Only one study examined the proportion of TGNC children in the younger age group. Shields and colleagues[49] analyzed the data from a 2011 survey that included 2730 students (grades 6–8) across 22 public middle schools in San Francisco. Thirty-three children self-identified as TGNC based on the question, "What is your gender?" with the response options "female, male, or transgender." The resulting overall proportion of TGNC survey respondents was 1.3%; however, the results by AMAB/AFAB status were not provided.

PROPORTIONS OF PEOPLE REQUESTING LEGAL NAME OR GENDER CHANGES

Three studies calculated proportions of people who applied for or underwent administrative sex or name change. Two of these studies were conducted in Germany, and one used data from New Zealand.

Weitze and Osburg[50] relied on the 1981 German Transsexuals' Act, which allowed applicants to change their name or documented gender. Within 10 years following implementation of the law, the courts issued 683 decrees on first-name changes and 733 rulings on legal affirmation of gender identity. These rulings involved 1199 individuals, of whom 1047 received approval. Based on the adult population of West Germany before reunification, the proportion of individuals who sought change of their legal record was estimated at 2.1/100,000. The AMAB to AFAB ratio of applicants was approximately 3:1. A more recent report extended the work of Weitze and Osberg by evaluating changes in legal sex status between 1991 and 2000 in all of Germany.[51]

Table 4
Number and population proportion of children and adolescents who self-reported transgender identity and gender nonconformity

Reference	Location; Time Period	Case Definition	Source of Numerator	Numerator			Size of Denominator	Proportion (per 100,000)			Ratio AMAB/ AMAB
				Total	AMAB	AFAB		Total	AMAB	AFAB	
Almeida et al,[46] 2009	Boston, Massachusetts, 2006	Self-identity as transgender	Boston Youth Survey data	17	11	6	1032	1600			
Clark et al,[47] 2014	New Zealand, 2012	Self-identity as transgender Not sure of gender identity	National survey of secondary school students	96 202	44 82	52 120	8164 (3669 males, 4495 females)	1176 2474	1157 2235	1199 2670	1:1 1:1.2
Eisenberg et al,[48] 2017	Minnesota, 2016	Self-identity as transgender	Minnesota Student Survey	2198			80,929	2700	1700	3600	1:2
Shields et al,[49] 2013	United States, 2011	Self-identity as transgender	Youth Risk Behavior Survey of San Francisco middle schools	33			2701	1300			

The overall proportion of individuals requesting the change was 3.88 per 100,000, using the German population in 2000 as the denominator. The corresponding proportions for AMAB and AFAB were reported to be 4.95 per 100,000 and 2.87 per 100,000, respectively.

In New Zealand, individuals may request a change of their gender marker from "M" or "F" to "X." To determine the frequency of this change, Veale[52] contacted the New Zealand Department of Internal Affairs Passport Office in 2008. A total of 385 such changes were identified. Given the number of passport holders in New Zealand, the proportion of TGNC individuals was calculated as 16 per 100,000 overall, 27 per 100,000 for AMAB, and 4.4 per 100,000 for AFAB.

EVALUATION OF TEMPORAL CHANGES

Virtually all studies evaluating secular trends reported dramatic increases in the numbers (and therefore the population proportions) of TGNC people in recent decades. These observations are confirmed independently regardless of the geographic area of interest, TGNC definition, or statistical methodology. For example, frequency of requests to undergo gender-affirming surgery or hormone therapy were reported to increase between 1960 and 2010 in Sweden,[15] between 1975 and 1992 in the Netherlands,[53] and between 1999 and 2006 in Serbia.[13] Similarly, the proportions of people with documented TGNC status in medical records increased between 1975 and 2015 in the Netherlands,[30] between 2007 and 2015 in Spain,[29] and between 2002 and 2014 across various health systems in the United States.[34,36]

The temporal changes in the proportion of people who self-identify as TGNC are also evident. For example, Meerwijk and Sevelius[2] summarized data from five different population-based surveys that collect data on TGNC identity in the United States. Although the data were limited to the recent years (2007–2015), a meta-regression analysis demonstrated that the proportion of TGNC respondents increased on average 0.026% per year.[2]

Another notable phenomenon is the temporal change in age of presentation. For example, a recent study from Denmark reported that the median age at the time of gender-affirming surgery decreased from 40 years in 1994 to 27 years in 2015.[54] Similar observations were reported more recently with respect to the temporal changes in the median age of the first TGNC-related clinic visit in the Netherlands.[30]

The ratio of AFAB/AMAB also seems to be undergoing transition. In a previously cited study of TGNC people enrolled in Kaiser Permanente the composition of the TGNC population also changed over time.[36] Whereas in 2006 the AMAB/AFAB ratio among TGNC health plan members was approximately 1.7:1, in 2014 the same ratio was 1:1.

The temporal change in the AMAB/AFAB ratio may be especially pronounced among TGNC youth. Two groups of researchers in Canada and in the Netherlands compared data from their respective specialized gender identity clinics for the most recent time period (2006–2013) versus earlier years.[55] At both study sites, there was a notable switch in the AMAB/AFAB ratio. In Canada the ratio changed approximately 1.4:1 in the earlier time period to 1:1.7 in the later period. The changes in the Netherlands were reported to be in the same direction.

A similarly designed study conducted in the United Kingdom reported evidence that the AMAB/AFAB ratio among adolescents changed from 1.6:1 in 2009 to 1:2.5 in 2016. The corresponding ratios for children (younger than 12 years of age) changed from 5:1 to approximately 1:1.[56] In an expanded analysis of the same data covering the period from 2000 to 2017, the results were generally the same.[57]

DISCUSSION

The current literature on the number and proportion of TGNC people is highly heterogeneous. Whereas in most studies focusing on individuals who seek or receive TGNC-related care at specialized institutions, the estimates of interest generally ranged between 1 and 30 per 100,000 individuals, self-reported TGNC identity was found to be orders of magnitude more frequent. The reported proportions of people self-identified as TGNC ranged from 100 to 2000 per 100,000 or 0.1% to 2% among adults. The corresponding range among schoolchildren was 1.3% to 2.7%. One study reported an even higher proportion of almost 5%,[45] but there is a good reason to suspect that the specific survey item ("I wish I was the opposite sex") used in that study may have resulted in an inflated estimate.

In addition to differences in definitions, other sources of heterogeneity across reported results may include diverse cultural and legal population-specific contexts and a wide range of time periods covered in different studies. With respect to the former, the magnitude of the reported proportions may depend on how TGNC people are perceived and treated in a society. With respect to the latter, the reported inconsistencies of findings over time are likely attributable to the increasing likelihood of acknowledging and disclosing one's TGNC status.

Proportion, by definition, is a ratio in which all observations in the numerator arise from a predefined denominator. With this definition in mind, it is important to acknowledge that most studies included in this review first assessed the number of patients seen at a particular clinical center and then divided that number by an approximated population size. Such an approach is unlikely to produce an accurate estimate because the numerator and the denominator are ascertained without a defined sampling frame and are both subject to error. These methodologic shortcomings have been discussed previously, and it is encouraging that several of the recently published studies were able to use more formal statistical methodology.[35,36,41,44]

In summary, it is clear that people who identify as TGNC represent a sizable proportion of the general population. Based on the credible evidence available to date, this proportion currently ranges from 0.1% to 2.7%, depending on the inclusion criteria, age of participants, and geographic location. By contrast, clinic-based studies seem to capture only a small subset of the TGNC population. It is also clear that TGNC population is undergoing rapid changes in terms of its size and in terms of its demographic characteristics, such as age of "coming out," and AMAB/AFAB ratio. Accurate estimates of the proportion, distribution, and composition of the TGNC population depend on the availability of systematically collected high-quality data. Far more accurate and precise estimates should become available when population censuses begin collecting data on sex assigned at birth and gender identity, including nonbinary categories.

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