ORIGINAL RESEARCH

The Clitoral Photoplethysmograph: A Pilot Study Examining Discriminant and Convergent Validity

Kelly D. Suschinsky, PhD,* Amanda J. Shelley, BScH,* Jeroen Gerritsen, MSc,† Adriaan Tuiten, PhD,† and Meredith L. Chivers, PhD*

*Department of Psychology, Queen's University, Kingston, ON, Canada; †Emotional Brain BV—R&D FSD, Almere, The Netherlands

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ABSTRACT

Introduction. The clitoral photoplethysmograph (CPP) is a relatively new device used to measure changes in clitoral blood volume (CBV); however, its construct validity has not yet been evaluated.

Aim. To evaluate the discriminant and convergent validity of the CPP. For discriminant validity, CBV responses should differ between sexual and nonsexual emotional films if the CPP accurately assesses clitoral vasocongestion associated with sexual arousal; for convergent validity, CBV responses should significantly correlate with subjective reports of sexual arousal.

Methods. Twenty women (M age = 21.2 years, SD = 3.4) watched neutral, anxiety-inducing, exhilarating, and sexual (female–male sex) audiovisual stimuli while their genital responses were measured simultaneously using vaginal and clitoral photoplethysmographs and CPPs. Most of these participants continuously reported sexual arousal throughout each stimulus ($n = 16$), and all reported their sexual and nonsexual affect before and after each stimulus; subjective responses were recorded via button presses using a keypad.

Main Outcome Measures. Vaginal pulse amplitude (VPA), CBV, and self-reported sexual arousal and nonsexual affect were used as main outcome measures.

Results. CBV demonstrated both discriminant and convergent validity. CBV responses were similar to VPA responses and self-reported sexual arousal; all responses differed significantly as a function of stimulus content, with the sexual stimulus eliciting greater relative changes than nonsexual stimuli. CBV, but not VPA, was significantly (negatively) correlated with continuous self-reported sexual arousal during the shorter sexual stimulus. CBV was significantly negatively correlated with VPA for the shorter sexual stimulus.

Conclusion. CBV may be a valid measure of women's genital sexual arousal that provides complementary information to VPA and correlates with self-reported sexual arousal. Given our relatively small sample size, and that this is among the first research to use the CPP, the current findings must be replicated. More research using the CPP and other devices is required for a more comprehensive description of women's physiological sexual arousal.

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Key Words. Clitoral Photoplethysmography; Vaginal Photoplethysmography; Sexual Arousal; Subjective Sexual Arousal; Discriminant and Convergent Validity

Women's genital responses can be measured using a variety of techniques (reviewed in [1–3]). For example, vaginal vasocongestion, a reliable and valid indicator of genital sexual response, is commonly assessed using vaginal photoplethysmography [4–6]. The vaginal photoplethysmograph (VPP) assesses two different aspects of vaginal vasocongestion: vaginal

blood volume (VBV), the total blood volume within the vaginal walls, and vaginal pulse amplitude (VPA), the phasic changes in vaginal vasocongestion with each heartbeat [7]. Changes in VPA, but not VBV, are specific to sexual stimuli [5,6] and are thus more commonly reported.

Although vaginal photoplethysmography is the most commonly used method of assessing genital responses in women, researchers have argued that changes to internal genitalia associated with sexual response may be less perceptible to women [8] and that the vaginal photoplethysmograph cannot assess important sensory information that may be provided by external genital structures [9]. Changes in external genitalia have been assessed using laser Doppler imaging (LDI; to assess superficial blood flow in vulvar skin [9]), as well as thermographic methods that assess changes in genital temperature, including thermal imaging cameras [10–12] and labial thermistors [8]. Although LDI [9,13,14] and thermographic [11,12] methods can provide additional information about vasocongestion of the genitals during sexual response, and have the benefit of not being in direct contact with a participant's genitals, they typically require the presence of a trained experimenter to position the imager or camera during testing, which may be invasive for some participants [15].

Recently, a new device for measuring genital response via clitoral complex vasocongestion was developed [16]. The clitoral photoplethysmograph (CPP) assesses blood volume of the left clitoral (i.e., vestibular) bulb [16], an elongated and rounded structure comprised of erectile tissue that surrounds the introitus and urethra ([17,18], but see [19]). After instruction, it is easily positioned by participants and does not require the continued presence of a trained technician for placement, unlike LDI. Initial testing of the CPP suggests that the device may be a valid measure of genital vasocongestion in women because clitoral complex blood volume (CBV) responses to erotic films were significantly different from CBV responses to neutral videos [16]. Likewise, CBV responses were inhibited during increased sympathetic nervous system (SNS) activity induced by an unexpected interruption during the erotic stimulus [16]. Inhibited CBV responses during increased SNS activation are consistent with research suggesting that decreased SNS tone is necessary to facilitate genital response [20].

Although the initial report on the CPP suggests that the device is promising for assessing genital sexual arousal, it is unclear whether CBV changes during other nonsexual emotional states associated with SNS arousal, such as fear or exhilaration. If CBV changes in response to nonsexual emotional inductions, such as anxiety [5,6] or exhilaration [6], then the CPP signal may not be specific to sexual arousal, and therefore not a valid measure of clitoral complex vasocongestion associated with sexual response. Given that some aspects of women's clitoral responses, including peak systolic velocity, peak diastolic velocity, and blood flow resistance, do not differentiate between erotic and positively-valenced stimuli using clitoral ultrasonography [21], it is prudent to further investigate the validity of the CPP before promoting its use. Furthermore, given that magnetic resonance imaging techniques have found that CBV increases in response to sexual stimuli, but that similar increases are not seen within the vaginal wall [22], it would be ideal to assess clitoral complex and vaginal responses simultaneously to generate a more comprehensive understanding of women's physiological sexual responses. Additionally, the relationship between CBV and subjective reports of sexual arousal is unclear. Although [23] reported low to moderate correlations between CBV and self-reports of genital response and sexual desire, their self-report measure was discrete rather than continuous, resulting in between-subjects correlations; within-subjects correlations based on continuous measurement of genital and subjective responses provide the opportunity to investigate the degree to which these two responses correspond within an individual [24].

The Current Study

The purposes of the current pilot study were to: (i) investigate the discriminant and convergent validity of the CPP as a device for measuring sexual arousal in women; (ii) to assess the relationship between concurrently assessed clitoral and vaginal vasocongestion; and (iii) to assess the relationship between CBV and subjective reports of sexual arousal. We presented women with sexual and positively and negatively valenced nonsexual audiovisual stimuli to examine discriminant validity of CBV; to demonstrate divergent validity, CBV responses should differentiate between sexual and nonsexual stimuli. To examine convergent validity, we simultaneously assessed another measure of genital sexual response, vaginal vasocongestion, and a measure of subjective sexual