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Menstrual Knowledge and Understandings of Normal and Extreme Bleeding: College Students' Overestimation of the Typical Amount of Menstrual Blood

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ABSTRACT

Accurate biological information about menstruation is crucial for menstrual health literacy. A diverse group of students ($N = 125$) at a large southwestern US university estimated—by pouring liquid into containers—the amount of menstrual blood produced during an average menstrual period. Only 14% could give a relatively accurate estimate, whereas 55% overestimated by at least 65 ml. Further, 7% gave extreme overestimations of one liter or more. Gender and race did not impact accurate knowledge, but queer/pansexual participants and women's and gender studies or social justice majors were significantly more accurate. Implications for health education and recognizing heavy bleeding are explored.

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Menstrual health; menstrual knowledge: menstrual education; health literacy; menstruation; women's bodies

Access to accurate medical information about menstruation is as a crucial step toward menstrual and general health literacy, and it can have numerous impacts on people's experiences of menstruation (Bobel, 2018; White, 2013). Many adolescent girls and adult women want additional information about menstruation because they fear they do not know enough about what is considered a normal menstrual cycle (Agnew & Gunn, 2019; Charmaraman et al., 2012; Wood et al., 2007). Given that disinformation about menstruation is especially widespread—from scarce or misleading educational experiences during adolescence (Diorio & Munro, 2000; Erchull et al., 2002) to distorted popular depictions of menstruating bodies (Przybylo & Fahs, 2020) to the silence that often surrounds the menstrual experience (Fahs, 2016; Pascoe, 2007; Rajagopal & Mathur, 2017)—there are many barriers to providing and receiving accurate information about menstruation and the menstrual cycle. Nevertheless, accurate information about menstruation has important links not only to individuals' experiences of health and well-being, but to broader notions of menstruation within a social justice framework (Bobel, 2018).

Menstrual Literacy

Accurate information about menstruation—including the first menstrual period (i.e., menarche)—is hindered by secrecy, shame, and the framing of menstruation as taboo

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(Chrisler et al., 2014; Forbes et al., 2003; Garside et al., 2008; Johnston-Robledo et al., 2007; Schooler et al., 2005). A few studies have addressed menstrual knowledge and its impact on the social and educational lives of girls and women (Chang & Chen, 2008; White, 2013). Other scholars have built on those and argued that menstrual literacy includes a wide variety of topics related to the menstrual cycle, including the role of menstruation in pregnancy, length of ovulation, menstrual cycle changes, the composition of menstrual blood, exercise and bathing during menstruation, menstrual sex, and fears of menstruation as "disease" or disability (Ali & Rizvi, 2010; Bobel, 2018; Cheng et al., 2007; Fahs, 2011). Bobel (2018) argued that menstrual literacy must move beyond merely teaching girls about menstruation and instead involve a wide variety of other stakeholders in menstrual education: family members, boys, teachers, teacher trainers, community and religious leaders, health care workers, government officials, NGOs, and product makers, as well as the media, policy advisors, and funders.

Knowledge about the material qualities of menstrual blood (e.g., how much blood is produced, what it looks like and feels like) has been examined in only a small handful of studies; most of these have been conducted with adolescent girls in Asia and the Global South (see Iyanda's [2020] analysis of ovulation timing knowledge in girls as young as 15-years-old). Only two menstrual knowledge studies have been done with U.S. college students, and one of them is three decades old (Henderson et al., 2020; Rierdan et al., 1986). In such studies, menstrual knowledge is often measured by awareness of facts in a multi-item scale (e.g., why menstruation occurs, how much blood is produced, how often it occurs, how long bleeding lasts) (Abedian et al., 2011; Abraham et al., 1985; Chang & Chen, 2008; Setyowati et al., 2019; Su & Lindell, 2016; Vyas et al., 2017). Knowledge about menstruation varies by the age of the participants and the countries in which they live. For example, American women have reported more menstrual knowledge and better preparation for menarche than Indian women (Hoerster et al., 2003), and Mexican women have reported a stronger sense of menstruation as forbidden and prescriptive than have American women (Marván et al., 2006).

Many girls and women have inaccurate information about their own menstrual cycles. This lack of information is especially clear when women are asked how much blood they believe women lose during a typical menstrual period. Studies conducted in Taiwan showed that 36% of elementary school girls lacked basic knowledge about menstruation and menstrual blood (Yen et al., 2001) and that 76% of early adolescent girls did not know the normal range of menstrual blood loss during a typical period (Chang & Chen, 2008). In Australian studies, only 10% of adolescent girls and 15% of college-aged women knew that menstruators typically did not lose a cup of blood during each menstrual period (Abraham et al., 1985; Moore, 1995). In one of these studies (Abraham et al., 1985), 28% of the women thought that women typically bled "cupsful" or "liters" of blood each month. One older study showed that 39% of American six-grade girls could guess the typical amount of menstrual flow, but many of them thought that women bled more than one cup per day (Koff & Rierdan, 1995). To date no studies have asked U.S. college students to estimate menstrual blood loss. Therefore, the present study was designed to look at college students' perceptions of menstrual blood/tissue production in order to assess predictors of having more or less accurate information

about the amount of menstrual blood produced during a typical or average menstrual period.

Impacts of Health Knowledge

Knowledge about menstruation is associated with other markers of health and well-being (Chang & Chen, 2008; Spadaro et al., 2018). However, menstrual health information is not widely dispersed beyond basic school curricula, popular culture, online sharing of information, and parent-child conversations about menstruation (Chandra-Mouli & Patel, 2020; Singh et al., 1999). The U.S. health care system has routinely failed to deliver information about menstruation to young menstruators. For example, one study of U.S. adolescents and young adults ages 12–21 showed that only 2% of girls had received information about menstruation from their health care provider (Houston et al., 2006).

To obtain menstrual knowledge, girls often turn to health teachers, school nurses, online resources, and mothers as their key sources of menstrual information (Beausang & Razor, 2000; Cheng et al., 2007; Erchull & Richmond, 2015; Jou et al., 2003; Rembeck & Gunnarsson, 2004; Rowlands et al., 2015). A number of studies have shown that a major source of menstrual information for girls is the knowledge they receive from their mothers (e.g., Orringer & Gahagan, 2010; Rana & Jami, 2018), although results vary about the utility and impact of the mothers' menstrual knowledge. One study showed that conversations between girls and their mothers often included negative content about menstruation and communicated a "grin and bear it" framework for coping with menstruation (Costos et al., 2002), whereas another study showed that the knowledge girls received about menstruation from their mothers tended to be particularly helpful and impactful (Koff & Rierdan, 1995). A study of Mexican adolescents showed that those who had had more conversations with their mothers about menstruation reported feeling more prepared for menstruation and more positive about it in general than did those who had not had such conversations (Marván & Molina-Abolnik, 2012).

Links between menstrual health knowledge and attitudes toward menstruation have been widely documented. Accurate information about menstrual blood and tissue production has been shown to improve women's attitudes toward menstruation in general (Borjigen et al., 2019; Setyowati et al., 2019), to reduce health stress (Borjigen et al., 2019), to improve self-care behavior (Chiou et al., 2007), and to reduce the likelihood that women perceive menstruation as a "debilitating" event (McPherson & Korfine, 2004). Accurate information about menstruation is also associated with greater body satisfaction and better body image (McPherson & Korfine, 2004; Spadaro et al., 2018), and it is correlated with improved sexual agency (Schooler et al., 2005) and better health behaviors (Borjigen et al., 2019; McPherson & Korfine, 2004).

Social Identities and Menstrual Knowledge

Social identity impacts people's self-image as well as their access to rights, opportunities, and possibilities. Health disparities (Mays et al., 2002) and access to education (Cooper, 2002) are often connected to gender, race, social class, and sexual identity. As such,

social statuses and identities also influence attitudes toward menstruation and the acquisition of menstrual health knowledge.

Gender

Girls generally have more accurate information about menstruation than boys do; girls are also less likely than boys to believe myths and taboos about menstruation (e.g., Cheng et al., 2007). College men have reported more negative attitudes toward menstruation and less knowledge about menstruation than college women (e.g., Forbes et al., 2003); in one study college men often called menstruation a confusing "puzzle" that they found difficult to understand (Koch, 2006). Adolescent girls may have more knowledge about menstruation because education about the menstrual cycle in schools often occurs in gender-segregated spaces, as some adults seem to think that boys do not "need" to learn about it (Allen et al., 2011). Further, adult men in Australia expressed confusion about how to communicate about menstruation with women and how to manage menstrual stigma within their intimate relationships with women (Peranovic & Bentley, 2017).

Other studies have suggested that both women and men have low general health knowledge about menstruation (Mas et al., 2014), including mothers (Lei et al., 1987). Among American college students, gender did not significantly predict knowledge of when girls typically experience menarche (Henderson et al., 2020). Men and women also have reported negative attitudes toward menstruation. For example, in one study, men and women from the U.S. and Mexico had similar attitudes and beliefs about the negative aspects of menstruation and its "annoyances" (Marván et al., 2006). This suggests that broader cultural stories about menstrual taboos impact both men and women in their attitudes and knowledge.

Race

Studies have shown significant health knowledge disparities along racial lines; people of color tend to report less access to accurate reproductive health information than do White people (Craig et al., 2014; Kutner et al., 2006). Conflicting findings with regard to menstrual knowledge indicate the necessity for intersectional understandings of menstrual literacy. Two studies showed that European American girls and women have more menstrual knowledge than Latina and African American girls and women (Henderson et al., 2020; Orringer & Gahagan, 2010). Another study showed that race did not predict menstrual knowledge but that more affluent European American girls had more menstrual knowledge than poor African American girls (White, 2013).

Age

Older college students tend to have greater overall health literacy than younger college students (Hansen et al., 2015), but the link between age and menstrual knowledge is more complex. An older study showed that mothers had better and more accurate menstrual information than their daughters, but this difference was minimal (Lei et al., 1987). Regarding attitudes, older adults (30–39-years-old) have been reported to

perceive menstruation as less debilitating and bothersome than do college students (18–23-years-old) (Chrisler, 1988), and younger women were found to be less ashamed of menstruation than were older women (Lawlor & Choi, 1998; Marván et al., 2005).

Further, adolescents have negative attitudes toward menstruation (Stubbs, 2008), and adolescents often describe it as something they dislike (Kissling, 1996). Older girls knew more about menstruation than younger girls (Abraham et al., 1985; Borjigen et al., 2019; Um et al., 2010), perhaps because they had had more experience with menstruation, but these studies relied only on girls in middle school and high school. Finally, two studies showed that age did not predict menstrual knowledge at all (Henderson et al., 2020; Spadaro et al., 2018).

Political Party

Although political party and menstrual literacy have not been explicitly studied, efforts to end the "tampon tax"—a key hallmark of recent menstrual activism in the U.S. and Europe—have been sponsored by liberal political parties (Harmer & Southern, 2018). Further, because political conservatives tend to be more easily disgusted by medical matters than liberals are (Inbar et al., 2012), Republicans in the US may be more likely than Democrats to respond to menstrual information with emotions such as disgust. During the 2016 election campaign, then candidate Donald Trump explicitly engaged in menstrual shaming of a woman reporter and won a large number of Republican voters based on his public displays of hostile sexism (Schaffner et al., 2018; Swank, 2018; Worthen, 2020).

Education

Educational experiences may increase general health knowledge and menstrual health knowledge in particular. Several studies have suggested that menstrual knowledge improved as students obtained more education (Borjigen et al., 2019; Vyas et al., 2017). Girls in Pakistan who attended school knew more about menstruation than girls who had dropped out of school (Ali & Rizvi, 2010). College students who took more health classes generally scored higher on health literacy tests (Hansen et al., 2015), and high school students knew more about menstruation after having completed a biology class that focused on human reproduction (Sirovina & Kovačević, 2019). In one study of college students, Nursing majors knew the most about typical bodily functions, whereas students in other majors (e.g., Chemistry, Computer Science, Marketing, Psychology, Social Work) had a similar degree of health knowledge that was much lower than that of the Nursing majors (Joseph et al., 2016). A study of college women in China showed that pre-medical students had the most sexual and reproductive health knowledge, followed by arts and literature/history majors; natural science and technology majors, on the other hand, had the *lowest* reproductive health knowledge (Zhang et al., 2010). That said, knowledge about menstrual health differs between different educational programs and majors.

Content on sexual and reproductive health was most commonly taught in college classes in programs related to Health, Psychology, and Women's Studies

(Chrisler, 2013; King et al., 2017). Access to classes about women's health boosted both men's and women's general awareness of the menstrual cycle (Busari, 2012; Su & Lindell, 2016), and taking a class on women's reproductive health improved students' knowledge about how much women bleed during menstruation (Abedian et al., 2011; Setyowati et al., 2019). A study of Turkish nursing students showed that taking even a single class on women's health improved students' ability to estimate correctly the amount of blood shed in a typical menstrual period (Ibrahim & Ismail, 2019). Further, taking a psychology class on lifespan development increased women's and men's knowledge of menstruation and fertility issues (Sohr-Preston, 2015), and taking classes with feminist content problematized traditional gender scripts and provided a critical lens for viewing medical models of health and well-being that often downplay women's health issues (Grose et al., 2014). Finally, college students who identified themselves as feminists held fewer negative attitudes toward menstruation than did those who rejected the label "feminist" (Mondragon & Txertudi, 2019), and students who expressed higher levels of hostile sexism were significantly more likely to be disgusted by menstruating women than students who did not express such sentiments (Chrisler et al., 2014).

Research Questions

Given the various findings on menstrual literacy and menstrual health knowledge, and given the relationship between social identities and menstrual health knowledge, we asked: 1) How accurate are college students' estimates of "typical" menstrual cycle blood production?; 2) Which social identities best predicted more or less accurate menstrual health knowledge about the material aspects of menstrual blood?

Method

Sampling Procedure

Data were collected in Fall 2019 at a suburban satellite campus of a large public university in the southwestern U.S. The campus offers predominately undergraduate degrees, enrolls roughly 4,000 students, and has been designated as a "Hispanic Serving Institution," which means that there are substantial numbers of Latinx students at the university. It is embedded within a larger multi-campus public university that enrolls over 70,000 students.

To recruit participants, a research team consisting of five undergraduate students and two faculty members stationed themselves in turn at the front of the campus library. Students who entered the campus library were asked by the research team to participate in a study about menstrual health. We recruited 125 participants during a four-hour period. Roughly one-third of students who passed by agreed to join the study.

Participants

The sample was slightly skewed toward women (68%) and people who were in the traditional age range of undergraduates (84% were 18–22 years old; $\bar{x} = 22.09$). White/

European American students constituted the largest racial group (43%), but there were sizeable numbers of people of color in the study, including Latinx Americans (25%), Black/African Americans (6%), and Asian Americans (6%). Self-identified heterosexuals were the most common (73%) sexual identity group; bisexual, lesbian/gay, and queer/pansexual individuals were in smaller numbers (11%, 8%, and 3%, respectively). As to political party affiliation, 43% of the sample identified as Democrats, 42% were unregistered or registered as independent voters, and 11% were Republican. The students were enrolled in a wide array of college majors; Business, Forensics, Psychology, and Biology each comprised about 10% of the sample.

Measures

Participants completed a one-page questionnaire that addressed the independent variables in the study (gender, age, race, social class, political party, sexual orientation, major, and whether they had ever menstruated). These questions were asked in an open-ended manner.

Dependent Variables

Three dependent variables addressed knowledge about menstrual blood. Whereas other researchers (Chang & Chen, 2008; Moore, 1995) have asked participants to complete a survey item about the typical amount of menstrual blood, we took a more experiential and visual approach to this question. If women receive any information about menstrual blood, they are usually told by health educators that the typical amount of menstrual blood loss is about 4–6 tablespoons (Wood et al., 2007). We wanted to see if college students' estimates would come close to this range. As such, participants were asked to pour a red liquid (fake red "blood" used during Halloween celebrations) into a measuring cup. They were told to stop pouring the red liquid into the measuring cup when they had reached the level of a "typical amount" of menstrual blood produced by a menstruator during an average menstrual period. The researchers provided three measuring cups of different sizes. The smallest cup held a maximum of 60 ml, the mid-size cup held up to 125 ml, and the largest cup held up to 250 ml. Students selected the cup they wanted and were given the option of filling up the cups multiple times in order to allow them to choose the exact amount of menstrual blood they wanted.

The volume of liquid was then measured in milliliters and recorded by the research team. This absolute score was then converted into three dependent variables. One dependent variable was called *a correct estimate*. Fluid levels between 30 and 60 ml were deemed correct, as most reproductive health experts define healthy and "typical" menstrual blood production as 30–60 ml per menstrual period (Fraser et al., 2001; Menorrhagia Research Group, 2004). All estimates that were below or above this range were considered incorrect. This binary coding is similar to that of surveys that coded for correct or incorrect answers (e.g., Chang & Chen, 2008; Moore, 1995).

We also tracked the extent of false "guestimates" because such errors are sometimes bigger than others. To determine the size of the error, we subtracted the correct answer (30–60 ml) from the amount of menstrual blood estimated by each participant. This

measure focused the *amount of incorrect estimate*. Finally, we wanted to gauge the *direction of the misestimate*. Estimates that fell below 30 ml were labeled underestimates, and estimates above 60 ml were labeled overestimates.

Independent Variables

Selecting appropriate variables in an understudied topic can be complicated and perplexing. We used variables that appeared in studies that were scattered across academic disciplines, which added to the challenge of designing the study. Further, we included variables that seemed relevant due to their impact on somewhat similar dependent variables. Students communicated their *gender* through an open-ended written response. Although students could provide any term they wanted, every participant identified within the gender binary (man/woman). We thus coded this in a binary manner. (Note that the question "Have you ever menstruated?" aligned with gender, as this study had no participants who identified as a man *and* who had previously menstruated.)

Racial status was determined through this open-ended prompt: "Please write down your race." Written replies with self-identified racial descriptors were translated into a series of dummy variables (White/European American = 1, other = 0; Latino/a/x = 1, other = 0; Black/African American = 1, other = 0; Asian American = 1, other = 0, Native American = 1, other = 0; Middle Eastern = 1, other-0). Seventeen students indicated that they were biracial or multiracial, and we gave them two or more cases in our coding.

Age was an interval response to the question: "Please write down your age." Every person was of a legal adult status, and the age scores ranged from 18 to 62 years old.

Sexual Identity was operationalized through Rankin and Garvey (2015) Queer Spectrum Scale. Written responses to the question "What is your sexual orientation?" were classified in a dichotomous fashion: lesbian or gay (yes = 1, no = 0), bisexual (yes = 1, no = 0), queer/pansexual (yes = 1, other = 0), heterosexual (yes = 1, other = 0), asexual (yes = 1, other = 0), and questioning (yes = 1, other = 0).

Political party affiliation was also recorded. Members of the three largest parties in the US were coded in dummy variables (Democrat = 1, other = 0; Republican = 1, other = 0; Libertarian = 1, other = 0).

To determine *college major,* we asked participants to provide the name of their major area of study. We grouped majors by their connection to medical knowledge and in intuitive clusters (e.g., Business majors). Students who indicated they were in Medical Studies, Community Health, or Nursing were grouped into a single category, and students while majors such as Biology or Environmental Studies were treated as separate entities. Natural Science majors such as Chemistry and Forensics were treated as distinct variables, and people who majored in Accounting, Marketing, or Economics were grouped together as Business majors. Students with Women's and Gender Studies Majors were combined with Social Justice majors, and a few other majors were combined into different combinations of social science and humanities majors (i.e., Political Science, Psychology, and Sociology with the social sciences; English, History, and Philosophy with the humanities).

Procedure

Three research assistants greeted potential study participants, and the rest of the research team administered the experiment. Data collection was conducted in a small vestibule that serves as the only entrance and exit to the larger library on campus. The procedure was completed quickly; most participants finished the experiment in less than 2 minutes. No debriefing was conducted, per the IRB protocol.

This research received approval from the Institutional Review Board at the university. All participants reviewed a consent form prior to participation in the study. Participants were first asked to review a consent form, and were then asked to write down their answers to some demographic questions. Participation was purely voluntary, and no compensation was offered or received.

Analytical Plan

Patterns of menstrual knowledge were identified through several statistical procedures. We used means and standard deviations to address central tendencies and the amount of dispersion from these central tendencies. Next, we computed Pearson correlation coefficients to identify significant bivariate relationships between the independent variables and the menstrual knowledge variables. Last, we then turned to Ordinary Least Squares (OLS) regressions to estimate the direct association between the blood estimates and each variable when controlling for the influence of the other independent variables. Significance and direction of relationships were determined through standard β coefficients and the adjusted R^2 discerned the amount of variance explained by the entire model. Several regression diagnostics were conducted, and these tests suggest that none of the models violated these assumptions of homoscedasticity, lack of multicollinearity, or linearity in function (the highest VIF score was 1.01). A listwise analysis excluded participants who were missing data on any of the variables.

Results

Table 1 displays the frequencies, means, and standard deviations for the menstrual blood estimates. Almost all of the participants could *not* correctly estimate the typical

Table 1. Descriptive statistics for estimates of typical amounts of menstrual blood loss.

Variable	Number & percent									
Correct answer	18 (14%)									
	Number & percent									
Direction of estimation	Under estimate 3 (2.5%)		Correct estimate 8 (14.3%)					Over estimate 104 (82.5%)		
	Central tendency		Number & percent							
	Mean	Standard deviation	0	1–65 ML	66–130	131–195	196–300	301–600	601–1000	1000 plus
Amount of incorrect estimate	282.4	567.8	18 (14%)	37 (29%)	12 (7%)	27 (22%)	4 (3%)	12 (9%)	6 (5%)	9 (7%)

Table 2. Descriptive statistics and correlations with dependent variables.

Variable	*M*	Correct estimate	Overestimate	Amount incorrect
1. Female[a]	.68	.14	−.17*	.00
2. Latino/a/x[b]	.25	−.11	.09	.03
Black	.06	.03	−.01	−.04
Asian American	.06	.11	−.08	−.00
3. Age	22.0	.12	−.09	−.08
4. Lesbian/Gay[c]	.11	−.02	.04	.00
Bisexual	.08	−.06	−.05	−.06
Queer/pansexual	.03	.31***	−.27***	−.07
5. Democrat	.43	.14	−.10	−.05
Republican[d]	.14	−.07	.03	−.07
6. Medical major[e] biology	.04	.03	−.12	−.05
Chemistry	.13	−.03	.05	−.02
Forensics	.02	−.05	.05	.17*
Business	.11	.07	−.17*	−.10
WST/social justice	.11	−.07	.09	.20*
Psychology	.02	.28***	−.25*	−.05
	.10	−.06	.08	−.01
Humanities	.10	.01	.01	.06

[a]0 = male; [b]0 = White; [c]0 = heterosexual; [d]0 = independent/no party; [e]social science major.
*$p < .05$; **$p < .01$; *** $p < .001$.

amount of blood in a menstrual period: 86% of their estimates were inaccurate. The estimates ranged from 0 to 5093 ml. Only three participants underestimated the amount of menstrual blood, thus almost all of the inaccurate estimates were *overestimations*. Almost one-third of the inaccurate estimates were small, as 29% of the sample misgauged the typical amount of menstrual blood by less than 65 ml. On the other hand, slightly over one-half of the sample misgauged the correct level of menstrual blood by over 66 ml. Further, many of the false estimates were quite large. For example, 7% of participants overestimated by over one liter (1000 ml), and 14% misgauged the correct amount by 300–999 ml.

Table 2 presents the variables' means and a correlation matrix for the independent and dependent variables. Few of the bivariate associations were significant, but the ability to make correct estimates was significantly higher among queer students and Women's Studies/Social Justice majors. Women, people with queer identities, and students who were majoring in Forensics or Women's Studies were significantly less likely to make overestimates, whereas the proclivity to make vastly incorrect estimates was more common among students who were majoring in Chemistry or Business.

The multivariate regressions are displayed in Table 3. To enact a best model approach, we ran a series of stepwise regressions in SPSS that automatically added variables based on their statistical significance. To implement a forward stepwise regression, we instructed SPSS to begin with the null model of zero independent variables. Steps were then created by adding the most significant variable not in the earlier model. The last step included ends with a list of significant independent variables that made the largest adjusted R^2 possible (this best or optimal model is reported in Table 3). With few significant predictors, the number of steps necessary to get a best-fit model was between five (tendency to overestimate) and one step (amount of incorrect estimates). This approach is atheoretical but, as shown in previous research, it excels in producing a parsimonious list of important variables when a study has a smaller sample size (Harrell, 2001).

Table 3. Final models of forward stepwise regressions for correct estimates, overestimates, and amount of incorrect estimates.

	Correct estimate			Overestimate			Amount of incorrect estimate		
Input	*β*	*SE*	Sig	*β*	*SE*	Sig	*β*	*SE*	Sig
1. Women									
2. Latino/a/x									
Black									
Asian American									
3. Age				−.16	.00	.049			
4. Lesbian/Gay									
Bisexual									
Queer/pansexual	.32	.16	.000	−.32	.23	.000			
5. Democrat									
Republican									
6. Medical major				−.18	.15	.025			
Biology									
Chemistry							.17	50.06	.049
Forensics				−.24	.09	.003			
Business									
WST/social justice	.31	.22	.000	−.30	.20	.000			
Psychology									
Humanities									
Adjusted R^2		.18			.23			.02	

Notes. Blank cells indicate that the input variable was not statistically significant at .05 level in the final model of the stepwise regression.

Table 3 shows that the type and number of significant associations varied by the ways that menstrual knowledge was coded. The ability to estimate the amount of menstrual blood correctly is linked to one's sexual identity and to one's college major. People who identified as queer/pansexual identity were more accurate at pouring the correct amount of blood than were heterosexuals, lesbians, gay men, and bisexuals, $\beta = .32$, $p < .001$. Women's and Gender Studies/Social Justice majors were also more accurate at that task than were students from every other major in the study, $\beta = .31$, $p < .001$.

The next regression determined which groups of students generally made overestimates of the amount of menstrual blood. Like the regression for correct estimates, a queer/pansexual identity and a Women's and Gender Studies major each predicted a significantly smaller percentage of overestimates, $\beta = -.32$ and $-.30$, respectively, $p < .001$. However, the demographic variables of age, $\beta = -.16$, $p < .05$, and Forensics major, $\beta = -.24$, $p < .01$, or Pre-medical Studies/Nursing major, $\beta = -.18$, $p < .05$, also predicted a significantly lower tendency to overestimate menstrual blood substantially. The last regression showed that only one factor—a Chemistry major—significantly predicted the tendency to overestimate the amount of blood. These students were prone to the most extreme versions of overestimates for menstrual blood, $\beta = .17$, $p < .05$. All other variables did not predict the degree of students' inaccuracies in blood estimates.

Discussion

Quantitative studies of menstrual blood knowledge are relatively rare. Moreover, nearly all studies of menstrual knowledge have focused on adolescent girls and largely have

ignored adult populations and their knowledge about menstruation. To address this gap in the literature, we explored the ability of undergraduate students to estimate accurately the amount of blood/tissue shed during a typical menstrual period. The practice of having students pour liquids into a measuring cup revealed a lack of knowledge about the materiality of menstrual blood among our sample. Only 14% of the sample could correctly identify the typical amount of blood in a menstrual period (30–60 ml). This finding matches those of previous studies that show than between 10% and 15% of Australian women and adolescent girls made correct estimates (Abraham et al., 1985; Moore, 1995) but falls much lower than the approximately 39% of American sixth-grade girls who could estimate the typical volume of menstrual flow (Koff & Rierdan, 1995).

Only three participants underestimated the amount of menstrual blood, whereas over 80% overestimated it; several other studies also show a tendency toward overestimation (Abraham et al., 1985; Koff & Rierdan, 1995). The overestimation by our sample was often quite large, as participants (on average) inflated the amount of menstrual blood by a full 282 ml. In fact, some of the participants were so misinformed that they overestimated the amount of menstrual blood by 1000 ml or more. Given that humans have only 4500–5700 ml of blood in their entire body (Sullivan, 2017), these numbers suggest that some participants imagined menstrual periods as catastrophically disruptive to the human body. One participant imagined that menstruators lost 5100 ml each menstrual period, which actually does exceed the amount of blood in some human bodies.

Younger students were more likely to overestimate the amount of menstrual blood, and people who took classes that prepared them for the medical fields were less inclined to inflate the estimate for menstrual blood. Also, gender, racial identities, and political parties did not influence the general tendency to imagine very high amounts of menstrual blood.

The results suggest that there are widespread knowledge gaps and forms of misinformation circulating about menstrual health, *even for those who themselves menstruate and interact with menstrual blood regularly*. We were particularly struck by the lack of difference between men's and women's estimates, as we had expected that those who interact with menstrual blood—via changing tampons or pads, seeing menstrual blood on their clothing or in the toilet, etc.—would have more accurate knowledge about how much blood and tissue they were expelling each month. Our expectation turned out to be inaccurate, as women significantly differed from men only in the bivariate analysis of those who made overestimates. Moreover, gender was not a significant predictor in any regression, which suggests that other factors were more important to knowledge about menstrual blood. This lack of menstrual health information suggests a profound disconnect between people and their own bodies, as those who menstruated and had regular interactions with menstrual blood overestimated *at the same rates* as those who had never menstruated.

We also looked closely at why menstrual health knowledge was different between students. Earlier studies showed that women had more accurate menstrual knowledge than did men (Cheng et al., 2007) and that taking classes on menstrual health improved the students' menstrual knowledge (Abedian et al., 2011; Setyowati et al., 2019). However,

our results challenge the claim of gender differences in knowledge as women and men made similarly inaccurate estimates. Moreover, access to medical, nursing, and biology classes did *not* seem to result in an especially well-informed population of students in regard to menstrual blood volume (Henderson et al., 2020). Students in these medical and science-based majors were not any better at providing correct estimates, but they were somewhat better at not making vast overestimates. This also seemed somewhat surprising to us given that previous research showed that nursing students in particular had better knowledge of bodily functions (Joseph et al., 2016), but students in all health majors were not especially good at identifying the health concerns related to early menarche, perhaps because menstruation is not taught in detail in general health classes (Henderson et al., 2020).

On the other hand, although students with majors connected to health were not associated with better menstrual blood knowledge, other majors *did* correlate with more accurate estimates of menstrual blood. In previous research, students with majors that situated women's health and well-being within patriarchal social structures had better menstrual health knowledge (Grose et al., 2014). In our study, Women's and Gender Studies and Social Justice majors and those who identified as queer and/or pansexual more accurately estimated menstrual blood. This suggests that feminist and queer identities may make people more attuned to menstrual health and menstruating bodies, and they may be more willing to examine gender norms critically. They may also be less squeamish about touching and interacting with menstrual blood (i.e., their own or their partners' blood). Further, they may be more likely to seek out information and talk about menstruation with knowledgeable others (e.g., parents, medical doctors, friends, online resources), which is notably different than what might occur for students with other majors (e.g., Business, Chemistry) that are more fact-based and less critical, social, and politically-minded.

This suggests that exposure to the most explicitly politicized college classes and queer identities were correlated with greater understandings of this form of menstrual health information. These results also revealed that women and men were equally unskilled at making correct menstrual blood estimates and that age, political party membership, and racial identity were not associated with a tendency to make a correct estimate. Further, students in the medical and health majors (e.g., Nursing, Medical Studies, Public Health, Biology) were notably not significantly better in providing correct estimates of menstrual blood than were students in other majors. Feminist and queer identities might correlate to a more attuned relationship to the body and more knowledge about embodiment more broadly. This is an exciting area for future research, and it suggests that Women's and Gender Studies and Social Justice programs may create students who are well-suited for work in providing health education and advocating for reproductive justice.

The inability of other variables to predict estimates also interested us, as lesbian identities did not correlate with better menstrual knowledge, and knowledge about menstrual blood did not differ by race/ethnicity, as some previous studies have implied (Orringer & Gahagan, 2010; White, 2013). Further, although age did not correlate with accurate estimates of menstrual blood, it was associated with the tendency to make *over*-estimates. That is, older (and more mature) students did not tend toward overestimates

as much as younger (and less mature) students. All of these findings are worthy of deeper inquiries in future research about menstrual health knowledge and general health knowledge.

These findings also suggest that overestimations of menstrual blood may happen for a variety of reasons, particularly given the shame and stigma related to menstruation in many cultures. Patriarchal framings of women's bodies as "dirty" and "gross," cultural norms for silence and not talking honestly about bodies, and broader messages—in the media, at school, at home, and in workplaces—about menstruation as taboo and debilitating all contribute to the lack of menstrual health information that individuals receive. Our sample included participants who were more educated and more upwardly mobile than the general public; we can thus assume that the general population may be even *less* informed and even *more* inaccurate in their knowledge of menstrual blood and menstrual periods. More research on non-college student populations could further contribute to our understanding of menstrual blood knowledge and menstrual literacy more broadly in the general population and across patterns of age, race, class, and sexual identity.

Furthermore, the fact that people tended to make such vast overestimates of the amount of menstrual blood suggests that people may code menstruation as especially negative, traumatic, difficult to manage, "gross," and taboo. This fits with previous literature that shows that people consistently have negative attitudes toward menstruation (e.g., Marván et al., 2006; Stubbs, 2008). Thus, the notion that people imagine enormous volumes of blood coming out of menstruators' bodies—in some cases *liters and liters* of blood—is not just a technical lack of menstrual health knowledge but also potentially a reflection of the ways that menstrual periods get coded as big, excessive, and unruly. We read these findings as an indicator of general menstrual distress, not only for menstruators themselves but also for those who *do not* menstruate.

Limitations

The design of the study could have impacted the generalizability of the results. A study of undergraduate students in the southwestern U.S. may not reflect the menstrual knowledge of other populations, such as graduate or medical students, those not enrolled in college, or different age cohorts (older and younger). College students may have more advantages (e.g., upward mobility, more education, more training in critical thinking) than other populations. Further, traditional college student age cohorts (18–22 years) likely have less menstrual and health knowledge than older people with more life experiences. As such, the truncated age distribution of college students could have obscured the role of age in the ability to make accurate estimates of menstrual blood. Moreover, menstrual taboos and the desire to avoid menstrual cycle-related topics may have dissuaded certain students from participating in the study (Matteson & Clark, 2010). Students who walked into the library on campus might also have unique features not representative of the broader campus population, including being more likely to read or study, or more likely to be taking in-person (as opposed to online) classes. This suggests that a more general sample of college students or broader the population in general may be even *less* informed than this particular group. National

random samples could lead to fewer selection biases, but it is exceedingly rare to have direct studies of menstrual health knowledge built into national surveys. The experiential component of the present study would also be difficult to replicate on a much larger scale.

In a small sample, such as this one, it is harder to find statistically significant relationships, as the cell sizes for sexual minorities and many of the different college majors were fairly small. Different measures might have produced different results. Issues of social desirability can be present because some women and men strongly dislike thinking or talking about menstruation (Matteson & Clark, 2010; O'Flynn & Britten, 2000), especially when asked to estimate blood loss. It is also possible that asking women to think about menstruation can serve as a "stereotype threat" that distorts the cognitive skills of menstruators because of implied stigma (Wister et al., 2013).

There is some debate among researchers as to what constitutes a typical volume of menstrual blood (Wood et al., 2007). Asking people about the number of tampons and/or pads that they used during their menstrual periods can act as a good proxy for blood loss (Garside et al., 2008; Koff & Rierdan, 1995). That said, the great variation in the size and absorbency of such products (e.g., super-plus versus regular tampons) could provide an even less reliable measure than the one we used. Tampon saturation estimates rely on people's understanding that the *whole* tampon would need to be saturated with blood in order to produce 5 ml of menstrual blood. Lastly, overestimation of liquids may be at play, as "free-pour" studies of alcohol have shown that college students often overestimate the size of a typical alcoholic drink (Schultz et al., 2017), which suggests that people might generally pour too much liquid because they lack knowledge of a topic or are unfamiliar with the measures.

Future Directions

Future researchers could explore other contributors to menstrual knowledge, health knowledge, and people's understanding of the material qualities of menstrual blood and menstrual flow. Given that menstrual shame and menstrual knowledge may be related (Spadaro et al., 2018; White, 2013), and that many people who accept traditional gender roles or have hostile attitudes toward women have more negative attitudes toward menstruation (Chrisler et al., 2014; Forbes et al., 2003) and less knowledge of sexual health (Grose et al., 2014), the connections between social and political attitudes, shame, and stigma could be fruitful in better understanding what people do and do not understand about menstruating bodies. Researchers could also explore how menstrual knowledge might differ by geographical location (Vyas et al., 2017), religious beliefs (Dunnavant & Roberts, 2013), or menstrual education histories. Whether people even *want* more menstrual knowledge is also a question worthy of more exploration, as one study suggests that adolescent girls do not express much interest in greater biological knowledge about menstruation (Koff & Rierdan, 1995). Researchers can also address why certain disciplines and specific teachers are unwilling or too embarrassed to teach about menstruation (Agnew & Gunn, 2019; Chrisler, 2013; Diorio & Munro, 2000). Finally, more experiential studies of menstruation could also prove useful, as people express their own relationship to the material experiences of menstrual periods rather than only imagining

menstruation as an abstraction. For example, researchers might need to imagine new ways for women with "heavy bleeding" to communicate to their doctors what heavy bleeding looks like and feels like. Being able to relate such information accurately is important to understanding the relationship between normal or average bleeding and heavy or extreme bleeding.

In general, health education and sex education—though currently under political attack in the U.S. and elsewhere—are crucial components to integrating experiences of the body with medically-accurate information. Of course, embodiment encompasses much more than mere medical knowledge, but we found it alarming that so few participants in the present study could accurately estimate the amount of blood in a typical menstrual period. It is further notable that the U.S. state in which this study was conducted offers *no* mandatory sex education and teaches menstrual health through a Procter and Gamble-sponsored (and thus, product-heavy) curriculum in the 5th grade for *one single day*. We argue that menstrual education should not have a myopic or "how to manage your period" approach, rather, menstrual educators should work to teach both menstruators and non-menstruators alike more holistically about the physiological, biological, and social aspects of menstruation. Understanding typical menstrual flow helps menstruators to know when something is unhealthy or different than usual in their bodies or when they need to seek medical consultation. Thus, the results of our study suggest that there is value in understanding the menstrual cycle as the "Fifth Vital Sign" (American Academy of Pediatrics & American College of Obstetricians & Gynecologists, 2006). Knowledge of many other aspects of the menstrual cycle (e.g., ovulation, menstrual pain, normal cycles, menstrual flow) is a crucial aspect of reproductive justice (Bobel, 2018; Iyanda, 2020; O'Keefe, 2006; Przybylo & Fahs, 2018). Better menstrual knowledge is a way to challenge menstrual shame and stigma and situate menstruation as a form of resistance against sexist and patriarchal mandates that strip menstruators of knowledge about and comfort with their own bodies.

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