



## Measurement of gender and sexuality in the Adolescent Brain Cognitive Development (ABCD) study

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### ABSTRACT

The Adolescent Brain Cognitive Development<sup>SM</sup> (ABCD) study is a longitudinal study of adolescent brain development and health that includes over 11,800 youth in the United States. The ABCD study includes broad developmental domains, and gender and sexuality are two of these with noted changes across late childhood and early adolescence. The Gender Identity and Sexual Health (GISH) workgroup recommends measures of gender and sexuality for the ABCD study, prioritizing those that are developmentally sensitive, capture individual differences in the experience of gender and sexuality, and minimize participant burden. This manuscript describes the gender and sexuality measures used in ABCD and provides guidance for researchers using these data. Data showing the utility of these measures and longitudinal trends are presented. Including assessment of gender and sexuality in ABCD allows for characterization of developmental trajectories of gender and sexuality, and the broad scope of ABCD data collection allows examination of identity development in an intersectional manner.

### 1. Introduction

Gender and sexuality are important aspects of development in adolescence, relevant for how all youth understand themselves and interact with one another. Additionally, youth who identify as sexual and gender minorities (SGM) may have unique developmental experiences related to gender and sexual development that warrant specific

attention, particularly in light of the ongoing health disparities adversely affecting SGM youth (Patterson et al., 2020). The purpose of this manuscript is to describe how gender and sexuality are measured in the Adolescent Brain Cognitive Development (ABCD) study and provide recommendations for researchers who wish to use these data. Table 1 provides definitions of gender and sexuality terms used in this manuscript.

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**Table 1**  
Gender and sexuality terms.

Sex, Sex assigned at birth	The assignment as male or female, usually based on physical anatomy and/or chromosomes at birth (Potter et al., 2021).
Intersex	Refers to a range of conditions associated with atypical development of physical sex characteristics (American Psychological Association, 2006).
Gender	Refers to the attitudes, feelings, and behaviors that a given culture associates with a person's biological sex (American Psychological Association, 2015).
Gender Identity	Internal sense of oneself as boy, girl, or something else (Potter et al., 2021).
Cisgender	Refers to individuals who have a match between the sex they were assigned at birth and their gender identity (Schilt and Westbrook, 2009). <sup>a</sup>
Transgender	An umbrella term encompassing those whose gender identities or gender roles differ from those typically associated with the sex they were assigned at birth (American Psychological Association, 2018).
Felt-gender	The degree to which an adolescent experiences congruence between their subjective feeling like a boy or girl and their assigned sex at birth (Potter et al., 2021).
Gender Expression	The communication of gender through appearance, mannerisms, etc (Potter et al., 2021).
Gender Nonconformity	Describes an individual whose gender roles or gender expression differs from the gender norms associated with the sex they were assigned at birth (American Psychological Association, 2018). <sup>a</sup>
Gender Contentedness	Feelings of contentment with one's biological sex (Egan and Perry, 2001).
Gender Dysphoria	Discomfort or distress related to an incongruence between an individual's gender identity and the gender assigned at birth (American Psychological Association, 2018).
Gender Minority	Individuals whose gender identity or expression is different from their sex assigned at birth.
Sexual Development	Process wherein youth learn to understand their sexual and romantic attractions, explore sexual behaviors, and are socialized into norms of sexuality by peers, parents, and the broader culture (Tolman and McClelland, 2011).
Sexuality	A central aspect of being human throughout life that encompasses sex, gender identities and roles, sexual orientation, eroticism, pleasure, intimacy and reproduction (World Health Organization, 2006).
SGM	Acronym for sexual and gender minority
Sexual Minority	Individuals who identify as gay, lesbian, or bisexual, or who are attracted to or have sexual contact with people of the same gender.
Sexual Orientation	Refers to an individual's enduring pattern of emotional, romantic and/or sexual attractions, a person's sense of identity based on those attractions, and their related behaviors and membership in a community of others who share those attractions (American Psychological Association, 2008).
Sexual Health	Sexual health is a state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity (World Health Organization, 2006).

<sup>a</sup> Definition adapted from.

ABCD is a 10-year longitudinal study of more than 11,800 adolescents enrolled at ages 9/10 at 22 sites across the United States (study details are available at [www.abcdstudy.org](http://www.abcdstudy.org)). The sample was recruited using primarily school-based recruitment, with schools selected to reflect the US demographics of 9/10 year old youths (Garavan et al., 2018). Data collection began in 2016 (baseline visit), and participants are seen in person for yearly follow-up visits. The overarching goal of ABCD is to capture development (biological and behavioral) from late childhood through adolescence, using a comprehensive assessment battery to allow examination of how childhood experiences relate to outcomes including brain development, school achievement, and health (Auchter et al., 2018). ABCD is committed to open science, and curated data is released annually to the scientific community through the NIMH data archive (<https://nda.nih.gov/abcd>).

## 2. The gender identity and sexual health workgroup

The ABCD study is not specifically focused on gender or sexuality; rather, it aims to capture multiple aspects of adolescent development and health. The ABCD protocol is curated by 8 Assessment Workgroups in the areas of: brain development (structural, resting-state and task-based functional brain imaging), neurocognition, physical health, mental health, culture and environment, and gender and sexuality. Workgroups include domain expertise from within the ABCD consortium and federal partners to identify and recommend assessments to be used in ABCD and provide ongoing quality control of data collected (Auchter et al., 2018).

The Gender Identity and Sexual Health (GISH) workgroup follows principles used across ABCD workgroups (Barch et al., 2018; Lisdahl et al., 2018; Luciana et al., 2018; Zucker et al., 2018) to use instruments with documented reliability and validity when available, that are appropriate for longitudinal administration, are developmentally sensitive, minimize participant burden, and measure constructs that are empirically related to brain and behavioral development. Given historical views of gender and sexuality, particular attention is paid to selecting measures that are non-pathologizing and non-stigmatizing; and that will capture individual differences in the experiences of gender and sexuality across development. Table 2 presents the GISH measures, constructs, and assessment time points.

The GISH workgroup has implemented dimensional (rather than categorical) items when possible to maximize the ability to quantify individual differences in gender and sexuality in the ABCD sample. In regards to gender, items ask about both male and female aspects of gender (for example, asking "how much do you feel like a boy", and "how much do you feel like a girl" to each participant) as recommended (Martin et al., 2017). Dimensional items are also used to assess sexuality. For example to assess sexual attraction youth are asked to describe their

**Table 2**

Summary of measures used to assess gender and sexual health in the ABCD study for ages 9–12 (through 3-year follow-up visit). For the complete measures, see Appendix Tables 1 and 2.

Measure	Constructs	Time Point	Ref.
YOUTH			
ABCD Gender Survey	Felt-Gender, Gender Contentedness, Gender Expression	1-Year Follow-up+	(Potter et al., 2021; Egan and Perry, 2001 (Reisner et al., 2015))
ABCD Sexual Behavior Survey	Sexual Behaviors, Peer perception (behavior and attitude) Sexual Attraction	2-Year Follow-up+	Adapted from Windle et al. (2004), Schulenberg et al. (2017)
KSADS-5 Background Items	Gender Identity and Sexual Orientation	3-Year Follow-up+ Baseline+	(Townsend et al., 2020)
PARENT			
ABCD Demographic Items	Gender Identity of Youth	Baseline+	
Gender Identity Questionnaire (GIQ)	Gender Expression, Gender Dysphoria	1-, 2-, and 3-Year Follow-up	(Elizabeth and Green, 1984; Johnson et al., 2004)
ABCD Gender Survey	Gender Expression, Gender Contentedness	3-Year Follow-up+	
KSADS-5 Background Items	Gender Identity and Sexual Orientation of youth	Baseline+	(Townsend et al., 2020)

Baseline Assessments were at age 9/10, and annual follow-up assessments are administered. + indicates administration continues in subsequent yearly follow-up visits. KSADS-COMP; Kiddie Schedule of Affective Disorders and Schizophrenia – Computerized version.

attractions as “not at all, a little, a lot, I don’t know, or decline to answer” on (3) separate items “attracted to girls, boys, people of another gender (e.g. nonbinary)”; rather than rating their attraction from “only to boys, equally to boys and girls, only to girls”. This approach provides for greater description of attraction including the amount of attraction and is inclusive to genders outside of the binary.

In the fall of 2020, ABCD assessments were revised to eliminate the use of binary gender classifications where possible (i.e., “Have you ever had a boyfriend/girlfriend?” was revised to “Have you ever had a romantic relationship?”). While this meant losing longitudinal consistency of item wording, this concern was outweighed by being inclusive and more fully capturing the experiences of participants. Wording changes included replacing “s/he” with “they”; “his/her” with “their”; and “your son/daughter” with “your child” among others (i.e., “The child grinds his/her teeth during sleep.” was revised to “The child grinds their teeth during sleep.”).

### 3. Rationale for assessing gender in the ABCD study

Multiple aspects of gender and gender socialization shape health and wellbeing over the life course (Snow, 2008). For example, an egalitarian view of gender roles is associated with lower conduct problems for both boys and girls (King et al., 2019), and girls in middle-school who experience gender discrimination by an adult in their school report higher depression and worse sleep (Bell and Juvonen, 2020). In adolescence, girls who uphold rigid beliefs about femininity report low rates of sexual self-efficacy and a greater propensity for sexual risk taking (Impett et al., 2006). While it is acknowledged that gender shapes experiences, little is known about normative trajectories of gender development.

Previous large epidemiological studies of adolescents typically have either ignored gender (and only measured sex assigned at birth (Conron et al., 2018)) or have asked single questions about gender identity (i.e. are you transgender (Clark et al., 2014; Johns et al., 2019)). However, this approach is narrow for reasons including that the gender roles of men and women differ across cultures and historical periods, gender identities beyond cisgender and transgender have been recognized for decades (Bornstein, 1994), and that some babies are born intersex (which is not often captured in research questionnaires (American Psychological Association, 2006)). Examining the complexity of gender in adolescent development is essential for many reasons. First because extant literature demonstrate the multi-dimensional nature of gender, with strong links to psychological function (Egan and Perry, 2001). For example, depression, anxiety, and suicide risk behaviors have been reported among adolescents who are gender non-conforming in part due to the societal backlash from defying normative expectations of gender (Johns et al., 2019; Delozier et al., 2020; Lowry et al., 2018; Reisner et al., 2015). Little longitudinal data exists on this phenomenon in adolescence, including how gender non-conformity may change with other aspects of gender development. Conversely, gender minority youth may experience unique protective factors throughout adolescence, including pride in identity, gender-focused social support, and connection to community, which have been shown to increase wellness among gender diverse people (Fredriksen-Goldsen et al., 2017), and warrant further documentation and understanding.

Finally, sex differences have been reported between male and female adolescents in engaging in risky behavior including smoking, binge drinking, and using drugs (Heise et al., 2019; Becker et al., 2016). In addition, some mental health diagnoses differ in prevalence by sex during adolescence (e.g. depression and oppositional defiant disorder; Breslau et al., 2017; Demmer et al., 2017). These differences may reflect biological factors including hormones and the rate of physical maturation (see (Ullsperger and Nikolas, 2017) for review) and/or societal factors including gender roles and gendered expectations (Snow, 2008; Becker et al., 2017). Taken together, gender is important across adolescence and advancing understanding of individual differences in

gender development will broaden our understanding of adolescent development.

#### 3.1. Measures

Gender identity is included in the background items to the Kiddie Schedule of Affective Disorders and Schizophrenia (K-SADS (Kaufman et al., 1997)) and has been administered annually since the Baseline visit. The item asks whether the child is “transgender” with response options of “yes”, “maybe”, “no”, “I don’t know”, “I don’t understand this question”, and “decline to answer”. This item has been identified as developmentally inappropriate for young adolescents, evidenced by 2 out of 5 youth aged 9–10 years not understanding what the question is asking (Potter et al., 2021; Dube et al., 2021).

The ABCD study’s Youth Gender Survey includes three (3) core gender constructs. Felt-gender (2-items that ask each participant “how much do you feel like a girl”, and “how much do you feel like a boy”); Gender expression (dressing or acting like the sex not assigned at birth during play); and Gender (non)Contentedness (wishing to be the sex not assigned at birth). All items use a 5-point scale with higher scores reflecting more congruence with sex assigned at birth (sex-congruent anchor). Complete measures including item wording are in Appendix Table 1. Parents complete an adapted Gender Identity Questionnaire (GIQ) (Elizabeth and Green, 1984; Johnson et al., 2004) that measures sex-typed behavior during play (11 items), and gender dysphoria (3 items). This measure was selected as it is one of the few parent-report measures with psychometric analysis and response rates for many cis-gender children (Elizabeth and Green, 1984; Johnson et al., 2004).

As ABCD participants have aged, the gender expression construct has been expanded to include youth and parent items rating appearance in terms of masculinity/femininity. These items ask how the youth would describe themselves, and how the parent (or their peers) would describe the youth. Wording was adapted from Reisner et al. (2015) and participants respond on a 7 point scale (very masculine/very feminine). This provides multi-informant items that harmonize with other large studies that include gender expression (e.g., the YRBSS (Kann et al., 2018)). At the 3-year follow up the parent GIQ was removed because the play items were no longer developmentally appropriate. However the parent-reported non-contentedness item from the GIQ was retained for consistency with the youth gender survey.

#### 3.2. Data summary and recommendations

Table 3 summarizes the gender data in the data release 3.0 (available from the NIMH Data Archive) which contains the entire cohort at baseline and 1-year follow-up (N = 11,180) and the partial cohort (n = 6547) who had completed the 2-year follow-up prior to data release. Average scores from the Youth Gender Survey are provided for the entire sample and by sex assigned at birth in Table 3. Looking across constructs, gender expression shows the most variability across participants (lowest mean and largest standard deviation). Analysis by sex found that female participants gave more diverse responses to all 4 items at both time points compared to their male peers (Table 3; test statistics in Appendix Table 3). This may reflect greater social tolerance for gender nonconformity in young females (Potter et al., 2021). Across all four items, all of the response options were used at both time points (data not shown), and 36% (n = 4028) of youth at 10/11 years and 32% (n = 2062) at 11/12 years responded to one or more items with a response that was not a sex-congruent scale anchor. The Cronbach’s Alpha for the youth gender survey was 0.76 at the 1-Year follow-up visit and 0.79 at the 2-Year follow-up visit, supporting the scale average as a summary measure of gender. Overall, the descriptive data from the full data set at the 1-year follow-up visit are consistent with the results published in 2021 (Potter et al., 2021) using data release 2.0 which included approximately half of the sample at 1-Year follow up.

Means and standard deviations for expression and dysphoria as well

**Table 3**

Youth- and parent-report gender scales by visit and sex assigned at birth, 1-year and 2-year follow-up visits. *M*(*SD*).

	1-year follow-up, 10/11 years			2-year follow-up, 11/12 years		
	Total	Female	Male	Total	Female	Male
<b>YOUTH GS</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>
	<b>11,180</b>	<b>5328</b>	<b>5837</b>	<b>6510</b>	<b>3075</b>	<b>3435</b>
SC Felt-Gender	4.79 (0.58)	4.68 (0.70)	4.89 (0.41) **	4.81 (0.56)	4.70 (0.67)	4.91 (0.40) **
SI Felt-Gender	4.82 (0.55)	4.69 (0.70)	4.94 (0.31) **	4.84 (0.50)	4.73 (0.64)	4.94 (0.31) **
Contentedness	4.84 (0.53)	4.78 (0.64)	4.90 (0.41) **	4.85 (0.49)	4.78 (0.61)	4.92 (0.34) **
Expression	4.67 (0.74)	4.51 (0.89)	4.82 (0.53) **	4.71 (0.69)	4.53 (0.86)	4.86 (0.45) **
Total	4.78 (0.46)	4.66 (0.56)	4.88 (0.29) **	4.80 (0.44)	4.68 (0.56)	4.91 (0.27) **
<b>PARENT GIQ</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>	<b>n =</b>
	<b>11,171</b>	<b>5330</b>	<b>5841</b>	<b>6547</b>	<b>3075</b>	<b>3435</b>
Expression	3.68 (0.42)	3.46 (0.41)	3.88 (0.32) **	3.62 (0.43)	3.37 (0.40)	3.85 (0.30) **
Dysphoria	4.97 (0.18)	4.96 (0.19)	4.98 (0.16) **	4.97 (0.20)	4.95 (0.25)	4.99 (0.14) **
Total	3.99 (0.33)	3.82 (0.33)	4.14 (0.26) **	3.94 (0.34)	3.74 (0.32)	4.12 (0.25) **

\* $p < .05$ , \*\* $p < .0001$  male different from female by two-sided Wilcoxon Rank Sum. Abbreviations: GS, Gender Survey; SC Felt-Gender = sex congruent felt gender; SI Felt-Gender = sex incongruent felt gender; GIQ, Gender Identity Questionnaire. Discrepancies between youth and parent ns are due to missing data.

as the overall score from the parent-reported GIQ are presented in Table 3. Similar to what was observed with the youth gender survey, the gender expression items show more diversity and variability (lower means and larger standard deviations) at both time points than the items intended to index dysphoria (Johnson et al., 2004); and parents of female participants rated their children as more diverse than did parents of males (Table 3; test statistics in Appendix Table 3). While Johnson et al. (2004) report total mean scores for the GIQ, with the ABCD study's community sample, we recommend calculating mean scores for each of the two constructs separately, and caution against using this measure to identify youth experiencing gender dysphoria (discussed later).

The total mean scores of the youth ABCD Gender Survey and the parent GIQ were well correlated across informants ( $R = 0.33$ ,  $p < .0001$  at the 1-Year and  $R = 0.36$ ,  $p < .0001$  at the 2-Year follow-up). Individual constructs had statistically significant, although weaker correlations. Specifically, the expression constructs had correlation coefficients of  $R = 0.20$ ,  $p < .0001$  and  $R = 0.24$ ,  $p < .0001$  at the 1- and 2-year follow-up visits, respectively. The youth and parent non-contentedness item were significantly correlated ( $R = 0.24$ ,  $p < .0001$  and  $R = 0.32$ ,  $p < .0001$  at Year 1 and Year 2, respectively). The strength of the correlations between youth and parent report of gender is consistent with what is seen in the literature for psychopathology (Achenbach et al., 1987; De Los Reyes et al., 2015), and traits such as emotional intelligence (Gugliandolo et al., 2015), and may strengthen as the youth age as is seen in multi-informant data on psychopathology (reviewed in De Los Reyes et al., 2015).

#### 4. Rationale for assessing sexuality in the ABCD study

Sexual development is a normative component of childhood and adolescence, wherein youth learn to understand their sexual and

romantic attractions, develop a sexual orientation/identity, explore sexual behaviors, and are socialized into norms of sexuality by peers, parents, and the broader culture (Tolman and McClelland, 2011). Adolescents who engage in risky sexual behaviors are in turn more likely to engage in other risky behaviors, such as misuse of alcohol and other drugs (Bellis et al., 2008), and it stands to reason that adolescents who engage in safer sex practices may be making conscious choices about safety in other aspects of their life.

There are sex-differences in sexual development and behavior that have important health implications for adolescents. These differences are the result of biological (e.g. puberty) as well as societal factors (e.g. the sexual double standard; see (Cacciatore et al., 2019) for review). Social norms and gender role expectations around sexual attractions and sexual behaviors influence adolescent experiences of harassment, as youth who fall outside the norms of their community (i.e. sexual minority youth) often experience bullying and other forms of victimization (Cutbush et al., 2016; Sterzing et al., 2018). Sexual behavior in adolescents is related to peer (perceived or actual) behavior, as is seen with other adolescent risk behaviors such as substance use (Van de Bongardt et al., 2015; D'Amico and McCarthy, 2006). Given the myriad ways sexual development interplays with other aspects of adolescent health and development, it is impossible to build a complete picture of adolescence without accounting for sexuality.

#### 4.1. Measures

The current publicly available data (release 3.0) includes a brief survey of early dating behavior, peer perceptions about sex, and a single demographic item assessing sexual orientation. The sexuality constructs are expanding as youth age, with current data collection including measures of sexual attraction, a refined measure of sexual orientation, further questions about sexual behavior (i.e. types of intercourse and methods of safe sex), and questions about communication between parents and youth about sex. All items are described below, and complete wording is provided in Appendix Table 2.

Sexual orientation has been assessed since the Baseline visit, with both parents and youth completing the item "are you/is your child gay or bisexual" from the background section of the Kiddie Schedule of Affective Disorders and Schizophrenia (K-SADS (Kaufman et al., 1997); Appendix Tables 1 & 2). However, 25% ( $n = 3006$ ) of youth at baseline, and 9% at the 1-Year follow up visit endorse not understanding this question (Potter et al., 2021; Dube et al., 2021; Calzo and Blashill, 2018). In addition the question does not separate gay from bisexual, nor does it give other options for sexual orientation. While the K-SADS background items have been retained, the 5-Year follow-up assessment includes an additional sexual orientation item for youth ("would you describe yourself as... heterosexual (straight), gay or lesbian, bisexual, another, unsure, decline to answer").

The ABCD Sexual Behavior Survey introduces sexual behavior using the early dating items from the grade 10 *Healthy Passages* battery. *Healthy Passages* is a multi-level, mixed methods study of adolescent health and development (Windle et al., 2004). These items include asking about romantic relationships, kissing, and touching (Appendix Table 1). Given the low frequencies of endorsement of these behaviors (Table 4), further sexual behaviors (i.e. types of intercourse, methods of safe sex) were added at the 5-year follow-up. The ABCD Sexual Behavior Survey also assesses peer perceptions (youths perception of peer behavior and attitudes towards sex, paralleling the questions used in ABCD to assess peer behavior and attitudes towards substance use (taken from Monitoring the Future; Schulenberg et al., 2017, Appendix Table 1). Sexual attraction is queried as part of the ABCD Sexual Behavior Survey beginning at the 3-year follow-up visit.

#### 4.2. Data summary and recommendations

Response rates to the Sexual Behavior Survey for the first half of the



**Table 4**ABCD sexual behavior survey responses at 2-year follow up, N = 6526). n(%) See [Appendix Table 1](#) for exact wording of measure.

EARLY DATING BEHAVIORS						
<i>Have you ever</i>						
Wanted a relationship		Yes		No		Decline
		2500 (38.3)		3738 (57.3)		288 (4.4)
Had a relationship		1600 (24.5)		4778 (73.2)		148 (2.3)
Kissed anyone on the mouth		509 (7.8)		5903 (90.4)		114 (1.8)
Others' hands under your clothes		51 (0.8)		6415 (98.3)		60 (0.9)
Your hands under someone's clothes		35 (0.5)		6440 (98.7)		51 (0.8)
PEER ATTITUDES						
<i>How would your friends feel about you</i>						
Having a relationship	Approve	Neither		Disapprove		DK
	2069 (31.7)	1602 (24.6)		838 (12.8)		1962 (30.1)
Kissing someone	760 (11.7)	1442 (22.1)		2128 (32.6)		2122 (32.5)
Having others' hands	61 (0.9)	401 (6.1)		4807 (73.7)		1179 (18.1)
Putting your hands	56 (0.9)	358 (5.5)		4884 (74.8)		1144 (17.5)
						84 (1.3)
PEER BEHAVIORS						
<i>How many of your friends have</i>						
Had a relationship	None	A Few	Most	All	DK	Decline
	1779 (27.3)	2965 (45.4)	939 (14.4)	196 (3.0)	610 (9.4)	37 (0.6)
Kissed someone	3630 (55.6)	1225 (18.8)	243 (3.7)	49 (0.8)	1344 (20.6)	35 (0.5)
Had others' hands	4949 (75.8)	144 (2.2)	22 (0.3)	12 (0.2)	1358 (20.8)	41 (0.6)
Put their hands	5001 (76.6)	123 (1.9)	15 (0.2)	12 (0.2)	1336 (20.5)	39 (0.6)

cohort, n = 6526 at the 2-Year follow-up visit, are in [Table 3](#). These behaviors were not frequently endorsed, with only 8% reporting having kissed someone and < 1% reporting touching or being touched under clothes. Most youth perceive positive or ambivalent peer attitudes about dating (13% report disapproval of having a romantic relationship) and negative peer attitudes about sexual behaviors like putting hands under clothes ([Table 4](#)). Consistent with reports of their own behavior, most participants reported that “none” or “a few” of their peers had a relationship (73%) or kissed (74%) ([Table 4](#)).

## 5. Identifying sexual and gender minority youth in the ABCD study

Prior research demonstrates the importance of acknowledging the unique experiences of sexual and gender minority (SGM) youth to understand health disparities and societal factors that may influence their wellness, as well as to understand the specific strengths of SGM populations including pride in identity, and connection to a SGM community ([Johns et al., 2019](#); [Delozier et al., 2020](#); [Fredriksen-Goldsen et al., 2017](#)). However, the best way to identify SGM youth during early adolescence is unclear ([Turban and Ehrensaft, 2018](#)).

The background items to the Kiddie Schedule of Affective Disorders and Schizophrenia (K-SADS ([Kaufman et al., 1997](#))) ask whether the child is “transgender” and whether the child is “gay or bisexual” (See [Appendix Table 2](#)). Prior research has used answers of “maybe” and “yes” to identify SGM youth ([Potter et al., 2021](#); [Calzo and Blashill, 2018](#)), however as noted previously these items are not well understood by young adolescents ([Dube et al., 2021](#)). Future data releases will include youth self-report of their gender identity (3-Year follow up), and sexual orientation (5-Year follow up), which are preferred for identifying SGM youth in ABCD.

In addition to these categorical items, the dimensional items in the ABCD surveys can be leveraged to identify SGM youth. The summary (average) score of the youth gender survey captures gender dimensionally. There is no recommended cut-off score for gender minority youth from this measure. Both felt-gender and gender expression have been shown in prior research to relate to other experiences known to be prevalent among SGM youth such as mental health concerns including suicidality ([Potter et al., 2021](#); [Lowry et al., 2018](#)). The finding that felt-gender groups (as described in [Potter et al., 2021](#)) are sensitive to individual differences suggests it may be a viable strategy for measuring gender diversity among young adolescents with emerging identities.

The ABCD data does not fully assess gender dysphoria, as youth are asked a single non-contentedness item, and wishing to be the opposite sex does not necessarily represent gender dysphoria. For example, a youth may wish to be a different sex to have access to the societal and

behavioral norms/expectations of that sex, without feeling dysphoric about their sex assigned at birth. The three parent items on the GIQ are recognized by the creators of the GIQ to be “crude and insufficient” measures of gender dysphoria ([Johnson et al., 2004](#)).

Youth self-report their sexual identity categorically on both the K-SADS background items, and at the 4-year follow-up using a more refined measure. Dimensional measures of sexual attraction and sexual behaviors include follow up questions that indicate attraction to and behaviors with boys, girls, and people of another gender, which may also be used to identify if youth have sexual minority attractions or behaviors.

## 6. Limitations

While the ABCD study is a large, novel resource to explore gender and sexuality in adolescents, there are limitations. First, ABCD is a study of US adolescents, and the meaning of the gender and sexuality terms/constructs may not hold for other cultures. For example, there is no consensus on the Spanish translation for they/them pronouns, raising the issue of whether this construct makes sense to Spanish language speakers. The ABCD study has broad aims, and therefore the assessment of gender and sexuality is brief and does not include all possible constructs. We recognize that there may be important constructs that are not being addressed. For example, we did not include a complete assessment of gender dysphoria, per se. Lastly, the items used to measure gender and sexuality underwent a large conceptual change to eliminate the assumption of the gender binary. While the benefits of this revision are believed to outweigh the costs, there is a loss of continuity across all waves of data in ABCD.

## 7. Conclusions and future directions

The ABCD study® is a large scale, longitudinal study that includes multiple, dimensional measures of gender and sexuality in a community cohort of children moving through adolescence. It provides the unique opportunity to examine individual differences in gender and sexuality dimensionally in American youth beginning at age 9/10, and to chart developmental trajectories of these domains. In addition, a better understanding of resilience/risk factors for SGM youth can guide policy development to reduce negative outcomes and health disparities.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data Statement

Data used in the preparation of this article were obtained from the Adolescent Brain Cognitive Development<sup>SM</sup> (ABCD) Study (<https://abcdstudy.org>), held in the NIMH Data Archive (NDA).

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.dcn.2022.101057](https://doi.org/10.1016/j.dcn.2022.101057).

## References

- Achenbach, T.M., McConaughy, S.H., Howell, C.T., 1987. Child/adolescent behavioral and emotional problems: implications of cross-informant correlations for situational specificity. *Psychol. Bull.* 101 (2), 213–232.
- American Psychological Association, 2006. *Answers to Your Questions about Individuals with Intersex Conditions*. American Psychological Association, Washington DC.
- American Psychological Association, 2015. *Key Terms and Concepts in Understanding Gender Diversity and Sexual Orientation Among Students*.
- American Psychological Association, 2018. Defining transgender terms. *Monit. Psychol.* 49 (8).
- American Psychological Association, 2008. *Answers to your questions: for a better understanding of sexual orientation and homosexuality*. Washington, DC.
- Auchter, A.M., Hernandez Mejia, M., Heyser, C.J., Shilling, P.D., Jernigan, T.L., Brown, S. A., Tapert, S.F., Dowling, G.J., 2018. A description of the ABCD organizational structure and communication framework. *Dev. Cogn. Neurosci.* 32, 8–15.
- Barch, D.M., Albaugh, M.D., Avenevoli, S., Chang, L., Clark, D.B., Glantz, M.D., Hudziak, J.J., Jernigan, T.L., Tapert, S.F., Yurgelun-Todd, D., Alia-Klein, N., Potter, A.S., Paulus, M.P., Prouty, D., Zucker, R.A., Sher, K.J., 2018. Demographic, physical and mental health assessments in the adolescent brain and cognitive development study: rationale and description. *Dev. Cogn. Neurosci.* 32, 55–66.
- Becker, J.B., McClellan, M., Reed, B.G., 2016. Sociocultural context for sex differences in addiction. *Addict. Biol.* 21 (5), 1052–1059.
- Becker, J.B., McClellan, M.L., Reed, B.G., 2017. Sex differences, gender and addiction. *J. Neurosci. Res.* 95 (1–2), 136–147.
- Bellis, M.A., Hughes, K., Calafat, A., Juan, M., Ramon, A., Rodriguez, J.A., Mendes, F., Schnitzer, S., Phillips-Howard, P., 2008. Sexual uses of alcohol and drugs and the associated health risks: a cross sectional study of young people in nine European cities. *BMC Public Health* 8, 155.
- Bell, A.N., Juvonen, J., 2020. Gender discrimination, perceived school unfairness, depressive symptoms, and sleep duration among middle school girls. *Child Dev.* 91 (6), 1865–1876.
- Van de Bongardt, D., Reitz, E., Sandfort, T., Deković, M., 2015. A meta-analysis of the relations between three types of peer norms and adolescent sexual behavior. *Personal. Soc. Psychol. Rev.* 19 (3), 203–234.
- Bornstein, K., 1994. *Gender Outlaw: On Men, Women and the Rest of Us*.
- Breslau, J., Gilman, S., Stein, B., Ruder, T., Gmelin, T., Miller, E., 2017. Sex differences in recent first-onset depression in an epidemiological sample of adolescents. *Transl. Psychiatry* 7 (5), e1139.
- Cacciatore, R., Korteniemi-Poikela, E., Kaltiala, R., 2019. The Steps of Sexuality—A Developmental, Emotion-Focused, Child-Centered Model of Sexual Development and Sexuality Education from Birth to Adulthood. *International Journal of Sexual Health* 31 (3), 319–338. <https://doi.org/10.1080/19317611.2019.1645783>.
- Calzo, J.P., Blashill, A.J., 2018. Child sexual orientation and gender identity in the Adolescent Brain Cognitive Development cohort study. *JAMA Pediatr.* 172 (11), 1090–1092.
- Clark, T.C., Lucassen, M.F., Bullen, P., Denny, S.J., Fleming, T.M., Robinson, E.M., Rossen, F.V., 2014. The health and well-being of transgender high school students: results from the New Zealand adolescent health survey (Youth '12). *J. Adolesc. Health* 55 (1), 93–99.
- Conron, K.J., Goldberg, S.K., Halpern, C.T., 2018. Sexual orientation and sex differences in socioeconomic status: a population-based investigation in the National Longitudinal Study of Adolescent to Adult Health. *J. Epidemiol. Community Health* 72 (11), 1016–1026.
- Cutbush, S., Williams, J., Miller, S., 2016. Teen dating violence, sexual harassment, and bullying among middle school students: examining mediation and moderated mediation by gender. *Prev. Sci.* 17 (8), 1024–1033.
- Delozier, A.M., Kamody, R.C., Rodgers, S., Chen, D., 2020. Health disparities in transgender and gender expansive adolescents: a topical review from a minority stress framework. *J. Pediatr. Psychol.* 45 (8), 842–847.
- Demmer, D.H., Hooley, M., Sheen, J., McGillivray, J.A., Lum, J.A., 2017. Sex differences in the prevalence of oppositional defiant disorder during middle childhood: a meta-analysis. *J. Abnorm. Child Psychol.* 45 (2), 313–325.
- Dube, S., Ivanova, M., Potter, A., 2021. “I don’t understand”: who is missed when we ask early adolescents, “are you transgender”? *Arch. Sex. Behav.* 50 (3), 741–745.
- D’Amico, E.J., McCarthy, D.M., 2006. Escalation and initiation of younger adolescents’ substance use: the impact of perceived peer use. *J. Adolesc. Health* 39 (4), 481–487.
- Egan, S.K., Perry, D.G., 2001. Gender identity: a multidimensional analysis with implications for psychosocial adjustment. *Dev. Psychol.* 37 (4), 451–463.
- Elizabeth, P.H., Green, R., 1984. Childhood sex-role behaviors: similarities and differences in twins. *Acta Genet. Med. Gemellol.* 33 (2), 173–179.
- Fredriksen-Goldsen, K.I., Kim, H.-J., Bryan, A.E., Shiu, C., Emler, C.A., 2017. The cascading effects of marginalization and pathways of resilience in attaining good health among LGBT older adults. *Gerontologist* 57 (suppl.1), S72–S83.
- Garavan, H., Bartsch, H., Conway, K., Decastro, A., Goldstein, R.Z., Heeringa, S., Jernigan, T., Potter, A., Thompson, W., Zahs, D., 2018. Recruiting the ABCD sample: design considerations and procedures. *Dev. Cogn. Neurosci.* 32, 16–22.
- Gugliandolo, M.C., Costa, S., Cuzzocrea, F., Larcan, R., Petrides, K.V., 2015. Trait emotional intelligence and behavioral problems among adolescents: a cross-informant design. *Personal. Individ. Differ.* 74, 16–21.
- Heise, L., Greene, M.E., Opper, N., Stavropoulou, M., Harper, C., Nascimento, M., Zewdie, D., on behalf of the Gender Equality, Norms, and Health Steering Committee, 2019. Gender inequality and restrictive gender norms: framing the challenges to health. *Lancet* 393 (10189), 2440–2454.
- Impett, E.A., Schooler, D., Tolman, D.L., 2006. To be seen and not heard: femininity ideology and adolescent girls’ sexual health. *Arch. Sex. Behav.* 35 (2), 131–144.
- Johnson, L.L., Bradley, S.J., Birkenfeld-Adams, A.S., Kuskis, M.A., Maing, D.M., Mitchell, J.N., Zucker, K.J., 2004. A parent-report gender identity questionnaire for children. *Arch. Sex. Behav.* 33 (2), 105–116.
- Johns, M.M., Lowry, R., Andrzejewski, J., Barrios, L.C., Demissie, Z., McManus, T., Rasberry, C.N., Robin, L., Underwood, J.M., 2019. Transgender identity and experiences of violence victimization, substance use, suicide risk, and sexual risk behaviors among high school students – 19 states and large urban school districts, 2017. *MMWR Morb. Mortal. Wkly. Rep.* 68 (3), 67–71.
- Kann, L., McManus, T., Harris, W.A., Shanklin, S.L., Flint, K.H., Queen, B., Lowry, R., Chyen, D., Whittle, L., Thornton, J., Lim, C., Bradford, D., Yamakawa, Y., Leon, M., Brener, N., Ethier, K.A., 2018. Youth risk behavior surveillance—United States, 2017. *MMWR Surveill. Summ.* 67 (8), 1–114.
- Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., Williamson, D., Ryan, N., 1997. Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *J. Am. Acad. Child Adolesc. Psychiatry* 36 (7), 980–988.
- King, T.L., Singh, A., Milner, A., 2019. Associations between gender-role attitudes and mental health outcomes in a nationally representative sample of Australian adolescents. *J. Adolesc. Health* 65 (1), 72–78.
- Lisdahl, K.M., Sher, K.J., Conway, K.P., Gonzalez, R., Feldstein Ewing, S.W., Nixon, S.J., Tapert, S., Bartsch, H., Goldstein, R.Z., Heitzeg, M., 2018. Adolescent brain cognitive development (ABCD) study: overview of substance use assessment methods. *Dev. Cogn. Neurosci.* 32, 80–96.
- De Los Reyes, A., Augenstein, T.M., Wang, M., Thomas, S.A., Drabick, D.A.G., Burgers, D. E., Rabinowitz, J., 2015. The validity of the multi-informant approach to assessing child and adolescent mental health. *Psychol. Bull.* 141 (4), 858–900.
- Lowry, R., Johns, M.M., Gordon, A.R., Austin, S.B., Robin, L.E., Kann, L.K., 2018. Nonconforming gender expression and associated mental distress and substance use among high school students. *JAMA Pediatr.* 172 (11), 1020–1028.
- Luciana, M., Bjork, J.M., Nagel, B.J., Barch, D.M., Gonzalez, R., Nixon, S.J., Banich, M.T., 2018. Adolescent neurocognitive development and impacts of substance use: overview of the adolescent brain cognitive development (ABCD) baseline neurocognition battery. *Dev. Cogn. Neurosci.* 32, 67–79.
- Martin, C.L., Andrews, N.C., England, D.E., Zosuls, K., Ruble, D.N., 2017. A dual identity approach for conceptualizing and measuring children’s gender identity. *Child Dev.* 88 (1), 167–182.
- Patterson, C.J., Sepúlveda, M.-J.E., White, J.E., 2020. *Understanding the Well-being of LGBTIQ+ Populations*. The National Academies Press.
- Potter, A., Dube, S., Allgaier, N., Loso, H., Ivanova, M., Barrios, L.C., Bookheimer, S., Chaarani, B., Dumas, J., Feldstein-Ewing, S., Freedman, E.G., Garavan, H., Hoffman, E., McGlade, E., Robin, L., Johns, M.M., 2021. Early adolescent gender diversity and mental health in the Adolescent Brain Cognitive Development study. *J. Child Psychol. Psychiatry* 62 (2), 171–179.
- Reisner, S.L., Greytak, E.A., Parsons, J.T., Ybarra, M.L., 2015. Gender minority social stress in adolescence: disparities in adolescent bullying and substance use by gender identity. *J. Sex Res.* 52 (3), 243–256.
- Schilt, K., Westbrook, L., 2009. Doing gender, doing heteronormativity: “gender normals,” transgender people, and the social maintenance of heterosexuality. *Gen. Soc.* 23 (4), 440–464.
- Schulenberg, J.E., Johnston, L.D., O’Malley, P.M., Bachman, J.G., Miech, R.A., Patrick, M.E., 2017. *Monitoring the Future National Survey Results on Drug Use, 1975–2016: Volume II, College Students and Adults Ages 19–55*. Institute for Social Research, The University of Michigan.
- Snow, R.C., 2008. Sex, gender, and vulnerability. *Glob. Public Health* 3 (sup1), S58–S74.
- Sterzing, P.R., Gibbs, J.J., Gartner, R.E., Goldbach, J.T., 2018. Bullying victimization trajectories for sexual minority adolescents: stable victims, desisters, and late-onset victims. *J. Res. Adolesc.* 28 (2), 368–378.

- Tolman, D.L., McClelland, S.I., 2011. Normative sexuality development in adolescence: a decade in review, 2000–2009. *J. Res. Adolesc.* 21 (1), 242–255.
- Townsend, L., Kobak, K., Kearney, C., Milham, M., Andreotti, C., Escalera, J., Alexander, L., Gill, M.K., Birmaher, B., Sylvester, R., Rice, D., Deep, A., Kaufman, J., 2020. Development of three web-based computerized versions of the Kiddie Schedule for affective disorders and schizophrenia child psychiatric diagnostic interview: preliminary validity data. *J. Am. Acad. Child Adolesc. Psychiatry* 59 (2), 309–325.
- Turban, J.L., Ehrensaft, D., 2018. Research review: gender identity in youth: treatment paradigms and controversies. *J. Child Psychol. Psychiatry* 59 (12), 1228–1243.
- Ullsperger, J.M., Nikolas, M.A., 2017. A meta-analytic review of the association between pubertal timing and psychopathology in adolescence: are there sex differences in risk? *Psychol. Bull.* 143 (9), 903–938.
- Windle, M., Grunbaum, J.A., Elliott, M., Tortolero, S.R., Berry, S., Gilliland, J., Kanouse, D.E., Parcel, G.S., Wallander, J., Kelder, S., Collins, J., Kolbe, L., Schuster, M., 2004. Healthy passages. A multilevel, multimethod longitudinal study of adolescent health. *Am. J. Prev. Med.* 27 (2), 164–172.
- World Health Organization, 2006. Defining Sexual Health: Report of a Technical Consultation on Sexual Health, 28–31 January 2002. World Health Organization, Geneva.
- Zucker, R.A., Gonzalez, R., Feldstein Ewing, S.W., Paulus, M.P., Arroyo, J., Fuligni, A., Morris, A.S., Sanchez, M., Wills, T., 2018. Assessment of culture and environment in the Adolescent Brain and Cognitive Development study: rationale, description of measures, and early data. *Dev. Cogn. Neurosci.* 32, 107–120.