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The effect of condoms on penile vibrotactile sensitivity thresholds in young, heterosexual men

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Abstract

Introduction—Investigating the ways in which barrier methods such as condoms may affect penile sensory thresholds has potential relevance to the development of interventions in men who experience negative effects of condoms on sexual response and sensation. A quantitative, psychophysiological investigation examining the degree to which sensations are altered by condoms has, to date, not been conducted.

Aim—The objective of this study was to examine penile vibrotactile sensitivity thresholds in both flaccid and erect penises with and without a condom, while comparing men who do and those who do not report condom-associated erection problems (CAEP).

Methods—Penile vibrotactile sensitivity thresholds were assessed among a total of 141 young, heterosexual men using biothesiometry. An incremental two-step staircase method was used and repeated three times for each of four conditions. Intra-class correlation coefficients (ICC) were calculated for all vibratory assessments. Penile vibratory thresholds were compared using a mixed-model Analysis of Variance (ANOVA).

Main Outcome Measures—Penile vibrotactile sensitivity thresholds with and without a condom, erectile function measured by International Index of Erectile Function Questionnaire (IIEF), and self-reported degree of erection.

Results—Significant main effects of condoms (yes/no) and erection (yes/no) were found. No main or interaction effects of CAEP were found. Condoms were associated with higher penile vibrotactile sensitivity thresholds ($F(1, 124)=17.11$, $p<.001$). Penile vibrotactile thresholds were higher with an erect than with a flaccid penis ($F(1, 124)=4.21$, $p=.042$).

Conclusion—The current study demonstrates the feasibility of measuring penile vibratory thresholds with and without a condom in both erect and flaccid experimental conditions. As might be expected, condoms increased penile vibrotactile sensitivity thresholds. Interestingly, erections were associated with the highest thresholds. Thus, this study was the first to document that erect penises are less sensitive to vibrotactile stimulation than flaccid penises.

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Keywords

young men; penile sensory thresholds; penile vibratory thresholds; penile biothesiometry; condoms; male sexual health

Introduction

Penile sensation and tactile stimulation play an important role in male sexual response and function [1,2]. Studies have explored the relevance of penile sensitivity to erectile functioning in men with diabetes, premature ejaculation, and erectile dysfunction [3,4,5]. However, studies on penile sensitivity in sexually functional men are few in number and have focused on sensitivity of either the flaccid or the erect penis, not both [6,7,8]. Although research on sensory stimulation of the flaccid penis has clear clinical significance when evaluating patients whose penile sensitivity may be altered by neuropathy associated with various disorders, the study of penile sensory thresholds in both flaccid *and* erect penises can be expected to have added value and implications for sexual health and medicine beyond the scope of male sexual dysfunction. In addition, investigating the ways in which condoms affect penile sensation and sensory thresholds may have implications for the development of interventions for men who report condom-associated erection problems (CAEP) or decreased sensation, both of which have been associated with inconsistent or incomplete condom use [9].

Erection problems and loss of sensation, together with condom breakage or slippage and problems with ‘fit and feel,’ are among the most commonly reported condom-associated problems in men [9]. While the correlates of breakage and slippage have received substantial attention in the sexual health literature, surprisingly little research to date has addressed the roles of arousal, condom-associated erection problems, and loss of sensation when using a condom. Recently, studies have found that condoms can negatively impact sensations and that sensation loss is an important self-reported reason for men and women to sometimes avoid or abandon using condoms [9]. Although a laboratory approach to the study of penile sensitivity in condom-using men would allow for a more controlled way to assess penile sensations (e.g., in the absence of a partner, and other situational and possibly interfering factors), a quantitative, psychophysiological investigation examining the degree to which sensations are altered by condoms has, to date, not been conducted.

The aim of the current study was to examine penile vibrotactile sensitivity thresholds in both flaccid and erect penises in men who do and men who do not report condom-associated erection problems. Additionally, we examined how the use of a male condom may alter penile sensory thresholds. The current study utilized biothesiometry, a reliable and validated method for assessing vibrotactile sensitivity thresholds in the human body including the genitalia [4,5,8,10].

Methods

Participants and Testing Procedures

Participants were recruited using public and university advertisements (e.g., online classifieds, flyers, newspaper advertising). Men were eligible if they were self-identified heterosexual, between 18–29 years of age, not in a committed relationship, and if they had used condoms for penile-vaginal intercourse within the past ninety days. Men reporting condom-associated erection problems (CAEP) were oversampled. Participants were asked to complete an online questionnaire and participate in laboratory session examining the psychophysiology of condom use among young condom-using men. The questionnaires

focused on demographic information, sexual history, and included the Condom Use Errors/ Problems Survey (CUES) [11] and the International Index of Erectile Function (IIEF) [12]. Men were classified as CAEP if they indicated that they had experienced problems with erection loss during condom application and/or during penile-vaginal intercourse while using condom at least occasionally during the previous 90 days.

Penile sensitivity thresholds were measured using a biothesiometer (Biomedical Instruments, Newsbury, OH). Previous research has demonstrated biothesiometry, which utilizes vibrotactile stimulation, as a reliable method to measure penile sensitivity thresholds [4,5,8,10]. The biothesiometer used a fixed frequency of 100Hz with variable amplitude, expressed in volts [10]. Thresholds were established using a staircase method: Stimulation started at zero and was increased in intensity until the participant indicated that he could detect the vibration. After this, the amplitude of the stimulation was gradually decreased until the participant indicated that he could no longer detect the stimulation. This two-step approach was repeated three times within each condition.

Penile sensitivity thresholds were assessed during four different conditions, in the following, fixed order: (1) erection with a condom; (2) flaccid with a condom; (3) erection without a condom; and (4) flaccid without a condom. Participants were shown a series of 1.5 min film clips that included two erotic film clips, shown prior to the erection conditions and two neutral film clips, shown prior to the flaccid conditions. For condom-associated conditions, participants were asked to apply a standard latex condom to their penis. As a manipulation check for the erection and flaccid conditions, a self-reported degree of erection measure was added to the protocol after approximately one-third of men had participated; therefore these data are available for the majority of but not all participants. The erection measure was based on a computerized slider, with a scale from 0% to 100%. To measure penile thresholds we used a method based on Schrader et al., (2008), which included a medical grade plastic trough (10.2 cm in length) with a holding strap that could be attached to the tractor of the biothesiometer. Additionally, a stand consisting of a 91.5 cm flexible steel arm with pivoting handle was constructed to hold the biothesiometer, allowing the participant to position the biothesiometer. Participants were instructed to strap their penis into the trough maintaining contact between the ventral section of the penile shaft, frenulum, and glans and the inside of the trough. A red line marked the furthest point the penis could be placed in the trough to avoid the glans from making contact with the biothesiometer tractor. Participants were seated, in private, in a recliner chair with the stand and biothesiometer placed right in front of the chair. The flexibility of the biothesiometer stand allowed each participant to adjust the biothesiometer and place the trough at the most optimal angle to assure full contact with the trough. All procedures and laboratory protocols were approved by the university's Institutional Review Board.

Data Analysis

Intra-class correlation coefficients (ICC) were calculated on all penile vibratory assessments to evaluate measurement reliability. Independent sample t-tests were employed to compare group differences in age, IIEF scores, self-reported degree of erection, and penile vibratory thresholds based on reporting CAEP. Penile vibratory thresholds were compared across the four conditions and the two groups (CAEP yes/no) using a mixed-model analysis of variance (ANOVA). All statistical analyses were performed using IBM SPSS 19.0.

Results

Sample Characteristics

A total of 141 men completed the questionnaire and took part in the laboratory session. The mean age of the participants was 20.8 years (SD=1.9). The majority was White (75.9%), with 9.8% of the participants being Asian, 6.0% African American/Black, and the remainder selected other races. Hispanic ethnicity was reported by 4.0% of the men. The majority of the participants (88.8%) reported being circumcised. Of the remainder, 8.8% reported being uncircumcised and 2.4% reported not being sure whether they were circumcised or not. The mean number of times men used condoms in the 90-day recall period was 11.7 (SD = 18.0 times) with a median of 5. Just under half of the men (49.6%) indicated reliance on condoms as their only form of birth control at least some of the time. The majority (66.4%) had more than one female sex partner in the past 90 days.

By design, half (50%) of the participants reported condom-associated erection problems (CAEP), with the remaining participants reporting no CAEP. Group comparisons revealed a group difference in the mean IIEF score for erectile function. Men reporting no CAEP (M=29.3) had higher erectile function scores compared to the men reporting CAEP (M=26.5), $t(97)= 5.92$, $p<.001$. However, IIEF erectile function scores of both groups were within the “no dysfunction” range (scores between 25–30) [12]. The mean IIEF score for erectile function for all participants was 27.9 (SD=3.1). Additionally, men reporting no CAEP reported significantly higher levels of erection for both the erection condition with a condom (M=63.2), $t(84)=2.56$, $p<.05$; and the flaccid condition without a condom (M=15.0), $t(68)=2.55$, $p<.05$; compared to men who reported CAEP (M=49.5/M=8.1).

Threshold Reliability and Correlations

Intra-class correlation coefficients (ICC) were used to evaluate the penile vibratory threshold reliability for each condition. All four conditions demonstrated strong reliability: 1) erection with a condom, ICC = 0.96 (CI = .94 – .97), $F(107)=22.55$, $p<.001$; 2) flaccid with a condom, ICC = 0.99 (CI .98–.99), $F(124)=64.6$, $p<.001$; 3) erection without a condom, ICC=0.86 (CI .82–.90), $F(124)=7.25$, $p<.001$; 4) and flaccid without a condom, ICC=0.77 (CI .70–.83), $F(122)=4.40$, $p<.001$. Strong correlations were found between penile vibratory thresholds across conditions. Thresholds were strongly correlated for erection and flaccid conditions, both with a condom (r=.77, $p<.01$) and without a condom (r=.86, $p<.01$).

Penile Vibrotactile Sensitivity Thresholds

Table 1 presents the mean self-reported degrees of erection and the average penile vibratory thresholds for all four conditions. A paired-samples t-test revealed that erection levels were significantly higher during erect (M=52, SD=24) than during flaccid (M=13, SD=14, $t(1,136)=21.46$; $p<.001$) conditions. A mixed-model ANOVA, using Group (CAEP yes/no) and the two within-subject factors, Condom (yes/no) and Erection (yes/no), revealed no significant main or interaction effects of Group (CAEP yes/no) on penile sensitivity thresholds. However, a significant main effect of Condom (yes/no) was found: Condoms were associated with higher vibratory thresholds ($F(1, 124)=17.11$, $p<.001$). In addition, a significant main effect was found for Erection (yes/no): Penile vibrotactile thresholds were higher with an erect than with a flaccid penis ($F(1, 124)=4.21$, $p=.042$). No significant interaction was found between Condom and Erection conditions.

A secondary ANOVA was conducted using more explicit criteria for erect and flaccid conditions. Only self-reported erections equal to or higher than 50% for erect conditions (M=70, SD=11) and those below 50% for flaccid conditions (M=12, SD=11) were included. This analysis again revealed significant main effects of Condom and Erection, but included

a significant interaction of Condom × Erection ($F(1,32)=4.33$, $p=.046$). Follow-up tests on this two-way interaction revealed that the condition combining an erect penis with a condom was associated with significantly higher vibrotactile thresholds compared to the other three conditions (all p values<.01).

Conclusion

The present study was, to our knowledge, the first to examine penile vibrotactile sensitivity thresholds in aroused and non-aroused states, with and without a condom, in young, sexually-functional men. The findings of the study demonstrate the feasibility of measuring penile vibrotactile thresholds in both erect and flaccid penises. Further, the current study validates the feasibility of measuring penile vibratory thresholds with and without a condom in place. We found that a penis with a condom, whether the penis was erect of flaccid, was associated with higher vibratory thresholds than a penis without a condom; indicating that condoms may decrease penile sensitivity with empirical data. This finding is consistent with findings from questionnaire and qualitative studies that have previously been reported in the condom use errors and problems literature [5, 9]. The condom we chose represents a standard condom, future research should investigate empirically the degree to which thinner condoms may ameliorate this effect and the degree to which product choice is important to sensation. Interestingly, penile threshold measurements in the erection conditions were associated with the highest vibratory thresholds, indicating that erect penises are less sensitive to vibrotactile stimulation than flaccid penises.

The findings of this study contribute to our basic understanding of how erections and condoms affect penile sensitivity. Furthermore, the study demonstrates the feasibility of our approach to the measurement of penile sensitivity thresholds in erect and flaccid penises, with and without condoms. Although the analyses revealed no differences between CAEP and no CAEP groups in penile sensitivity thresholds, the approach used in this study can be applied to future research on other aspects of the relationship between condom use and penile sensitivity, for example by comparing different types of condoms, a wider age range of men, and sexual orientation groups, men who do and do not report sensation loss during condom use, and by testing penile sensitivity under different conditions (e.g., after consumption of alcohol, during different erection levels) for both flaccid and erect penises. Moreover, the approach of measuring penile sensitivity under different conditions (erect and flaccid, with and without condoms) may also prove of value in studies using clinical populations (e.g., men who experience premature ejaculation), as it may contribute to our understanding of the impact of such conditions on ejaculation latency and erection processes [3, 13–15]. Beyond the importance of improving our basic understanding of factors and processes that may impact penile sensitivity, this research can be expected to have implications for the development of novel condom use interventions for individuals who report that condoms interfere with sexual pleasure, sensation, or function, and for whom these factors may be a reason for avoiding or abandoning condoms [9].

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Table 1

Self-reported erection and penile vibrotactile sensivity thresholds.

	Degree of Erection		Penile Vibrotactile Threshold		
	Mean (%)	SD	Mean (volts)	SD	Range
Erection with condom	55.2	26.1	7.50	2.36	3.20–15.18
Flaccid penis with condom	14.5	17.5	7.28	2.68	2.93–18.60
Erection without condom	47.6	27.6	6.87	2.21	2.78–14.00
Flaccid penis without condom	12.0	14.7	6.68	2.33	2.53–18.82