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# Sleep health among youth outside of the gender binary: Findings from a national Canadian sample

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ABSTRACT

*Objectives:* Sleep is important for adolescent health. The unique needs of suprabinary youth (youth with gender identities outside of the gender binary), along with the growing number of youth with these identities, underscores the need to better understand sleep health within this population. The current study's objectives were to (1) examine differences in sleep health between suprabinary and binary youth and (2) explore how social support, peer victimization, and technology use accounted for these differences.
*Methods:* Data were drawn from the 2017/2018 Health Behavior in School Aged Children Survey. Adolescents (individuals ages 14 to 17, n = 10,186), indicated whether they were suprabinary (n = 182) or binary (n = 10,004), and completed measures of sleep health (difficulty falling asleep, difficulty staying awake, weekday and weekend sleep length), covariates (age, family affluence, race/ethnicity, depressive symptoms), as well as variables that may account for differences between suprabinary and binary youth (family, friend, and teacher support, as well as peer victimization, and technology use before bed).
*Results:* Suprabinary youth reported worse sleep health on all outcomes, and differences persisted for both difficulty falling asleep and weekday sleep hours accounting for covariates. Significant indirect effects between suprabinary status were observed across all sleep outcomes for family support and school climate. Indirect effects for sleep quality were also observed via peer victimization.
*Conclusions:* Findings support the relevance of looking at basic health processes like sleep to better understand how the stressors associated with suprabinary status impact health outcomes among this vulnerable population.


## Introduction

Sleep health is a multifaceted construct reflecting how an individual's sleep/wakefulness patterns are adapted to their environment.[1,2] Identifying populations that are vulnerable to negative sleep outcomes is essential, given the role played by sleep health for positive physical and mental well-being. Measures of sleep health among child and adolescent populations frequently focus on constructs such as difficulty falling asleep, day-time wakefulness, and duration of sleep, with research prospectively linking these sleep measures to health and psychosocial outcomes including depressive symptoms.[3,4] Gender-minoritized youth (i.e., youth with gender identities that differ from the sex they were assigned at birth) report poorer sleep health compared to their cisgender (i.e., youth whose gender identities coincide with their sex assigned at birth) peers.[5,6] And while the existing literature focuses on gender-minoritized youth more broadly, research is increasingly suggesting the need to understand the sleep health of suprabinary youth (i.e., youth whose genders are outside of the gender binary), more specifically. Taking inspiration from Indigenous scholars among others,[7,8] the term "suprabinary" is used here rather than the more common term "nonbinary." This choice was made to reflect the broad range of identities outside of the gender binary, as "nonbinary" is a specific label that may not accurately reflect how some youth understand

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their identity. For instance, in the current study, participants were asked whether they were male, female, or whether they were defined by neither of these terms (i.e., they reported being outside of the binary). Recent data suggests that anywhere between one-third to one-half of gender-minoritized individuals report identities outside of the gender binary, whether as nonbinary or with other identities, suggesting the need to better understand risk and resilience within this increasingly visible population.[9,10] The goal of this study is to use national data to better understand the extent to which suprabinary youth differ in sleep health compared to their binary peers, and to identify how factors associated with sleep health and suprabinary status (i.e., peer victimization, social support, technology use before bed) may account for these differences.

### *Sleep health among suprabinary adolescents*

The minority stress model posits that individuals from stigmatized groups experience poorer health outcomes because of how stigma increases the likelihood of discrimination, observed discrimination, and internalized stigma.[11,12] The minority stress model is informative for understanding sleep health, as discrimination is linked to poorer sleep health, and particularly individual evaluations of sleep quality.[13] While the minority stress model was initially developed to explain health variation among sexual minoritized populations, this model also has also been used to understand health disparities among gender minoritized populations more broadly,[14,15] as well as sleep health in particular.[16] Finally, the minority stress framework also points to the buffering role of social support,[12] which is linked to improved sleep health outcomes among adolescent populations.[17]

Health disparities between gender minoritized (including suprabinary individuals) and cisgender populations are observed across the life course,[18] but adolescence is a particularly relevant period for understanding the development of poor sleep health among gender-minoritized youth. From a sleep health perspective, research links poor adolescent sleep health with negative health outcomes later in development,[19] suggesting that disrupted sleep during this period has consequences over time. Furthermore, the growing emphasis on identity exploration among adolescents coincides with increasingly restrictive peer views regarding conformity to gender norms,[20] creating a challenging environment for the sleep health of suprabinary youth. Together, these findings suggest that gender-minoritized youth, including suprabinary youth, are increasingly likely to experience minority stressors during an important developmental period for sleep health outcomes.

While health disparities have been broadly documented among gender-minoritized youth, suprabinary youth are unique from binary gender-minoritized youth (i.e., transgender youth who identify as boys or girls),[21] in ways that emphasize the need to focus on health outcomes among suprabinary populations specifically. For example, compared to their binary gender minoritized peers, suprabinary individuals show larger gaps between service need and service access for both gender affirming and more general forms of health care. And while a recent review of the literature is mixed as to whether this population experiences worse health outcomes compared to their binary gender minoritized peers,[21] the same review found that suprabinary individuals experience lower levels of some important buffering factors (i.e., family support) than binary gender minoritized individuals, suggesting the need for a better understanding of this population. Together, these findings suggest the relevance of understanding how the experiences of suprabinary youth are linked with health outcomes.

The existing literature posits several factors that may account for potential health disparities between suprabinary and binary youth. First, the higher levels of peer victimization among gender-minoritized youth in general (including suprabinary youth),[17] compared to their cisgender peers, has been well documented in explaining the health disparities between these two populations.[14] Peer victimization has also been consistently linked with poorer sleep health,[22] making this negative peer experience a pertinent factor to explore in the link between suprabinary status and sleep health. Social support is associated with both better outcomes among gender-minoritized youth,[23] and with better sleep outcomes.[24] Youth-perceived support may be important, then, for better understanding outcomes among suprabinary youth more specifically, especially given these youth may experience less social support than their binary peers.[21] Finally, in a developmental context in which youth increasingly conduct their lives in online environments, some research shows higher rates of problematic and risky internet use among gender-minoritized youth (including suprabinary youth) compared to their cisgender peers.[25] Technology use in the hour before bed is linked with poorer sleep quality, in some cases prospectively, although meta-analytic results suggest a weak association between technology use and sleep health overall.[26] Together, these findings suggest the relevance of examining technology use as accounting for sleep health disparities.

### *The current study*

Using nationally representative data, the goal of the current study was to understand the extent to which suprabinary youth differed in sleep quality (i.e., difficulty in falling or staying asleep and difficulty in staying awake) and sleep duration (i.e., typical length of sleep on weekends and weekdays) compared to youth with binary gender identities. Suprabinary youth were expected to report worse sleep quality (more difficulty falling asleep, more difficulty staying awake) and shorter sleep duration than their binary peers. We were interested in the role of technology use (i.e., prebedtime cellphone and computer/tablet use), social support (i.e., support from parents, friends, teachers), and peer victimization in accounting for these differences. We anticipated that technology use, social support, and peer victimization would account for differences between binary and suprabinary youth regarding both sleep quality and sleep duration outcomes. Understanding both overall level of risk for poor sleep health, as well as factors that may contribute to these sleep disparities, can help to better understand this important health outcome among youth outside of the gender binary.

## Method

### *Participants*

Data were obtained from the Canadian 2017/2018 Health Behaviour in School Aged Children (HBSC) survey. The HBSC survey is a cross-national study that examines the health and well-being of youth and is conducted every 4 years in collaboration with the Public Health Agency of Canada. Researchers collected anonymous data in school settings, either electronically, or using a paper-based survey, from a nationally representative sample of adolescents in grades 6 to 10 from all Canadian provinces and territories. Both the Canadian and Spanish versions of the HBSC have been used to examine psychosocial outcomes among gender-minoritized youth.[27,28] The Research Ethics Boards at Queen's University and the Public Health Agency of Canada provided ethics clearance for this data collection. School jurisdictions, school administrators, parents, and students all provided consent and participated voluntarily.

In total, 21,750 students in grades 6 through 10 completed the survey. Given our interest in adolescents, participants were retained for the current analysis when they were at least 14 and less than 18 years of age (11,197 participants dropped for being outside of the age range, 313 dropped for nonresponse) and whether they answered the question "are you male or female," where their options were "male," "female," and "neither term describes me" (54 participants

being dropped from the sample for nonresponse). This question allows for the identification of youth outside of the binary, though it does not permit for the identification of transgender boys or girls, nor does it provide the ability to examine the specific identities of the suprabinary youth. This left a total of 4848 participants who indicated that they were male, 5156 who indicated that they were female, and 182 who indicated that neither term applied to them and were considered suprabinary for the current study (total sample 10,186). This percentage of suprabinary youth (1.7%) is in line with previous estimates that have identified 1%-2% of youth with gender-minoritized identities more broadly in large-scale data collections.[29]

### Measures

The HSBC includes several indicators of sleep health which have been previously used to assess sleep quality and quantity.[30,31] First, participants were asked questions two questions about *sleep quality,* being "how often do you have trouble going to sleep or staying asleep?" and "how often do you have trouble staying awake during the daytime when you want to be awake?" Both variables were coded as 1 = Never, 2 = rarely, 3 = sometimes; 4 = most of the time; 5 = all of the time), with higher scores indicating more difficulties relating to sleep/wakefulness.

Participants were also asked about *weekday and weekend sleep duration*, where they responded to the questions "what time do you usually go to bed when you have school in the morning" and "what time do you usually wake up on school mornings?" and "when do you usually go to bed on weekends or during holidays?" and "what time do you usually wake up on weekend on during holidays?" Using these responses, average time sleeping on weekdays and average time sleeping on weekends was calculated, with larger values indicating more sleep.

#### *Friend support and family support*

Friend and family support were assessed using two four-item subscales of the Multidimensional Scale of Perceived Social Support.[32] Participants were asked statements such as "my friends/my family/really try to help me" and "I can talk about my problems with my friends/family." Participants could answer on a scale from one (very strongly disagree) to seven (very strongly agree). Responses were summed, with higher scores indicating greater feelings of support (Cronbach's alpha of 0.94 for the friendship support scale, 0.93 for the family support scale in the current sample).

#### *Teacher support*

Teacher support was assessed using the Teacher Support Scale, a three-item scale which captured elements such as "I feel that my teachers accept me as I am" and "I feel a lot of trust in my teachers," with higher scores indicating higher levels of teacher support.[32] Response options were recoded to range from 0 (strongly disagree) to 4 (strongly agree) scale. This scale had a Cronbach's alpha of 0.81 in the current sample.

#### *Peer victimization*

Participants were also asked about experiences of *peer victimization* using Revised Olweus Bully/Victim Questionnaire,[32] a six-item scale including items such as "was called names, was made fun of, or teased in a hurtful way," "other students left me out of things on purpose," and "I was hit, kicked, pushed, shoved around, or locked in doors." Response options were on a scale from 1 (I have not been bullied) to 5 (several times a week), with higher scores indicating higher levels of peer victimization (Cronbach's alpha = 0.87 in this sample).

#### *Technology use before bed*

Finally, we were also interested in understanding how technology use before bed was associated with sleep health. Participants were asked "how often do you use a cell phone in your bedroom in the last hour before going to sleep?," "how often do you watch television in the last hour before going to sleep?," and "how often do you use a computer or tablet in your bedroom in the last hour before going to sleep?" Response options ranged from 1 (never) to 5 (every night), with higher scores indicating higher frequency of use.

#### *Control variables*

First, *age* was measured by subtracting the participant's date of birth from the date at which they completed the evaluation. Second, *family affluence* was measured via the adolescent-reported Family Affluence Scale. This six-question scale asks adolescents about common items that adolescents would be able to accurately describe in their homes or not (e.g., number of cars, having their own room, having a washer/dryer).[33] This scale was summed, with higher scores indicating higher family affluence. Participants were also asked about their *race/ethnicity*. Their options were as follows: African Canadian or Black, Latin American, Indigenous, East and Southeast Asian, East Indian and South Asian, Arab and West Asian, White, other/multiple race ethnicities. This variable was dummy coded, with White (the largest group) being used as the referent category. Given both the significant literature suggesting higher levels of depressive symptoms among gender-minoritized youth in general,[34] and the link between depressive symptoms and sleep,[35] we controlled for depressive symptoms in the current via the question "During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing some usual activities?" Responses were no (coded as 0) and yes (coded as 1).[36]

### Planned analyses

Initial ANOVAs were conducted to compare suprabinary and binary students on the four sleep outcomes, using sampling weights in SPSS.[37] Then, linear regressions were conducted to examine whether differences observe across groups remained significant accounting for covariates (age, family affluence, race/ethnicity, depressive symptoms) using Mplus 7.4.[38] Finally, to examine the role of peer victimization, social support, and technology use in accounting for disparities, models were tested for each sleep outcome to examine indirect effects between suprabinary status and sleep health. Conducting these analyses in Mplus has notable advantages, including addressing non-normal data using the MLR estimator, the use of sampling weights (in this case data were weighted by province), providing a method of calculating indirect effects using bootstrapping (done 1000 times),[39] and addressing missing data using Full Information Maximum Likelihood. While only 7% of the data was missing for the analytic sample overall, listwise deletion would have resulted in the deletion of 55% of the sample.

## Results

Descriptive statistics for the sample appear in Table 1. The first objective was to assess differences in sleep health between suprabinary and binary participants, and to examine whether these differences remained significant accounting for covariates (i.e., age, family affluence, race/ethnicity, and depressive symptoms). Starting with trouble falling asleep, suprabinary youth reported significantly more difficulty falling asleep than their binary peers (see Table 1), an association that remained significant accounting for covariates ($\beta = 0.04$, $p < .05$) (see model 1 of Table 2). Suprabinary youth were also significantly more likely to report having difficulty staying awake during the day, but this association was not significant accounting for

**Table 1**
Descriptive statistics by binary status

| | Suprabinary youth ($n$ = 182) mean (standard deviations) | Binary youth ($n$ = 10,004) mean (standard deviations) | Eta$^2$/Chi$^2$ (%)[a] |
|---|---|---|---|
| *Sleep variables* | | | |
| Difficulty falling asleep | 3.27 (1.34)** | 2.79 (1.09) | 0.004 |
| Difficulty staying awake | 2.73 (1.15)** | 2.50 (1.01) | 0.002 |
| Weekday sleep hours | 7.51 (1.78)** | 8.29 (1.17) | 0.006 |
| Weekend sleep hours | 9.26 (2.09)* | 9.53 (1.61) | 0.000 |
| *Psychosocial variables* | | | |
| Family support | 11.43 (7.08)** | 15.42 (7.14) | 0.006 |
| Teacher support | 6.66 (3.48)** | 8.14 (2.63) | 0.000 |
| Friend support | 14.59 (7.64)** | 15.29 (7.04) | 0.006 |
| Peer victimization | 5.38 (7.01)** | 2.48 (4.19) | 0.005 |
| Television before bed | 2.42 (1.59) | 2.25 (1.51) | 0.000 |
| Cellphone use before bed | 4.09 (1.42) | 4.10 (1.42) | 0.000 |
| Computer or tablet use before bed | 3.06 (1.66)** | 2.53 (1.58) | 0.000 |
| *Control variables* | | | |
| Age | 15.17 (0.77) | 15.12 (0.74) | 0.000 |
| Family affluence | 2.90 (0.23) | 2.73 (0.03) | 0.001 |
| Depressive symptoms (% yes) | 59.0** | 34.4 | 50.39 |
| *Race/ethnicity (%)* | | | |
| Black/Afro-Canadian | 12.4** | 5.6 | 5.18 |
| Latin American | 0 | 1.6 | 1.88 |
| First Nations, Inuit or Métis | 9.5** | 3.1 | 1.65 |
| East and Southeast Asian | 7.1* | 3.5 | 5.42 |
| East Indian and South Asian | 5.9 | 4.9 | 0.28 |
| Arab and West Asian | 4.7* | 2.1 | 6.35 |
| White | 42.0** | 66.7 | 21.71 |
| Other (including multiple race/ethnicities) | 18.3* | 12.5 | 4.65 |

*$p$ < .05.
**$p$ < .01.
[a] Eta$^2$ with continuous variables Chi$^2$ with continuous variables.

**Table 2**
Linear regressions on the links between suprabinary status and sleep outcomes accounting for covariates

| | Difficulty falling asleep | | Difficulty staying awake | | Hours of weekday sleep | | Hours of weekend sleep | |
|---|---|---|---|---|---|---|---|---|
| | Std Est | SE | Std Est | SE | Std Est | SE | Std Est | SE |
| Suprabinary status | 0.04* | 0.02 | 0.01 | 0.02 | − 0.06* | 0.02 | − 0.01 | 0.02 |
| Age | − 0.02 | 0.01 | 0.08** | 0.01 | − 0.13** | 0.02 | − 0.07** | 0.02 |
| Family affluence | − 0.08** | 0.02 | 0.00 | 0.02 | 0.01 | 0.02 | 0.03 | 0.02 |
| *Race/ethnicity* | | | | | | | | |
| White (referent) | | | | | | | | |
| Black/Afro-Canadian | − 0.06** | 0.02 | 0.00 | 0.02 | − 0.09** | 0.02 | 0.00 | 0.02 |
| Latin American | 0.00 | 0.02 | 0.03* | 0.02 | − 0.04* | 0.02 | 0.02 | 0.02 |
| First Nations, Métis, or Inuit | 0.01 | 0.01 | 0.00 | 0.01 | − 0.06** | 0.02 | − 0.03 | 0.02 |
| East and Southeast Asian | − 0.04* | 0.02 | 0.04** | 0.02 | − 0.06** | 0.02 | − 0.04** | 0.02 |
| East Indian and South Asian | − 0.05* | 0.02 | − 0.02 | 0.02 | − 0.04* | 0.02 | 0.05** | 0.02 |
| Arab and West Asian | − 0.01 | 0.02 | 0.00 | 0.02 | − 0.02 | 0.02 | − 0.02 | 0.02 |
| Other (including multiple race/ethnicity) | − 0.02 | 0.01 | 0.05** | 0.01 | − 0.09** | 0.02 | − 0.04* | 0.02 |
| Depressive symptoms | − 0.32** | 0.01 | − 0.28** | 0.01 | 0.21** | 0.02 | 0.11** | 0.02 |
| $R^2$ | 0.12** | | 0.10** | | 0.10** | | 0.03** | |

SE, standard errors; Std Est, standardized estimate.
*$p$ < .05.
**$p$ < .01.

covariates (β = 0.01, *n.s.*) (see model 2 of Table 2). Focusing on hours of sleep, suprabinary youth reported significantly fewer hours of weekday sleep than their binary peers, with suprabinary youth's mean number of hours falling below the 8 to 10 hours recommend by the American Academy of Sleep Medicine.[40] This difference remained significant when accounting for covariates (β = − 0.06, $p$ < .05) (see model 3 of Table 2). Finally, in focusing on weekend sleep hours, while suprabinary youth reported less weekend sleep than their peers, this difference was no longer significant accounting for covariates (β = − 0.01, *n.s.*) (see model 4 of Table 2).

The second objective was to examine whether peer victimization, social support, and technology use accounted for differences observed between suprabinary and binary youth, using indirect effects (see Table 3). Starting with trouble falling asleep, significant indirect effects were observed via family support, teacher support, and peer victimization, and the links between suprabinary status and trouble falling asleep were nonsignificant once these variables were included in the model. Significant indirect effects were not observed, however, via friend support or via any of the technology use variables. For trouble staying awake, the same indirect effects were observed via family support, teacher support, and peer victimization (but not friend support or via any of the technology use variables), but the direct association remained nonsignificant. Moving to sleep duration, for weekday hours of sleep, significant indirect effects were observed via family support and teacher support (but not via friend support, peer victimization, or any of the technology use variables). The direct association between suprabinary status and weekday hours of sleep remained significant. Finally, for weekend

**Table 3**
Indirect effects linking suprabinary status with sleep outcomes

| | β | Standardized estimate | CI 95% | |
|---|---|---|---|---|
| *Trouble falling asleep* | | | | |
| Suprabinary status → Trouble falling asleep | 0.020 | 0.011 | − 0.002 | 0.041 |
| Suprabinary status → Friend support→ Trouble falling asleep | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Family support → Trouble falling asleep | 0.006** | 0.001 | 0.004 | 0.009 |
| Suprabinary status → Teacher support→ Trouble falling asleep | 0.006** | 0.002 | 0.003 | 0.009 |
| Suprabinary status → Peer victimization→ Trouble falling asleep | 0.005** | 0.001 | 0.002 | 0.008 |
| Suprabinary status → Television before bed→ Trouble falling asleep | 0.000 | 0.000 | − 0.001 | 0.000 |
| Suprabinary status → Cellphone before bed→ Trouble falling asleep | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Computer Tablet→ Trouble falling asleep | 0.000 | 0.000 | 0.000 | 0.000 |
| *Trouble staying awake* | | | | |
| Suprabinary status → Trouble staying awake | 0.001 | 0.012 | − 0.022 | 0.025 |
| Suprabinary status → Friend support→ Trouble staying awake | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Family support → Trouble staying awake | 0.006** | 0.001 | 0.003 | 0.008 |
| Suprabinary status → Teacher support→ Trouble staying awake | 0.009** | 0.002 | 0.005 | 0.013 |
| Suprabinary status → Peer victimization→ Trouble falling asleep | 0.003** | 0.001 | 0.001 | 0.005 |
| Suprabinary status → Television before bed→ Trouble staying awake | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Cellphone before bed→ Trouble staying awake | − 0.001 | 0.001 | − 0.002 | 0.001 |
| Suprabinary status → Computer Tablet→ Trouble staying awake | 0.000 | 0.000 | 0.000 | 0.001 |
| *Weekday hours of sleep* | | | | |
| Suprabinary status → Weekday sleep hours | − 0.043** | 0.015 | − 0.073 | − 0.012 |
| Suprabinary status → Friend support→ Weekday sleep hours | 0.000 | 0.000 | − 0.001 | 0.001 |
| Suprabinary status → Family support → Weekday sleep hours | − 0.006** | 0.001 | − 0.008 | − 0.003 |
| Suprabinary status → Teacher support→ Weekday sleep hours | − 0.006** | 0.002 | − 0.010 | − 0.003 |
| Suprabinary status → Peer victimization→ Weekday sleep hours | − 0.003 | 0.001 | − 0.005 | 0.000 |
| Suprabinary status → Television before bed→ Weekday sleep hours | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Cellphone before bed→ Weekday sleep hours | 0.002 | 0.002 | − 0.002 | 0.005 |
| Suprabinary status → Computer Tablet→ Weekday sleep hours | − 0.001 | 0.001 | − 0.003 | 0.000 |
| *Weekend hours of sleep* | | | | |
| Suprabinary status → Weekend sleep hours | 0.003 | 0.014 | − 0.026 | 0.031 |
| Suprabinary status → Friend support→ Weekend sleep hours | 0.000 | 0.000 | 0.000 | 0.000 |
| Suprabinary status → Family support → Weekend sleep hours | − 0.002* | 0.001 | − 0.004 | − 0.001 |
| Suprabinary status → Teacher support→ Weekend sleep hours | − 0.003* | 0.001 | − 0.005 | − 0.001 |
| Suprabinary status → Peer victimization→ Weekend sleep hours | − 0.001 | 0.001 | − 0.002 | 0.001 |
| Suprabinary status → Television before bed→ Weekend sleep hours | 0.000 | 0.000 | − 0.001 | 0.001 |
| Suprabinary status → Cellphone before bed→ Weekend sleep hours | 0.001 | 0.001 | − 0.001 | 0.003 |
| Suprabinary status → Computer Tablet→ Weekend sleep hours | − 0.001 | 0.000 | − 0.001 | 0.000 |

β, standardized coefficient.
*$p < .05$.
**$p < .01$.

sleep, significant indirect effects were also observed via family support and teacher support (but again not via friend support, peer victimization, or any of the technology use variables).

## Discussion

The increasing number of youth with identities outside of the gender binary,[9,10] along with the health vulnerabilities identified for suprabinary youth,[21] suggests the need to better understand basic health processes like sleep health among this population. Findings from the current study provide initial evidence for the existence of sleep disparities between suprabinary and binary youth across multiple indicators of self-reported sleep health within a large-scale, nationally representative sample. Of particular concern is in how compared to their binary peers, suprabinary youth were receiving less than the 8 hours of sleep per night recommended for adolescents.[40] The same differences were not observed between suprabinary and binary youth for weekend sleep after accounting for covariates. Given the risks to psychosocial functioning associated with disparities between weekday and weekend sleep among adolescents,[41] however, the findings regarding sleep duration for weekends are troubling. Suprabinary youth reported more difficulty falling asleep but not more difficulty staying awake, accounting for covariates. Research finds stronger links between difficulty falling asleep and depressive symptoms, compared other sleep health outcomes,[42] suggesting that suprabinary youth experience poorer sleep health specifically on facets of sleep health related to the well-established health disparities among gender-minoritized youth (likely including suprabinary youth) more broadly.[34] Together, these findings suggest that the poorer sleep health among gender-minoritized youth found in previous research extends to suprabinary youth in particular,[5,6] and highlight the need to understand poor sleep health as a pathway to worse psychosocial outcomes among suprabinary youth.

We were also interested in better understanding the extent to which social support, peer victimization, and technology use accounted for poorer sleep health among suprabinary youth. For all sleep health outcomes, indirect effects between suprabinary status and sleep health were observed via family support, in line with research underlining the importance of families in promoting sleep health, as well as the vital role of family support for psychosocial outcomes among gender-minoritized youth.[17,26] These findings underscore the importance of intervention and prevention approaches that help family members and teachers nurture positive relationships with suprabinary youth as being a potential mechanism for improving their basic health outcomes. Adding to the existing literature, indirect effects between suprabinary status and sleep health for teacher support were also observed, supporting the important role of supportive teachers for gender-minoritized youth more broadly.[43] This finding suggests the relevance of examining the school context for health outcomes among suprabinary youth, and reinforces the importance of providing adequate training to educators to support suprabinary youth.

Two peer processes were explored as accounting for differences in sleep outcomes among suprabinary youth: peer victimization and friend support. For peer victimization, significant indirect effects were

observed for sleep quality, but not quantity. These findings may reflect a larger literature linking social factors to sleep quality more so than quantity.[22] Friend support was not associated with sleep health across any of the sleep outcomes examined. Previous research suggests that parent, but not friend, support is linked to mental health among transgender and nonbinary youth,[44] and a recent meta-analysis suggests a reciprocal association between negative peer relationships and sleep health, but not between positive peer relationships and sleep health.[22] These findings suggest the need to address peer victimization to improve outcomes among suprabinary youth.

Indirect effects were not observed between suprabinary identities and sleep health via any type of technology use before bed. Suprabinary youth only differed significantly from their peers in terms of higher computer or tablet use before bed, and we found no links between technology use and sleep health outcomes. These findings may reflect previous research showing modest links between technology use and sleep health,[26] suggesting the need for a more nuanced understanding of how different aspects of technology use are associated with sleep health among adolescent populations in general, and suprabinary youth in particular.

Finally, while race/ethnicity was included as a control variable, some small differences were observed across race/ethnicity with regards to the sleep outcomes, in line with a mixed literature on race/ethnic differences regarding sleep health.[45] Compared to adolescents of European ancestry (the majority of the sample), Black/Afro-Canadian participants, East and Southeast Asian participants, and East Indian and South Asian youth all reported less difficulty falling asleep, while youth of Latin American origin, and of East and Southeast Asian origin and youth with multiple race/ethnicities reported more difficulty in staying awake. Conversely, compared to adolescents of European ancestry, Black/Afro-Canadian, Latin American, First Nations, Métis, or Inuit, East and Southeast Asian, East Indian and South Asian, and youth reporting multiple race/ethnicities all reported fewer hours of weekday sleep, while youth with East and Southeast Asian ancestry, East Indian and South Asian ancestry and youth reporting multiple ethnicities all reported fewer hours of weekend sleep. Future research is needed to understand how the unique experiences and stressors shape the sleep experiences of youth across a range of race/ethnicities.

### *Limitations and future directions*

The current study had several notable strengths including the use of a national sample of adolescents to examine both multiple indicators of sleep quality, and relevant psychosocial factors (including under-examined factors like teacher support). The findings must be considered, however, in light of several limitations. First, while including a measure of suprabinary identities provides an important first step in understanding health disparities among gender-minoritized populations, future findings will be clarified by asking more comprehensive questions about gender identity. As noted above, the current method of assessment precluded our capacity to identify transgender boys and girls within the sample and provides limited information about how youth in the suprabinary category identified themselves. As such, it is important to note that suprabinary youth were being compared to all binary youth, not just transgender binary youth. An important next step would be to ask more detailed questions about gender identity, sex assigned at birth, gender expression, and identity disclosure to better understand variation in vulnerability to poor sleep outcomes. Second, these findings are cross-sectional. Future research may clarify sleep health outcomes among suprabinary youth by examining how these processes unfold across time. Examining how sleep health relates to family support, school climate, and peer victimization longitudinally can help clarify directionality and identify key periods of intervention. A longitudinal approach would also clarify the potential link between sleep health and negative health outcomes among suprabinary youth. Third, given the well-established link between depressive symptoms and sleep, we controlled for depressive symptoms in all multivariate analyses, with supplemental analyses (available from the first author) suggesting the confounding rather than colliding role of depressive symptoms. Considering depressive symptoms as a colliding variable, however, may be important for future work. Finally, sleep health captures a complex and multifaceted construct.[1] And, while the current study measured four different dimensions related to sleep health (trouble falling asleep, trouble staying awake, length of sleep on week days and weekends), future work including detailed assessments of other aspects of sleep health (i.e., sleep behaviors, efficiency of sleep, and physiological sleep measures)[2] may nuance understanding of sleep health across binary status. Including these types of measures in future work would allow for an understanding of the precise nature of sleep health disparities, specifying targets for intervention and prevention approaches.

### *Conclusions*

These findings provide preliminary evidence suggesting greater vulnerability to poorer sleep health among suprabinary youth compared to their binary peers. Results also underscore the role of support from family members and from teachers, as well as peer victimization, in accounting or partially accounting for these differences. And while these results need to be replicated, findings regarding family and teacher support suggest the relevance of both improving the social environment of suprabinary youth and validating interventions to improve sleep health among suprabinary populations as two pathways for improving individual outcomes. Ultimately, better understanding sleep health among suprabinary youth may provide an important starting point for addressing the health vulnerabilities experienced by these young people.

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## Author contributions

Alexa Martin-Storey, Ph.D: Conceptualization, formal analyses, writing-original draft, reviewing and editing. Kyla Mayne, M.A: Data curation; writing- original draft, and writing-reviewing and editing. Will Beischel, Ph.D: Conceptualization, writing-original draft, and writing-reviewing and editing. Wendy Craig, Ph.D: Methodology, writing- reviewing and editing, supervision, project administration, funding acquisition.

## Declaration of conflicts of interest

We have no conflicts of interest, real or perceived, to report.

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