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ORIGINAL PAPER

Exercise-Induced Orgasm and Its Association with Sleep Orgasms and Orgasms During Partnered Sex: Findings From a U.S. Probability Survey

Debby Herbenick[1] · Tsung-chieh Fu[1] · Callie Patterson[1] · J. Dennis Fortenberry[2]

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Abstract
Prior research has described women's experiences with exercise-induced orgasm (EIO). However, little is known about men's experiences with EIO, the population prevalence of EIO, or the association of EIO with other kinds of orgasm. Using U.S. probability survey data, the objectives of the present research were to: (1) describe the lifetime prevalence of exercise-induced orgasm (EIO) and sleep orgasm; (2) assess respondents' age at first experience of EIO as well as the type of exercise connected with their first EIO; (3) examine associations between lifetime EIO experience and orgasm at respondents' most recent partnered sexual event; and (4) examine associations between lifetime EIO experience and sleep orgasms. Data were from the 2014 National Survey of Sexual Health and Behavior (1012 men and 1083 women, ages 14 years and older). About 9% of respondents reported having ever experienced exercise-induced orgasm. More men than women reported having experienced orgasm during sleep at least once in their lifetime (66.3% men, 41.8% women). The mean age for women's first EIO was significantly older than men (22.8 years women, 16.8 years men). Respondents described a wide range of exercises as associated with their first EIO (i.e., climbing ropes, abdominal exercise, yoga). Lifetime EIO experience was associated with lifetime sleep orgasms but not with event-level orgasm during partnered sex. Implications related to understanding orgasm and recommendations for clinicians and sex educators are discussed.

Keywords Exercise-induced orgasm · Orgasm · Sleep orgasm · Nocturnal emission · Probability sample

Introduction

In humans, orgasm may occur in connection with sexual or non-sexual events, as well as from both genital and non-genital stimulation (Herbenick et al., 2018; Komisaruk & Whipple, 1998, 2011). Pouillet (1880) provided early descriptions of female orgasm that arose from operating heavy sewing machines that required sufficient effort to operate, thus constituting a form of seated exercise. Ellis (1905)—invoking his own observations as well as those of other researchers and physicians—described reports of women having orgasms from using sewing machines, swinging, climbing, as well as from cycling—noting that males, too, may experience sexual excitation from climbing and cycling. Indeed, orgasms have been described in connection with toothbrushing, urinating, foot stimulation, riding along bumpy roads, eating particular foods, exercise, and other assorted experiences (Chuang et al., 2004; Herbenick & Fortenberry, 2011; Herbenick et al., 2018; Waldinger et al., 2013). These orgasms occur outside of sexual contexts, and little is known about their physiological and psychological contexts, let alone their prevalence at the population level. The present study focuses on two such kinds of orgasm: those that occur during physical exercise—described by Herbenick and Fortenberry (2011) as "exercise-induced orgasms"—and those that occur during sleep. The contexts of these two types of orgasm experiences raise questions about the intrinsic sexual nature of orgasm and informs a broader understanding of the diversity of orgasm in the U.S. population.

✉ Debby Herbenick
debby@iu.edu

[1] The Center for Sexual Health Promotion, Indiana University School of Public Health, Indiana University Bloomington, Room 116, Bloomington, IN 47405, USA

[2] Indiana University School of Medicine, Indiana University, Indianapolis, IN, USA

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Exercise-Induced Orgasm

In their reports of interviews with thousands of people living in the United States, Kinsey et al. (1948, 1953) ventured that about 5% of people had experienced orgasms from physical exercise or muscular tension. However, questions about orgasms during exercise were not standardized in their interviews, and thus their estimate was based largely on information volunteered by respondents.

To our knowledge, there has been only one systematic study of exercise-induced orgasm (EIO) (Herbenick & Fortenberry, 2011). That study used an online convenience survey that specifically recruited women who had prior experience with sexual arousal or orgasm from exercise. Thus, the study design was not situated to estimate a population-based prevalence of EIO. Also, the researchers surveyed only women, leaving men's experience with exercise orgasms unexamined. In their convenience survey, Herbenick and Fortenberry found that women reported an average age of 19 years at first EIO experience and that the kinds of exercise participants recalled as most often associated with their first EIO were traditional abdominal exercises (e.g., sit-ups, crunches, Roman's chair leg raises), climbing ropes or poles, and lifting weights—all of which engage the core musculature as part of strength training or stabilization (e.g., Oliva-Lozano & Muyor, 2020). This finding was consistent with descriptions of EIO in popular media, where the term "coregasm" was first coined by editors at *Men's Health* magazine to reflect correspondence they had received from their readers about unexpectedly experiencing orgasms during exercises that engage core abdominal musculature, whether for strength or for stability (Men's Health, 2007).

Most women in the Herbenick and Fortenberry (2011) survey indicated that they didn't fantasize sexually in connection with experiencing EIO; also, most generally felt happy about their experience. However, the survey did not assess any aspects of respondents' orgasm experiences outside of the exercise context, even though doing so might have helped to situate EIO within broader experiences of genital response and orgasm. For example, it is not known to what extent EIO is an idiosyncratic experience—a bodily quirk, even—or if it reflects something larger about how a person's body and orgasmic response are organized. The present research extends the limited literature on EIO by—in a U.S. nationally representative sample—assessing participants' age at first EIO experience, examining EIO among men as well as adolescents, and exploring relationships between EIO and other kinds or orgasm, including orgasms that occur during sleep.

Sleep Orgasms

Relatively little is known about orgasm occurring during sleep, particularly for women. Orgasms occurring during sleep have sometimes been called "nocturnal orgasms" but may more accurately be called "sleep orgasms" given that people vary as to the time of day they sleep. Historical accounts of women's sleep orgasms were often written by men, who suggested that women's orgasms occurred due to lack of a sexual outlet, such as prior to becoming coitally experienced or after having been widowed (Ellis, 1905; Tilt, 1881). These early writings often indicate that women's sleep orgasms were understood as pathological and in need of medical treatment (Tilt, 1881). Men's sleep emissions were similarly pathologized, with speculation about nocturnal emissions reflecting mental illness or sinfulness (Ellis, 1905). More research has addressed nocturnal emissions (also called "wet dreams") but mostly among pubertal and adolescent men. Nocturnal emissions appear to occur most frequently in 12- to 16-year old adolescent males, with most adolescent males reporting having experienced them prior to maturing past high school (Ellis, 1905; Hughes, 1926; Ramsey, 1943). Much of the nocturnal emission research has been concerned with linking the frequency of nocturnal emission in young males to a range of other sexual behaviors and outcomes including masturbation (Gul et al., 2018), pornography use (Yu, 2012), sexual risk (STI), sexual debut, and sexual intercourse more generally (Lee et al., 2016). It is not clear to what extent nocturnal emissions are associated with orgasm.

Fisher et al. (1983) used vaginal thermoconductance methods to demonstrate that females experience sexual excitation during REM sleep, similar to cycles of penile erection synchronous with REM sleep, which may be related to the experience of sleep orgasm. In their convenience interview sample, Kinsey et al. (1953) described sleep orgasm in men and women, with 37% of their subjects reporting that they had experienced nocturnal orgasm by 45 years of age. Other convenience samples had found prevalence of sleep orgasms varying from 22% (Henton, 1976) to 37% (Wells, 1986) to 47% (Tapia et al. 1958). Fisher et al. (1983) demonstrated that increases in vaginal blood flow (VBF) were associated with dreams that contained sexual content. Whether the experience of orgasm is preceded or accompanied by sexual dreams has been supported by only a handful of studies, with some respondents associating sexual dreams with their experience of sleep orgasm and others describing non-sexual dreams associated with sleep orgasms (Ellis, 1905; Henton, 1976; Kinsey et al., 1953; Pirzada et al., 2019; Schenck, 2015; Winokur et al., 1959).

Ellis (1905) speculated that "involuntary sexual orgasm during sleep" could occur as a consequence of experiencing sexual excitation, but not orgasm, from activities such as using sewing machines (for women) or cycling (for men). Other scholars have indicated that sleep orgasm experience may be related to experiencing orgasms by other means, suggesting that the experience of sleep orgasm is positively correlated with the ease of orgasm during intercourse or other

kinds of sexual stimulation (Kinsey et al., 1953; Wells, 1983). We were interested in possible connections between sleep orgasms and EIO as those who experience EIO have often described exercise orgasms as spontaneous, involuntary, surprising – in that way, similar to sleep orgasms (e.g., Herbenick & Fortenberry, 2011; Herbenick et al., 2018; Kinsey et al., 1948, 1953).

Aims

There were several purposes of the present research. Using data from a U.S. probability survey of individuals aged 14 +, we aimed to: (1) describe the lifetime prevalence of EIO as well as sleep orgasm; (2) assess respondents' age at first experience of EIO as well as their recollection of the kind of exercise that provoked their first EIO; (3) examine associations between lifetime EIO experience and orgasm at respondents' most recent partnered sexual event; and (4) examine associations between lifetime EIO experience and sleep orgasms.

Method

Respondents

Data for the present analyses were from the 2014 National Survey of Sexual Health and Behavior (NSSHB), a U.S. nationally representative probability survey of adolescents and adults. The first wave of the NSSHB was administered in 2009 (Herbenick et al., 2010); the 2014 NSSHB represents the fourth wave of data collection. Study protocols and instruments were reviewed and approved by the institutional review board at Indiana University. Respondents were recruited in fall 2014 from the Ipsos (formerly GfK) KnowledgePanel®, a nationally representative probability-based online panel. KnowledgePanel® members have been recruited to participate in a wide range of nationally representative surveys, including on topics related to health and human sexual behavior (e.g., Chang & Krosnick, 2009; Eisenberg et al., 2011; Harris et al., 2009; Herbenick et al., 2020; Rowen et al., 2016);

KnowledgePanel® members are first identified and recruited using address-based sampling methodologies that utilize the U.S. Postal Service's Delivery Sequence File. Random selection is used to identify households to join the panel; invitations are sent through mailings and a follow-up phone call. Households that do not have Internet connectivity are offered access to facilitate participation. KnowledgePanel® members can earn points for participating in surveys; they can then accumulate these points and exchange points for cash or merchandise.

In regard to this specific study, Ipsos sent KnowledgePanel® members an email invitation indicating that a new survey was available. Adult members of KnowledgePanel® were recruited directly with these email invitations whereas adolescents ages 14–17 were recruited through their parents, who were themselves adult members of the KnowledgePanel®. These parents or legal guardians were asked for their consent to invite their adolescent into the study; they were also asked to give their adolescent privacy for study participation. Individuals were told that the survey was confidential.

A total of 4596 KnowledgePanel® members were sent survey invitations with a follow-up email sent to non-responders three days into data collection. Of these 4596 individuals, a total of 2648 (57.6%) clicked on the study link to read about the research and 2098 (1674 adults and 424 adolescents) completed the survey. In total, 45.6% of those invited completed the survey. Three adolescent surveys appeared to be mischievous and were excluded from analyses, leaving 421 adolescent cases. The survey was cross-sectional and survey completion took place online; median completion time was 16 min. Although the sample is meant to be nationally representative, Ipsos prepares statistical weights to correct for nonresponse or under/over-coverage; they did so using the March 2014 supplement of the Current Population Survey and the following variables: age, gender, education, race/ethnicity, household income, Census region, metropolitan area, and Internet access. We used weighted data for the present analyses.

Measures

Ipsos asks KnowledgePanel® members numerous demographic profile questions upon enrollment and updates these at least annually during panel retention. Thus, certain demographic data (e.g., age, gender, race/ethnicity, education, annual household income) were included in the de-identified dataset and were not asked again in the survey. Other demographic items such as sexual orientation and current relationship status were developed by the research team and administered as part of the present survey.

Exercise-Induced Orgasm

Respondents were asked, "Thinking about your entire life, how many times have you had an orgasm while you were engaging in physical exercise (e.g., such as sit-ups, ab exercises, yoga, running, lifting weights, climbing, etc.)." Response choices were Never, 1 or 2 times, 3 to 5 times, 6 to 10 times, and more than 10 times. Those reporting lifetime EIO experience were asked how old they were the first time it happened. They were also asked "What kind of exercise were you doing the first time this happened to you?" and presented with a textbox for response entry.

Lifetime Sleep Orgasm Experience

Respondents were asked, "Thinking about your entire life, how many times have you had an orgasm while you were sleeping?" Response choices were Never to More than 10 times, as above.

Event-Level Orgasm

Respondents who reported a most recent partnered sexual experience were asked, "During this most recent sexual experience, did you have an orgasm?" Response choices were: Yes, I had one orgasm; Yes, I had more than one orgasm; No, I did not have an orgasm; and Not Sure.

Statistical Analysis

All statistical analyses were conducted using the Stata software version 15. Sociodemographic characteristics, lifetime number of EIO, age at first EIO, and lifetime number of sleep orgasms were stratified by gender. Ages at first EIO listed as younger than 3 were recoded as missing (n = 4), as memories may be less reliable under the age of 3 (Eacott & Crawley, 1998). Chi-squared tests (for categorical variables) and *t*-tests (for continuous variables) were used to identify statistically significant differences between gender; a *p*-value of less than .05 was considered statistically significant. Lifetime number of EIO and sleep orgasms were dichotomized into those who have had any number of such orgasms versus those without such experiences. Event-level orgasm during the last sexual event was cross-tabulated by the dichotomized EIO variable to explore potential associations; chi-squared tests were used to determine if a statistically significant association exists between orgasm during sexual activity and EIO. Spearman correlation was calculated to describe the association between the frequency of exercise orgasms and the frequency of sleep orgasms. Weighted ordinal logistic regression was used to determine if the frequency of sleep orgasms was associated with the frequency of EIO, separately for men and women. Covariates that were statistically significantly associated with EIO were entered into the final model to account for potential confounding. In the final model, we adjusted for race/ethnicity (White/Black/other/Hispanic/multiple races or ethnicities), education (less than high school/high school/some college/bachelor's degree or higher), and annual household income (< $25,000/$25,000-$49,999/50,000-$74,999/ > = $75,000). Those who reported any EIO experience in their lifetime reported the type of exercise that had provoked their first EIO; these text responses were examined separately by gender.

Results

Respondent Characteristics

The weighted study sample was composed of 1012 (48.3%) men and 1,083 (51.7%) women ages 14+ . Approximately two-thirds of the sample reported being white, non-Hispanic, 30% reported having a bachelor's degree or higher, and about 40% reported having an annual household income of $75,000 USD or more (Table 1). About half of respondents were married. No gender differences were observed with respect to age, race/ethnicity, education, household income, or current relationship status. Most respondents identified as heterosexual or straight, with slightly more men self-identifying as gay and more women describing themselves as bisexual ($p = .023$).

Exercise-Induced Orgasm: Prevalence, Age and Exercise Type

About 9% of the total sample reported having experienced EIO one or more times, with no statistically significant difference in the number of times observed between women and men (Table 2). Most EIO-experienced respondents reported 10 or fewer instances of EIO.

Among those who reported lifetime EIO, women's mean age of first EIO was significantly older than men's age of first EIO; 22.8 years for women (SD = 10.2, range 9–70; median = 20.0) versus 16.5 years for men (SD = 6.2, range 9–43; median = 16.0); $p = .001$. As shown in Table 3, respondents reported a wide range of exercises associated with their first EIO. Some of the most commonly described exercises across genders were traditional abdominal exercises, lifting weights, running, biking/cycling, and climbing roles or poles. Some respondents specifically referenced childhood or adolescent physical education (P.E.) class activities (e.g., rope climbing), sports (e.g., wrestling), or other childhood activities such as climbing poles on swing sets.

Sleep Orgasms

We found that 66.3% of men and 41.8% of women reported having ever experienced sleep orgasm. When thinking about their whole lives, men reported significantly more orgasms during sleep than women ($p < .001$). As shown in Table 2, most respondents who reported sleep orgasms indicated that they occurred ten or fewer times. However, 16.6% of men and 12.8% of women who reported sleep orgasms indicated that they had experienced them more often.

Table 1 Weighted demographic characteristics for respondents

Characteristics	Men *% (n)*	Women *% (n)*	Total *% (n)*
Total	N = 1012	N = 1083	N = 2095
Age	$p = .764$		
14–17	7.0 (71)	6.5 (70)	6.7 (141)
18–24	11.1 (113)	8.8 (95)	9.9 (208)
25–29	9.6 (97)	10.4 (112)	10.0 (209)
30–39	14.1 (143)	15.1 (163)	14.6 (306)
40–49	16.2 (164)	15.3 (166)	15.8 (330)
50–59	18.8 (191)	17.9 (193)	18.3 (384)
60 +	23.2 (235)	26.2 (283)	24.7 (518)
Race/Ethnicity	$p = .936$		
White, non-Hispanic	65.4 (663)	64.9 (702)	65.1 (1365)
Black, non-Hispanic	10.8 (109)	12.1 (132)	11.5 (241)
Other, non-Hispanic	6.0 (60)	6.5 (70)	6.2 (130)
Hispanic	16.1 (163)	15.0 (163)	15.6 (326)
Multiple races/ethnicities	1.7 (17)	1.5 (16)	1.6 (34)
Adult/Parent Education	$p = .669$		
Less than high school	13.0 (132)	11.0 (119)	11.9 (250)
High school	30.0 (304)	29.0 (314)	29.5 (618)
Some college	27.4 (278)	30.2 (327)	28.8 (604)
Bachelor's degree or higher	29.6 (300)	29.8 (323)	29.7 (623)
Adult/Parent Household Income	$p = .238$		
< $25,000	15.4 (155)	19.7 (213)	17.6 (369)
$25,000–$49,999	21.9 (221)	22.8 (247)	22.3 (468)
50,000–$74,999	18.6 (188)	18.2 (197)	18.4 (385)
> = $75,000	44.2 (448)	39.3 (426)	41.7 (873)
Sexual Orientation	$p = .023$		
Heterosexual/Straight	92.2 (934)	93.1 (1008)	92.7 (1941)
Gay or lesbian	4.7 (48)	2.2 (24)	3.4 (72)
Bisexual	1.4 (14)	3.1 (34)	2.3 (48)
Asexual/Other	0.9 (9)	1.5 (16)	1.2 (25)
Current Relationship Status	$p = .660$		
Single, not dating	23.3 (236)	21.4 (232)	22.3 (468)
Dating or in a relationship	21.5 (218)	22.3 (242)	21.9 (460)
Married	47.6 (482)	49.8 (539)	48.7 (1020)

Association between Exercise Orgasms and Event-Level Orgasms

Among women, orgasm at the most recent partnered sexual event was reported by 49.5% (n = 48) of those with one or more lifetime EIO experience and by 58.3% (n = 510) of those with no lifetime EIO experience. Among men, orgasm at the most recent partnered sexual event was reported by 75.8% (n = 53) of those with one or more lifetime EIO experience and by 82.6% (n = 675) of those with no lifetime EIO experience. The frequency of lifetime EIO experience was not statistically significantly associated with event-level orgasm for men or women.

Association between Exercise Orgasms and Sleep Orgasms

Frequency of sleep orgasm experience was positively correlated with frequency of exercise orgasm for both men (Spearman rho = .186, $p < .001$) and women (rho = .189, $p < .001$). Having more than two lifetime sleep orgasm experiences was positively associated with the frequency of EIO for men, even after adjusting for race/ethnicity, education, and household income. Adjusting for the same variables, for women, having one to two or over ten lifetime sleep orgasms were positively associated with the frequency of EIO they reported (Table 4). Among men, those reporting three to five lifetime sleep orgasm experiences were 7.74 times (95% CI: 0.74, 10.54) more likely to report a having had a higher frequency of lifetime EIO, and these odds increase with men who report more than ten lifetime sleep orgasms being 13.15 times (95% CI: 3.90, 44.34) more likely to also report having had a higher frequency of lifetime EIO. Among women, those reporting one or two lifetime sleep orgasm experiences were 3.19 times (95% CI: 1.43, 7.71) more likely to report having a higher frequency of EIO experience and women who reported more than 10 lifetime sleep orgasms were 7.51 times (95% CI: 3.47, 16.30) more likely. However, there was not a significant association for women who reported having between three and ten lifetime sleep orgasms and the frequency of EIO they reported. Men who had more formal education and a higher annual household income were significantly less likely to report having experienced more EIO during their lifetime. No other significant associations were observed among women.

Discussion

The present study describes EIO among adolescents and adults who participated in a U.S. nationally representative probability survey. Our study augments the existing literature by providing U.S. population-level estimates of EIO of about 9%, with no statistically significant difference by gender. We included men in our study, which extended the literature as the one prior study focused on EIO included only women participants. Our findings were consistent with Herbenick and Fortenberry (2011), showing that exercises commonly associated with one's first EIO experience vary considerably but are often exercises known to recruit the core abdominal muscles. These include exercises traditionally thought of as "abdominal exercises" (e.g., sit-ups, crunches, Roman chair leg raises) as well as exercises such as climbing ropes or poles, pull-ups, chin-ups, lifting weights, gymnastics, heavy lifting, and other exercises known to recruit the core musculature

Table 2 Descriptive characteristics of different types of orgasms

Characteristics	Men	Women	Total
	% (*n*)	% (*n*)	% (*n*)
Lifetime number of exercise orgasms	$p = .492$		
Never	92.4 (890)	90.5 (971)	91.4 (1861)
1 or 2 times	4.0 (38)	4.6 (49)	4.3 (87)
3–5 times	2.4 (23)	2.5 (27)	2.5 (50)
6–10 times	0.3 (3)	1.2 (13)	0.8 (16)
11 + times	0.9 (9)	1.1 (12)	1.0 (21)
Age at first exercise orgasm	$p = .001$		
Mean (SD)	16.8 (5.9)	22.8 (10.1)	20.3 (9.2)
Lifetime number of sleep orgasms	$p < .001$		
Never	33.7 (323)	58.2 (622)	46.6 (945)
1 or 2 times	21.3 (204)	14.6 (156)	17.8 (360)
3–5 times	21.6 (206)	9.1 (97)	15.0 (304)
6–10 times	6.8 (65)	5.4 (58)	6.0 (122)
11 + times	16.6 (159)	12.8 (137)	14.6 (296)

for strength or stabilization (e.g., Hewit et al., 2018; Olivia-Lozano & Muyor, 2020; Youdas et al., 2010). Additionally, our findings echo earlier research showing that some people recall first experiencing EIO as children or adolescents (Herbenick & Fortenberry, 2011); in the present study, participants described EIO occurring from P.E. class activities and from playful recreation, such as climbing poles on swing sets.

Among men, we found that those with lower annual income and less formal education were more likely to report experiencing EIO. This may reflect the fact that physical labor—itself a form of exercise—can contribute to EIO. For example, in the present study one man indicated that his first EIO occurred while "loading an eighteen-wheeler with 55-gallon steel drums" (Table 3). Similarly, Herbenick et al. (2018) provided an account from someone who indicated that they sometimes experience orgasm while lifting heavy bags as part of their work as an airline bag handler. The first author has also heard anecdotally from a number of men who described orgasms occurring during army training exercises and fitness tests. Just as Ellis (1905) noted that, historically, women using heavy sewing machines with foot pedals appeared to have orgasms, our contemporary finding about EIO and education/income may reflect the intersections of gender, socio-economic status, and labor.

Our research further extends the literature by providing population-representative data on the prevalence of sleep orgasm, or at least the prevalence of memory or awareness of sleep orgasms. We found that sleep orgasms are prevalent in the U.S. population. Significantly more men than women reported lifetime experience with sleep orgasm. Reasons for this difference are not clear but may be related to complex relationships of sleep and sexual physiologies, as with the common experience of nocturnal penile tumescence (NPT), or morning erections, among males. Alternatively, males may more often wake during sleep orgasms due to ejaculation or else may more often become aware of nocturnal emissions as a result of noticing semen on their underwear or bedding (e.g., Stein & Reiser, 1994). Even though it's not clear to what extent nocturnal emissions are associated with orgasm, it may be that males interpret emissions as evidence of orgasm and thus may overreport sleep orgasm. Females may less often have such a noticeable physical sign of a sleep orgasm and consequently may underreport sleep orgasm. Another explanation for our finding that men more often reported sleep orgasm may reflect the frequent finding that males more often report orgasm from a range of sexual experiences (Herbenick et al., 2010; Richters et al., 2006). People may also differ in how they interpret whether an orgasm has occurred; if one's personal understanding or definition of orgasm requires some form of sex as a necessary (though not always sufficient) condition for orgasm, then one might not report orgasms that didn't fit. Given that many adults in our sample provided early ages of EIO during childhood, subsequent qualitative research may shed light on how people interpret EIO sensations in the years before they understand much about orgasm.

We found a positive relationship between lifetime experience of EIO and sleep orgasms, though this relationship was clearer among men than women; subsequent research might use a continuous measure of orgasm frequency rather than an ordinal one. However, we found no statistically significant relationship between EIO and event-level orgasm during partnered sexual activities. The association between EIO and sleep orgasms may reflect an underlying predisposition to unintentional orgasm in some people; however, partnered sexual activities introduce a number of other variables such as one's own or a partner's efforts in regard to orgasm, various sexual behaviors, sexual fantasy, direct genital touching and stimulation, potentially sex toys, and so on. It may be

Table 3 Type of exercise associated with first exercise-induced orgasm

Men		Women	
Exercise	*n*	Exercise	*n*
Abdominal exercises, sit-ups	8	Abdominal exercises (including Roman Chair), sit-ups	13
Lifting weights	7	Biking/cycling	13
Climbing rope, pole, or swing sets	6	Jogging/running	10
Running	6	Lifting weights	5
Biking/cycling	3	Yoga	5
Wrestling	3	Climbing rope, poles	4
Chin ups	2	Horseback riding	3
Pullups	2	Calf raises; dancing; exercise class; floor exercises; gymnastics; jumping on large ball; leg lifts; rocking horse, on my stomach, hands and legs off floor and rocking; swimming; walking on tread mill	1 each
Push ups	2		
Gym class; jumping jacks; Loading an eighteen-wheeler with 55-gallon steel drums; Riding a small motorcycle; stretching; swimming; Using a Soloflex system apparatus; walking	1 each		

that partnered sexual activity has too much "noise" associated with it to clearly assess a relationship between partnered orgasm and experiences like EIO and sleep orgasm which more often appear to just happen and are not necessarily under voluntary control. Subsequent research might further examine how EIO experiences are related to other experiences of orgasm, such as during masturbation or specific partnered sex acts (e.g., vaginal intercourse, oral sex, hand-genital stimulation). Additionally, subsequent research might ask how people feel about both their EIO and sleep orgasms, to what extent these experiences have ever concerned people or their partners, as well as how individuals may use these experiences to learn from their bodies and enhance pleasure during solo or partnered sexual activities.

Sex therapists and sexual medicine providers may find these data useful in efforts to contextualize their clients' experiences. At about a 9% population prevalence, EIO is not unique to any particular sex or gender. Our data also demonstrate that sleep orgasms are prevalent but are not ubiquitous, even among males for whom they are most often described in relation to puberty and adolescence. Subsequent research might explore to what extent EIO or sleep orgasm changes for people with different sexual dysfunctions or are reliable signs of therapeutic response as is sometimes seen with NPT (e.g., Canguven et al., 2016). Sexual health educators might include information about exercise-induced orgasms in lesson plans that teach more broadly about orgasm. EIO is not openly discussed in many circles; in our professional experience conducting this research and discussing it with colleagues and students, we have encountered varied responses including disbelief that people could possibly orgasm during exercise, suspicion that EIO could only arise from vulvar or penile friction, as well as relief to hear that others (like them) experience EIO.

Strengths and Limitations

A strength of the present study is that data are from a U.S. nationally representative probability sample and thus can be used to estimate prevalence of lifetime EIO and sleep orgasms in the general population of those aged 14+. Additionally, although address-based sampling was used to establish the Ipsos KnowledgePanel®, data collection occurred online which can facilitate the reporting of sensitive behaviors including sexual experiences (Burkill et al., 2016). That said, our response rate was 45.6% which is respectable but does leave the possibility that those who participated in our study were somehow different than those who did not click on the link to learn about the research, or different from those who read about the study but chose not to participate. Another strength of our work is that our sample includes adolescents, thus adding to a growing body of literature that examines young people's experiences with orgasm and other aspects of human sexuality that move beyond risk (e.g., Tolman &

Table 4 Association between lifetime sleep orgasms and lifetime exercise orgasms

Characteristics	Men			Women		
	OR	(95% CI)	*p*-value	OR	(95% CI)	*p*-value
Lifetime sleep orgasms						
Never	1.00	–	–	1.00	–	–
1 or 2 times	2.78	(0.74, 10.54)	.123	3.19	(1.43, 7.11)	.004
3–5 times	7.74	(2.43, 24.71)	.001	2.51	(0.96, 6.57)	.060
5–10 times	15.15	(3.66, 62.67)	< .001	1.10	(0.25, 4.95)	.896
More than 10 times	13.15	(3.90, 44.34)	< .001	7.51	(3.47, 16.30)	< .001
Race/Ethnicity						
White, non-Hispanic	1.00	–	–	1.00	–	–
Black, non-Hispanic	2.09	(0.74, 5.89)	.161	0.52	(0.18, 1.50)	.227
Other, non-Hispanic	2.66	(0.72, 9.85)	.144	0.62	(0.08, 4.44)	.628
Hispanic	2.13	(0.92, 4.95)	.078	1.36	(0.56, 3.28)	.479
Multiple races/ethnicities	1.82	(0.27, 12.28)	.540	1.41	(0.29, 6.77)	.669
Education						
Less than high school	1.00	–	–	1.00	–	–
High school	0.17	(0.06, 0.53)	.002	0.45	(0.15, 1.32)	.147
Some college	0.33	(0.14, 0.77)	.011	0.42	(0.14, 1.28)	.126
Bachelor's degree or higher	0.19	(0.08, 0.52)	.001	0.52	(0.16, 1.65)	.264
Annual household income						
< $25,000	1.00	–	–	1.00	–	–
$25,000–$49,999	0.22	(0.07, 0.67)	.007	0.75	(0.28, 2.01)	.569
50,000-$74,999	0.30	(0.11, 0.82)	.019	0.73	(0.27, 1.99)	.539
> = $75,000	0.31	(0.13, 0.74)	.008	0.62	(0.24, 1.62)	.334

McClelland, 2011). However, we did not interrogate the developmental processes involved in young people's experiences with EIO. For those who first experience EIO in childhood or adolescence, how do they make sense of these bodily sensations if they don't yet even have a concept of orgasm? At what ages and under what circumstances is EIO immediately recognized as an orgasm as compared to being understood as an orgasm only later on, after acquiring adolescent or adult sexual experience? Subsequent research might investigate these experiences.

Although our study methodology (being a U.S. probability survey) is a strength, a weakness is that we are limited to a small percentage of respondents who described themselves as having a sexual identity other than heterosexual and even fewer described themselves as transgender (n = 145 non-heterosexual sexual identities; n = 0 who identified as transgender, though it is possible that some respondents were transgender but do not identify with that term). Thus, our data largely reflect the experiences of U.S. sexual and gender majorities. Subsequent research on EIO might focus more specifically on the experiences of sexual and/or gender minoritized individuals. Given the significant expense of U.S. nationally representative surveys, we were also limited in survey space. Thus, we chose to examine EIO experience in connection with event-level orgasm due to the fact that the NSSHB has a detailed assessment of participants' most recent sexual experience, including orgasm. However, it may be that other assessments of orgasm—for example, with different time frames (e.g., past month or past year) or focused on specific behaviors (e.g., masturbation or vaginal penetration)—would yield important insights. Subsequent research should continue to explore the ways in which EIO is, or is not, similar to other experiences of orgasm.

The present research does not address how EIO works; indeed, potential physiological explanations are beyond the scope of the present research, which used self-report. Additionally, the present research does not address who is or who is not capable of experiencing EIO—even if they haven't yet experienced it—nor does it address how EIO experiences may shift across the life course. Subsequent research might address biomechanical aspects of EIO as well as whether ease of experiencing EIO changes in regard to pregnancy, hysterectomy, vaginal delivery, c-sections, menopause, or treatments affecting the prostate or uterus, any of which can change how people experience orgasms during sexual activity (Levin, 2018). Until such physiological research is conducted, we urge caution in making any assertions about what causes EIO. Popular press articles about EIO often identify a range of causes of EIO including hormonal changes, muscular tension, pelvic floor muscles, "nerve impulses," and clitoral stimulation (e.g., Castillo, 2012; Evans, n.d.; Ilano, 2018)—even though no research

to date has investigated, let alone established, any of these as causal mechanisms of EIO.

Subsequent research might investigate more thoroughly how people feel about their experiences with EIO and with sleep orgasm, such as whether people's bed partner(s) have noticed their sleep orgasm, as well as other interpersonal and contextual issues related to sleep orgasm. Past research has shown, for example, that people interpret their orgasms outside of sexual contexts in varied ways, sometimes positively and other times with guilt or concern (Irfan & Schenck, 2018; Tilt, 1881). Although many people experience orgasm outside of sexual contexts, with or without direct genital stimulation, orgasm is still often seen as reflecting sexual feelings or experiences; thus, for some people orgasm may feel "out of place" or even concerning when experienced in other ways. Finally, while we asked about people's experiences with exercise and sleep orgasm, we did not define for them what an orgasm is or what it may feel like; thus, responding to the item requires some pre-existing understandings of orgasm. Given the diverse ways that people describe their own orgasms, we did not wish to artificially narrow the meaning of orgasm. Indeed, while orgasm is occasionally paired with the term "climax" in some studies, (e.g., Laumann et al., 2005; Mitchell & Wellings, 2013; Rosen et al., 2000), more often the term orgasm is not defined in survey or interview research (e.g., Chadwick et al., 2019; Heiman et al., 2011; Herbenick et al., 2018; Muehlenhard & Shippee, 2010; Opperman et al., 2014; Richters et al., 2006).

Conclusions

Although exercise-induced orgasm remains a poorly understood experience, the present research uses a population-representative sample to demonstrate that about 9% of Americans have experienced EIO at least once, that EIO can first begin in childhood, and that it appears to be associated with experience of sleep orgasms.

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Author contributions Herbenick and Fortenberry developed the survey. Fu and Herbenick analyzed data. All authors contributed to manuscript preparation, review, and approval.

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Data Availability If accepted for publication, a limited data set may be archived at Indiana University.

Declarations

Conflicts of interest The authors declare that they have no conflict of interest.

Ethical Approval The research involved human subjects and, as noted in the manuscript, the institutional review board at Indiana University reviewed and approved study protocols and measures (Protocol 1207009071).

Informed Consent Participants reviewed an IRB-approved Study Information Sheet and indicated consent to participate prior to completing the survey.

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