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Better Sleep, Lower Blood Pressure, and Less Stress Following Sex: Findings From a Large-Scale Ecological Momentary Assessment Study

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Objective: Previous cross-sectional studies have shown that more (vs. less) sexually active individuals tend to be mentally and physically healthier, but little is known about the proximal mechanisms underlying such associations. ***Method:*** We analyzed two experience sampling data sets ($N = 8{,}452$, 66,181 observations; 72% male, age $M = 46.42$, 76% White) to examine changes in sleep, cardiovascular responses, and affect in the morning following sex, putative processes implicated in long-term mental and physical health benefits of sex. ***Results:*** Consistent with previous findings, our results showed significant between-person associations, suggesting more positive daily health outcomes for more sexually active individuals. Further, we found significant within-person associations suggesting that when people reported having (vs. not having) sex the previous night, they experienced better sleep quality, fewer sleep disturbances and shorter wake after sleep onset, lower blood pressure, less stress, more positive affect, and better coping in the morning. None of these associations were moderated by gender or relationship status. ***Conclusions:*** Our findings provide novel evidence suggesting short-term psychological and physiological benefits of sex, which may accrue to create better health over time.

Public Significance Statement
This study found that people who are more sexually active tend to sleep better, show lower blood pressure, and feel more positive in the morning. Similar pattern of outcomes was observed when a given person did (vs. did not) have sex the previous night. These short-term psychological and physiological benefits of sex may accumulate over time, contributing to better overall health.

Keywords: sexual activity, well-being, emotions

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Sexual experiences are universally common and relevant to many throughout the lifespan (DeLamater, 2012; Laumann et al., 2006). As such, much attention has been devoted to exploring what benefits and risks are associated with sex. A substantial body of work, mostly based on cross-sectional surveys, has demonstrated that more sexually active individuals tend to be mentally and physically healthier (Brody, 2010; Gianotten et al., 2021). Some evidence also exists to suggest long-term implications of sex, with higher sexual frequency linked to lower incidence of long-standing illnesses (Jackson et al., 2020) and reduced mortality risk (Cao et al., 2020).

What is currently lacking in the literature is research capturing the proximal effects of sex, especially when it comes to health-related outcomes. Indeed, both cross-sectional studies and longitudinal studies with long time intervals between assessments of sexual activities and health outcomes are susceptible to confounding. The critical question remains as to whether the driving force behind the health benefits of sex is the sexual act itself or characteristics associated with being sexually active, such as having a more open personality or good social relationships (Iveniuk & Waite, 2018). In this regard, examining the short-term within-person relation between sex and health-related outcomes can be useful in crediting any health

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benefits to sexual experiences themselves. That is, what changes within a given person following sexual activity that may contribute to their long-term health? Although experimentally examining the immediate effects of sex (Siegle & Prause, 2022; van Anders et al., 2007) can be informative, this approach is often limited in uncovering generalizable within-person effects of sex as it typically focuses on a single occasion of sex that takes place in a unique context (i.e., being instructed to have sex; also see Loewenstein et al., 2015). In the present research, we used two experience sampling data sets to examine how having sex the prior night changes morning reports of sleep quality, affect, and physiology. These changes are implicated in the putative long-term mental and physical health benefits of sex.

Sex and Sleep

Sleep is one consequence of sex that is closely tied to daily and long-term health. Research has shown that people generally perceive sex to have soporific effects. For example, in one study, most participants, regardless of gender, indicated that sexual intercourse made them sleepier (Gallup et al., 2020). Similarly, more than half the participants in another study perceived an improvement in the quality of sleep and sleep onset when they had sex with a partner, with men more strongly endorsing this belief (Lastella et al., 2019). Both men and women reported experiencing such improvements particularly when they reached orgasm. Another study suggested that whether or not sex led to orgasm in fact affected how people linked sex to sleep, with better sleep quality and shorter sleep onset perceived only when they reached orgasm (Pallesen et al., 2020). Combined, these findings suggest a widespread belief in the sleep-promoting effects of sex, possibly more so among men and particularly after sex with orgasm.

The possibility of sex affecting sleep structure indeed seems to align with the cascade of hormonal changes that occur during and following sex. For example, sex (or orgasm in particular; Krüger et al., 2002) is followed by increases in prolactin, which can modulate rapid eye movement (REM) sleep (although the link between prolactin and REM sleep may be variable; Steiger, 2003). Oxytocin is also implicated in sexual arousal or activities (Cera et al., 2021), although as with prolactin, precisely how its influence on sleep manifests is not straightforward. For example, a meta-analysis suggested mixed evidence for the influence of oxytocin manipulation on sleep outcomes, with the effects dependent on factors such as doses of oxytocin (Raymond et al., 2021). Nevertheless, given the lack of empirical data directly testing how sex is related to sleep, it remains unclear whether people's beliefs about their supposed connection are warranted.

Sex and Cardiovascular Responses

The potential for sex to affect sleep architecture suggests downstream changes in cardiovascular responses the morning after sex. Just as with other activities involving physical movements, sex, which typically requires moderate energy expenditure (Frappier et al., 2013), is accompanied by immediate cardiovascular changes. For example, heart rate (HR) and blood pressure (BP) rise during sex and fall shortly afterward, with the magnitude and speed of such changes dependent on factors such as intercourse positions (Oliva-Lozano et al., 2022). To the extent that sex (among other factors) shapes sleep architecture and thus sympathetic and parasympathetic activities during sleep (Somers et al., 1993), we may expect to see changes in cardiovascular responses in the morning following sex. For example, sexual activity may lead to reduced HR and BP the next morning by promoting slow-wave sleep (stage 3 of non-REM sleep), which is associated with reductions in sympathetic nervous system activity (Javaheri & Redline, 2012).

Sex and Affect

Complementing cross-sectional findings on the link between sexual frequency and affective well-being (Laumann et al., 2006; Muise et al., 2016), a few studies have conducted short-term longitudinal investigations into sex and affect. In one descriptive study, participants who engaged in sex the previous day reported the consequences they experienced, including both positive (e.g., feeling better) and negative (e.g., feeling guilt) ones (Vasilenko et al., 2012). Researchers found that participants recalled at least one positive consequence on 96% of the days they had sex and a negative consequence on 42% of those days. The odds of experiencing a negative consequence increased if the sex was with a casual partner. Somewhat consistent with this latter finding, another study found in their monthly assessments of sex and affect among female college students that participants reported more negative affect in months they did (vs. did not) engage in sexual behavior, but only when the sexual behavior involved a casual partner (Wesche et al., 2019). In this study, no difference was observed in positive affect between months with versus without sexual behavior regardless of the partner type.

A more precise examination of the proximal effects of sex was conducted by Kashdan et al. (2018) who used daily (rather than monthly) assessments of sex and affect. Contrasting previous findings (Wesche et al., 2019), this study showed that having (vs. not having) sex on a given day was associated with greater positive affect and less negative affect the next day. Further, the (negative) relation between sex and negative affect only held for people who were not in a romantic relationship. That is, if anything, sex with a casual partner was more, not less, beneficial compared to sex with a romantic partner (although this assumes that those in relationships had sex only with their partner, which may not be true). Overall, previous findings provide initial insights into the proximal effects of sex on affective experiences. However, there is a lack of robust investigations using a large, diverse sample that ensures better generalizability (vs. college samples) and adequate statistical power to detect any effects of moderators such as relationship status.

Overview

We drew on two existing experience sampling data sets to examine the link between sex and subjective experiences of sleep, cardiovascular responses, and affect both at the between-person (i.e., differences between people who are more vs. less sexually active) and within-person levels (i.e., differences in the morning after sex vs. no sex). Specific outcomes were as follows: sleep experiences (sleep onset latency [SOL], quality, refreshedness, duration, disturbances, and wake after sleep onset [WASO]), cardiovascular responses (HR and BP), and stress and affect (acute stress event [yes/no], stress, coping, and positive emotions). We expected between-person differences such that more (vs. less) sexually active individuals show better sleep experiences (e.g., shorter SOL and greater sleep quality), lower BP, and better affective experiences (e.g., less stress and more positive emotions). We also expected to find within-person associations in the same direction. Based on previous research, we also explored gender and relationship status as potential moderators.

Method

Participants and Procedure

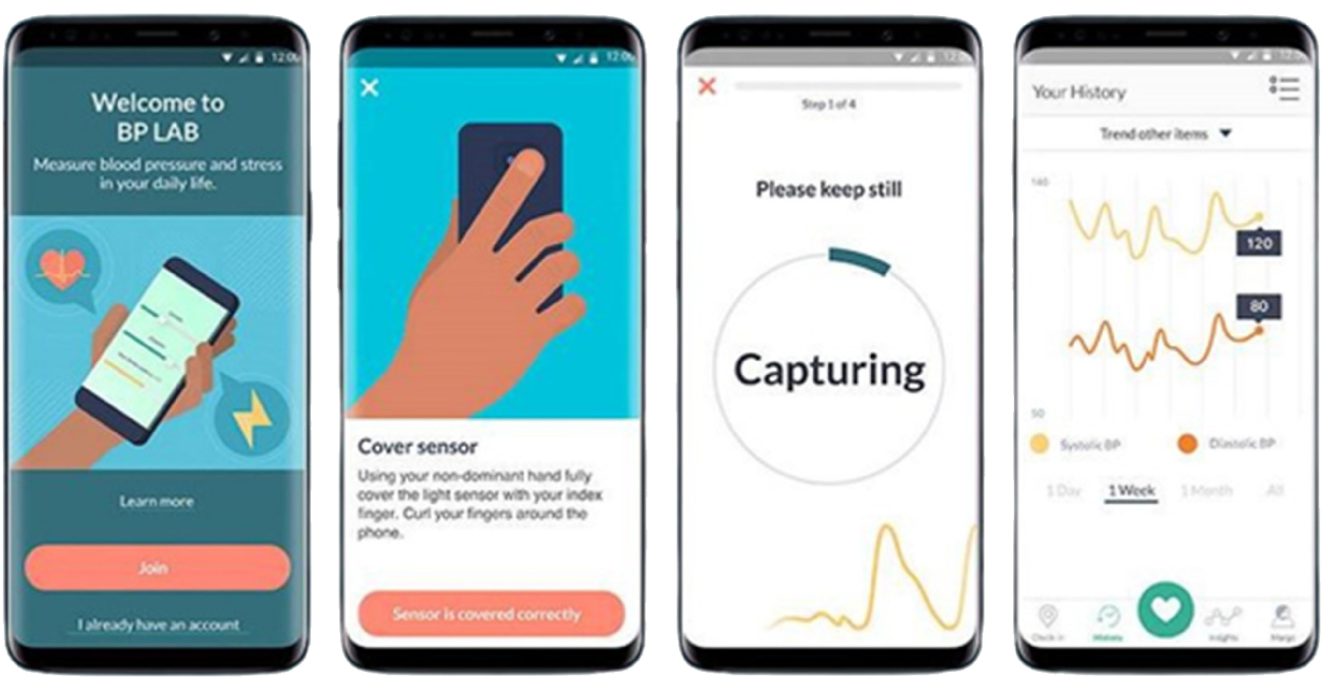
Deidentified data and R codes for the reported analyses can be found at https://osf.io/tq47h/. Data for the present research came from MyBPLab (https://mybplab.com), a study based on a mobile app that could be downloaded from the Google Playstore. Please see Figure 1 for sample screenshots from the app, and for more information on the study, see Gordon and Mendes (2021) and the associated Open Science Framework page (https://osf.io/ykmht/). We analyzed data from two versions of this app: MyBPLab v1.0 (data collected from January 2018 to December 2019; Sample A hereafter) and MyBPLab v2.0 (data collected from March 2019 to December 2021; Sample B). Individuals who downloaded the app on a compatible phone or watch (i.e., with a built-in optic sensor used to measure HR and estimate BP), were 18 years or older, and passed an English fluency quiz were presented with a consent form to participate in a 21-day study. Table 1 provides the demographic characteristics of participants in each sample (total $N = 8{,}452$). Our participants were predominantly male and White, and to the best of available data, from the United States. Reflecting the app's emphasis on health tracking, 69% of our participants were aged 40 years or older.

Every day, participants received notifications to complete check-ins. They could complete up to three check-ins a day (one in each of the following time windows: 7–10 a.m., 10 a.m.–4 p.m., and 8–11 p.m.). At every check-in, the participants provided a sensor reading and answered a standard set of questions about where they were, who they were with, and whether they had exercised vigorously in the past 30 min. Then, participants were presented with a rotating set of questions, which repeated every 3 days. Questions about sex and sleep, our primary variables, were included in one of the three morning check-in sets. Although the study was designed to last 21 days, participants could continue using the app, completing check-ins and providing sensor readings after 3 weeks. As an incentive to participate, participants received feedback about their HR and BP. In Sample A, active participants were also entered into a lottery for a Samsung smartphone. This study was approved by the Human Research Protection Program at the University of California, San Francisco. For the present research, we analyze a subset of data from participants who completed three or more morning check-ins that included questions about sex and sleep.

Cardiovascular Measures

At every check-in, participants placed their index finger over the optic sensor on their phone or waited while wearing their watch until a digital readout on the phone indicated the measurement was complete. We analyzed HR and BP values from these recordings. BP measurements were adjusted based on an external calibration measurement provided by the participants. Specifically, participants were encouraged to calibrate the optic sensor using an external BP device when they joined the study. They could also recalibrate it anytime during the study (for more information on the validity of phone- or watch-based optic sensors, see Gordon & Mendes, 2021).

Figure 1
Illustration of the Mobile Assessment



Note. See the online article for the color version of this figure.

Table 1
Sample Characteristics

Variable	Sample A (2018–2019)	Sample B (2019–2021)
n	3,959	4,493
Gender		
Male	2,965 (75%)	3,150 (70%)
Female	983 (25%)	1,296 (29%)
Another identity/unidentified	11 (<1%)	47 (1%)
Age, *M* (*SD*)	43.28 (12.15)	49.17 (12.43)
Race[a]		
White	2,989 (76%)	3,420 (76%)
Asian/Pacific Islander	398 (10%)	378 (8%)
Black	320 (8%)	284 (6%)
American Indian	52 (1%)	101 (2%)
Other/declined	326 (8%)	194 (4%)
Ethnicity		
Latinx		362 (8%)
Sexual orientation		
Heterosexual		4,060 (90%)
Homosexual		147 (3%)
Bisexual		99 (2%)
Other/unidentified		187 (4%)
Relationship status (valid *n*)	531	545
Partnered	1,070 (69%)	1,229 (74%)
Unpartnered	484 (31%)	440 (26%)
Country		
United States		3,065 (68%)
Australia		407 (9%)
United Kingdom		422 (9%)
Canada		279 (6%)
India		69 (2%)
Singapore		65 (1%)
New Zealand		32 (<1%)
Hong Kong		27 (<1%)
Other/unidentified		127 (3%)

[a] Multiple responses were allowed. The exact wording of options for race was as follows: Caucasian, Asian/Pacific Islander, African American, Native American in Sample A, and White/European, Asian, Pacific Islander, Black or African American, Native American or Alaska Native in Sample B. We did not obtain ethnicity or country information in Sample A. For individuals included in both versions of the app, their earlier information (i.e., information in Sample A) is used.

Morning Check-In Measures

Participants completed check-ins in the morning (7 a.m.–10 a.m.) that included the following items. Given that participants received little compensation for participating in this study, we used brief, face-valid items to maximize participation.

Sex Last Night

In both samples, participants were asked if they had sex the previous night. Responses were coded as 1 = *yes* and 0 = *no*. Participants could also refuse to answer this question (see the Analytic Sample Differences section).

Subjective Sleep Measures

In both samples, participants reported how long it took them to fall asleep in minutes (SOL) and rated the quality of their sleep (sleep quality) on a scale ranging from 1 (*very bad*) to 4 (*very good*). In Sample B, participants also reported how refreshed they felt when they woke up in the morning (*refreshed*) on a scale ranging from 1 (*not at all*) to 5 (*a great deal*). Additionally, they reported how many hours they slept (sleep duration, options ranging from 0 to 12+), how many times they woke up and tried to return to sleep (sleep disturbances, options ranging from 0 to 10+), and how many minutes they were awake during the sleep disturbances (WASO). Response options for the last question ranged from <5 min, followed by 15-min intervals starting from 15 min up to 180 min, and 180 min or more. We recoded the first and last options as 5 and 180 for the analyses. For people who reported 0 for sleep disturbances, we recoded their WASO as 0.

Stress and Affect Measures

In Sample B, participants were asked if they had experienced any particularly stressful events since their last check-in (1 = *yes* and 0 = *no*). If participants clicked "no" (which was the case for 92% of the check-ins), they rated to what extent they felt "stressed, anxious, overwhelmed" (stress), "in control, coping well, on top of things" (coping), and "joyful, glad, happy" (positive affect). All items were rated using a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*).

Background Measures

Upon signing up (and at any time during the study), the participants had the option to complete an additional series of questionnaires, including a question assessing the relationship status. Given that the survey was optional, only a subsample of participants completed it; thus, our analyses using relationship status are based on a smaller sample (see Table 1).

Data Cleaning

We excluded individuals with missing data on gender or age. For models predicting cardiovascular outcomes, we also excluded individuals with missing data on body mass index (BMI) or with BMI < 15 or >60. Further, we excluded check-ins from analyses if extreme values of HR (<30 and >200), systolic blood pressure (SBP) (<80 and >210), or diastolic blood pressure (DBP) (<50 and >180) were recorded, either in raw sensor estimates or when calibrated. Finally, in models with cardiovascular measures as outcomes, we excluded check-ins if participants indicated having exercised vigorously within the past 30 min as it can temporarily increase HR and BP.

Results

Analytic Sample Differences

As our analyses involved a specific subgroup of people (those with valid responses to a question about sex), we examined if and how our analytic sample differed in terms of our key outcomes from those who were not included in our analyses. In the pooled sample, there were participants who had three or more valid responses to sleep questions but not to the sex question, allowing us to compare people who were vs. were not comfortable answering questions about sex ($n = 5{,}496$). On average, our sample tended to take less time to fall asleep and report better sleep quality. In terms of morning physiology, our sample's average HR was higher compared to those excluded, although there was no difference in BP. In Sample B, the analyzed sample did not differ from the unanalyzed sample ($n = 2{,}696$) in any outcomes other than coping for which our analytic sample scored higher.

We also examined if the reports we analyzed are representative of the typical mornings of our analytic sample. When we compared our sample's sleep measures on the mornings that we did versus did not analyze (i.e., participants were not presented with the sex question or indicated "prefer not to respond"), analyzed mornings were higher on sleep quality but were not different in SOL. In terms of morning physiology, there was no difference in HR or BP. In Sample B, analyzed mornings did not differ from unanalyzed mornings in any outcomes other than coping for which analyzed mornings appeared higher. Please see the online supplementary materials for the full results.

Analytic Plan

All analyses were conducted using R. Given the nested nature of the data (days nested within participants), we conducted multilevel modeling using the package lme4. For count and time-based outcomes (SOL, sleep duration, sleep disturbances, and WASO), we used robust estimation to ensure our results are robust to violation of model assumptions (Koller, 2016). In all models, our primary predictors were person-mean-centered sex (capturing within-person effects of having sex) and grand-mean-centered person mean of sex (capturing between-person effects of having sex). Put simply, the former captures the effect of having versus not having had sex (within a given individual), whereas the latter captures the effect of being someone who is more or less likely to report having had sex. All models included a random intercept and a random slope of person-mean-centered sex (unless noted otherwise). Finally, given prior work showing some gender and age-related differences in our outcome variables (Jonasdottir et al., 2021; Pinquart & Sörensen, 2001), gender (male/female/another identity) and age (continuous) were included as covariates for between-person effects. Note that we use the term "gender" instead of "sex" as the latter is used to refer to sexual experience in the current paper. For models predicting cardiovascular measures, BMI was additionally entered as a control for between-person effects, given its link with cardiovascular outcomes. The number of missing data varied by outcomes, some more substantial than others, likely due to the order of the questions. For example, in Sample B, 25% of the time when the sleep duration question (presented first among our sleep outcomes) was answered, there was no response to the WASO question (presented last). We report the exact numbers of participants and their observations used in each model.

To fully use the large sample size and increase our statistical power, we conducted an integrative data analysis (Hussong et al., 2013) when predicting outcomes that were included in both samples. Specifically, we pooled raw data from the two samples and ran the multilevel models in this pooled data set. To account for the sample heterogeneity, we created a binary variable indicating sample membership (coded as 0 = *Sample A* and 1 = *Sample B*) and controlled for it in all models. The interactions between the sample membership and our effects of interest (both the between- and within-person effects of sex) were also included in the model. However, as we found no evidence of our primary effects varying by the sample, these terms were dropped from our final models. Finally, we report $R^{2(fv)}$, which indicates the proportion of total outcome variance explained by all fixed effects and random slope variation (Rights & Sterba, 2019) as our effect size per model.

Moderation Analyses

We examined gender (male vs. female) and relationship status (partnered vs. unpartnered) as potential moderators in separate models. Each model included the moderator and two interaction terms (i.e., Moderator × Person Mean and Moderator × Person-Mean-Centered Sex) as additional predictors of the given outcome.

Additional Analyses

We conducted additional analyses in smaller subsets of data to (a) ensure the robustness of our analyses to the presence of super-responders and (b) examine if any observed effects on stress and affect held controlling for previous evening's responses (applicable $n = 2{,}253$, $\geq 14{,}133$ reports). The former involved analyses using a subset of data in which only the first 100 check-ins were included for participants who had more than 100 check-ins, as the duration of study participation can potentially influence participants' responses (Hoemann et al., 2021). This analysis thus draws on the same number of participants but fewer reports (>58,336 for sleep and 38,111 for cardiovascular outcomes). Please see the online supplemental materials for the full results.

Inference Criteria

Considering the large sample size of our data sets (also see Weston et al., 2019) and multiple hypothesis testing, we adopted a conservative alpha level ($p < .01$) for inferring statistical significance.

Preliminary Results

Out of 66,181 observations, there were 6,083 (9%) reports of sex. Individuals identifying as female, *odds ratio* (OR) = 0.69, $z = -5.72$, $p < .001$, and older, $OR = 0.98$, $z = -10.41$, $p < .001$, were less likely to report having had sex. Being unpartnered was also associated with lower likelihood of reporting sex, $OR = 0.42$, $z = -8.49$, $p < .001$ (based on a smaller sample with relationship status data; see Table 1). Among our full sample, about 30% of the participants ($N = 2{,}532$) had a variation in sexual activity (i.e., had at least 1 day reporting sex and 1 day reporting no sex), contributing 26,907 reports to estimating within-person associations involving sex. Within-person correlations among the study variables are presented in Table 2.

Primary Results

Sleep and Cardiovascular Outcomes

Table 3 shows significant between-person effects of sex such that more frequent reports of sex were associated with better sleep quality and lower morning DBP, and in Sample B, reporting more refreshed feelings and fewer sleep disturbances (items not assessed in Sample A). Further, we found significant within-person associations suggesting that independent of the between-person differences, having (vs. not having) sex the night before was associated with higher quality of sleep and lower morning BP, and in Sample B, feeling more refreshed and waking up fewer times and for shorter period of time at night. No significant interactions with gender or relationship status were found.

Stress and Affect Outcomes (Assessed Only in Sample B)

There was no significant between-person association between sex and the odds of reporting an acute stress event in the morning,

Table 2

Within-Person Correlations Among the Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	ICC
1. Sex last night	—	.00	.03**				.01	−.02*	−.02*			.47
2. Sleep onset latency	.00	—	−.29**				.02	.01	.00			.49
3. Sleep quality	.03**	−.25**	—				−.06**	−.07**	−.04**			.33
4. Refreshed	.05**	−.18**	.56**	—								.52
5. Sleep duration	−.01	−.17**	.35**	.35**	—							.42
6. Sleep disturbances	−.01	.21**	−.36**	−.22**	−.03**	—						.58
7. HR	.02	.01	−.05**	−.05**	−.06**	.01	—	.26**	−.15**			.64
8. SBP	−.02	.01	−.05**	−.04**	−.02*	.01	.25**	—	.83**			.33
9. DBP	−.02*	.00	−.03**	−.03**	.00	.01	−.03**	.86**	—			.38
10. Stress	−.03**	.03**	−.13**	−.15**	−.07**	.05**	.06**	.06**	.05**	—		.52
11. Coping	.02**	−.04**	.11**	.17**	.06**	−.04**	−.03**	−.02**	−.02	−.36**	—	.60
12. Positive affect	.06**	−.03**	.13**	.23**	.05**	−.03**	−.03**	−.02**	−.02*	−.32**	.44**	.66

Note. Values above the diagonal indicate correlations in Sample A and values below the diagonal indicate correlations in Sample B. ICC = intraclass correlation coefficient; HR = heart rate; SBP = systolic blood pressure; DBP = diastolic blood pressure.
* $p < .01$. ** $p < .001$.

$OR = 1.13$, $z = 0.55$, $p = .579$. However, the within-person association was significant such that participants were less likely to report that they had experienced a stressful event in the morning when they reported having (vs. not having) had sex, $OR = 0.48$, $z = -3.34$, $p < .001$. Table 4 summarizes the results from models predicting follow-up affect questions when no particularly stressful event had occurred. There were significant between-person associations suggesting that people who reported having sex more frequently tended to report better coping and more positive affect in the morning. Further, significant within-person associations suggested that, in the morning after sex, participants reported less stress, better coping, and greater positive affect compared to mornings following nights without sex. No significant interactions with gender or relationship status were found.

Discussion

Using two sets of ecological momentary assessment data, this research extended previous cross-sectional work by showing that those with a greater proportion of sex (vs. no sex) nights tend to report better sleep quality and higher levels of coping and positive affect as well as have lower DBP in the morning. Further, our research provided novel evidence supporting differences associated with sex at night at the within-person level. That is, in the morning after sex (vs. no sex), participants not only reported having slept better, feeling more refreshed, and having experienced fewer sleep disturbances but also were less likely to report an acute stress experience and generally felt less stressed, more in control, and more positive. Their BP was also lower on such mornings.

Our findings on BP levels are noteworthy particularly considering previous findings linking sexual activity to long-term cardiovascular health outcomes. For example, research has linked declines in sexual frequency to higher odds of coronary heart disease among women (Jackson et al., 2020) and lower sexual frequency to increased risk of cardiovascular disease among men (Hall et al., 2010) as well as to increased risk of cardiovascular disease mortality across genders (Cao et al., 2020; cf. Liu et al., 2016). Nevertheless, the present study is the first to link sexual activity to between-person and within-

Table 3

Summary of Results From Models Using Last Night's Sex as a Predictor of Sleep and Cardiovascular Outcomes in the Morning

		Sex last night (between-person effects).				Sex last night (within-person effects)				
Outcome	N (k)	b	t	99% CI	p	b	t	99% CI	p	$R^{2(fv)}$
Pooled sample										
Sleep onset latency[a]	8,426 (64,652)	−0.93	−1.39	[−2.66, 0.79]	.164	0.14	1.41	[−0.12, 0.41]	.158	.02
Sleep quality	8,450 (65,767)	0.12	4.08	[0.05, 0.20]	<.001	0.06	5.87	[0.03, 0.08]	<.001	.02
HR	5,343 (41,838)	1.00	1.14	[−1.27, 3.28]	.256	0.34	1.94	[−0.11, 0.80]	.052	.08
SBP	5,343 (41,838)	−1.14	−2.59	[−2.28, −0.01]	.010	−0.38	−2.99	[−0.71, −0.05]	.003	.01
DBP	5,343 (41,838)	−0.98	−2.62	[−1.94, −0.02]	.009	−0.34	−3.33	[−0.59, −0.08]	.001	.01
Sample B										
Refreshed	3,949 (28,503)	0.37	4.55	[0.16, 0.58]	<.001	0.15	6.54	[0.09, 0.21]	<.001	.05
Sleep duration	4,955 (37,540)	0.11	1.17	[−0.13, 0.35]	.242	−0.04	−2.06	[−0.10, 0.01]	.040	.01
Sleep disturbances[a]	3,943 (28,277)	−0.32	−2.62	[−0.64, 0.01]	.009	−0.08	−3.18	[−0.15, −0.02]	.001	.02
Wake after sleep onset[a]	3,939 (28,289)	−2.15	−2.54	[−3.81, 0.49]	.011	−0.77	−3.27	[−1.24, −0.31]	.001	.01

Note. N (k) = number of participants (number of reports); b = unstandardized coefficient; CI = confidence interval; HR = heart rate; SBP = systolic blood pressure; DBP = diastolic blood pressure; $R^{2(fv)}$ = proportion of total outcome variance explained by all predictors via fixed slopes and random slope variation (Rights & Sterba, 2019). Each row indicates one model, and $R^{2(fv)}$ is reported per model.
[a] Models run without a random slope of sex (e.g., due to singular fit issues). Sex last night was coded as 1 = *yes* and 0 = *no*. All models controlled for gender, age, and for models based on the pooled sample, sample membership. Models predicting HR, SBP, and DBP also controlled for BMI.

Table 4
Summary of Results From Models Using Last Night's Sex as a Predictor of Affect Assessments in the Morning (Sample B)

		Sex last night (B)				Sex last night (W)				
Outcome	*N* (*k*)	*b*	*t*	99% CI	*p*	*b*	*t*	99% CI	*p*	$R^{2(fv)}$
Stress	4,923 (33,858)	0.01	0.09	[−0.16, 0.17]	.926	−0.07	−4.95	[−0.11, −0.04]	<.001	.003
Coping	4,923 (33,845)	0.21	2.78	[0.02, 0.40]	.005	0.06	3.51	[0.01, 0.10]	<.001	.004
Positive affect	4,923 (33,843)	0.40	5.08	[0.19, 0.60]	<.001	0.16	9.53	[0.12, 0.20]	<.001	.01

Note. *N* (*k*) = number of participants (number of reports); B = between-person effects; W = within-person effects; *b* = unstandardized coefficient; CI = confidence interval; $R^{2(fv)}$ = proportion of total outcome variance explained by all predictors via fixed slopes and random slope variation (Rights & Sterba, 2019). Sex last night was coded as 1 = *yes* and 0 = *no*. All models controlled for gender and age. Each row indicates one model, and $R^{2(fv)}$ is reported per model. Due to singular fit, stress model was estimated without a random slope of sex.

person variations in BP levels, which are predictive of the said outcomes (Kario et al., 2016; Ward et al., 2012) and thus may underlie the purported long-term cardiovascular health benefits of sex.

Further, in contrast to previous studies in which participants recalled how their sleep was typically affected by sex (Gallup et al., 2020), our approach allowed for near real-time assessments and a direct examination of the link between sex and sleep rather than people's perceptions of it. Notably, contrary to evidence of gender differences in previous work examining people's perceptions (Lastella et al., 2019), we found no gender differences in the within-person effects of sex; that is, the relationship between sex and sleep experiences appeared more similar for men and women than their perceptions suggest. Our findings on the link between sex and sleep deserve special attention as they raise the possibility that sleep underlies the health benefits of sex. Although our data do not allow for a good test of mediational paths, our supplementary analyses provided some evidence to the idea that sexual activity may be linked with reduced BP and better affective experiences in the morning through improved sleep quality (results in the online supplementary materials). Sleep as a key mechanism driving the health benefits of sex warrants exploration in future research, ideally using both objective and subjective measures of sleep (Zinkhan et al., 2014). Of course, precisely how sexual activity affects sleep also requires more attention. Some evidence implicates neuroendocrine mechanisms such as changes in prolactin or oxytocin in sleep improvements. Other possibilities include changes in the autonomic nervous system such as increases in parasympathetic nervous system and decreases in HR and BP after orgasms, which can promote relaxation and sleepiness (Janssen et al., 2007; Pfaus et al., 2014).

Our findings on stress and affect also extended the existing literature by conceptually replicating and generalizing previous findings (Kashdan et al., 2018). Specifically, we found that having sex was associated with better affective experiences the next day in a larger, more diverse sample (vs. a small college sample). Further, there was some evidence against an alternative explanation that these relations are solely driven by the effects of affective experiences on sexual activity (e.g., positive affect leading to having sex); we found that the relations between sex and positive affect held even after controlling for the previous evening's affect (see the online supplementary materials). Our larger sample also allowed for a better test of the moderation by gender and relationship status, which revealed no significant differences in the within-person effects of sex. Together with the limited evidence for the moderation effects of gender or relationship status in previous work (Kashdan et al., 2018), our data seem to challenge the potential for these variables' role as moderators. Possibly, the variability in the effects of sex (if at all) may lie at the situation level (e.g., the presence of orgasm) rather than at the person level.

Despite several strengths of our research including investigations of within-person effects of sex in natural environments and exploration of diverse health-related outcomes, there were limitations. First, our sample primarily consisted of male, White, and heterosexual individuals, living in industrialized and democratic cultural contexts (see Table 1), limiting the generalizability of our findings. Further, with the type of methods and analyses we used, there are questions about who and what we analyze. Indeed, we found some evidence that the sample included (vs. excluded) in our analyses and the mornings included (vs. excluded) in our analyses may be characterized by better sleep quality and higher levels of coping (see the Analytic Sample Differences section), although there was limited evidence for differences in other outcomes. On the one hand, it is notable that we found variability in sleep quality and coping related to sex even within days and people positioned at the higher end of these outcomes; on the other hand, such selection of the data requires careful attention when interpreting and generalizing our findings.

Another limitation, given our use of existing data sets, concerns the assessment of sex. Specifically, no information about the types or quality of the sexual experiences was obtained; our inability to capture the variability in sexual activities may partly explain the small effect sizes observed across our outcomes. Future research should include more specific and diverse assessments of sexual experiences to advance our understanding of the effects of sex. This can also help us understand what aspects of sex are particularly beneficial. For example, considering previous meta-analytic finding that exercise in the evening has no effect on subjective sleep quality (Stutz et al., 2019), we might expect a more specific experience (e.g., orgasm) beyond physical activity is necessary to observe positive sleep outcomes. Finally, although examining within-person associations helps rule out potential confounding effects of other stable characteristics (e.g., general health status driving both sexual activity and our outcomes), there are daily experiences we did not assess (e.g., daily relationship quality) that could have served as a third variable. Ultimately, our data are observational and experimental data that can better address causality (despite their own limitations; Loewenstein et al., 2015) will be helpful in providing a more complete understanding of the benefits of sex. For example, researchers could randomly assign couples to have sex versus cuddle (see van Anders et al., 2007) and then examine subsequent sleep processes.

To conclude, drawing on a large number of sex experiences in people's daily lives, we provide novel evidence that having sex at night is related to better sleep quality and lower BP the next morning. Our findings also support and extend previous work suggesting the affective benefits of sex. Overall, these findings suggest that the long-discussed health benefits of sex can be observed at a more proximal level, and that examining daily dynamics may be one promising way to further our understanding of when and how sex can benefit physical and mental health. Although small, the observed effects can accumulate over time and contribute to substantial differences in long-term health outcomes (Götz et al., 2022).

Resumen

Objetivo: Estudios transversales anteriores han demostrado que más (frente a menos) personas sexualmente activas tienden a ser mental y físicamente más saludables, pero se sabe poco sobre los mecanismos proximales subyacentes a tales asociaciones. ***Métodos:*** Analizamos dos conjuntos de datos de muestreo de experiencias ($N = 8{,}452$, 66,181 observaciones; 72% hombres, Medad [*SD*] = 46.42 [12.64], 76% Blancos) para examinar los cambios en el sueño, las respuestas cardiovasculares y el afecto en la mañana siguiente. sexo, procesos putativos implicados en los beneficios a largo plazo del sexo para la salud física y mental. ***Resultados:*** De acuerdo con hallazgos anteriores, nuestros resultados mostraron asociaciones significativas entre personas que sugieren resultados de salud diarios más positivos para personas más sexualmente activas. Además, encontramos asociaciones significativas entre personas que sugieren que cuando las personas informaron haber tenido (frente a no haber tenido) relaciones sexuales la noche anterior, experimentaron una mejor calidad del sueño, menos alteraciones del sueño y un despertar más corto después del inicio del sueño, una presión arterial más baja, menos estrés, más afecto positivo y mejor afrontamiento por la mañana. Ninguna de estas asociaciones fue moderada por el género o el estado civil. ***Conclusiones:*** Nuestros hallazgos proporcionan evidencia novedosa que sugiere beneficios psicológicos y fisiológicos a corto plazo del sexo, que pueden acumularse para crear una mejor salud con el tiempo.

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