Physically fit with a higher cancer risk? Influences of cervical cancer screening among a sample of physically active women ages 21–49 living in the United States

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ABSTRACT

To achieve the lowest risk level for various cancers, individuals would engage in several healthy lifestyle behaviors and age-eligible cancer screenings as recommended. Nonetheless, research has largely omitted exploration of concurrent primary and secondary prevention behaviors. This study was designed to explore influences of cervical cancer screening among physically active women who reported participation in recreational sports.

U.S. based women between the ages of 21–49, who had never been diagnosed with cancer, were eligible to complete a web-based survey. Logistic regression analyses were conducted using SAS 9.4.

On average, women were 31 years of age (N = 394) and self-identified as Black (51.3 %). Although low overall (30.7 %), higher odds of cervical cancer screening were associated with age (OR = 1.06, 95 % CI = 1.03–1.10), employment (OR = 2.43, 95 % CI = 1.14–5.18), knowledge of cancer-related risk behaviors (OR = 4.04, 95 % CI = 1.33–12.28), routine doctor's visit (OR = 4.25, 95 % CI = 1.56–11.54), and team-based vs individual-based sport participation (OR = 1.95, 95 % CI = 1.13–3.34).

Our study provides insight into the health profile of physically active women, ages 21–49, as it relates to risks for cervical cancer. Screening uptake among this diverse sample was much lower than the general population and national goals set by Healthy People 2030. Interventions should be tailored to increase knowledge of cancer-related risk behaviors, access to healthcare, and recommended cervical cancer screenings among even assumed-to-be healthy populations.

1. Introduction

Worldwide, cervical cancer is the fourth most commonly diagnosed cancer among women (World Health Organization and Cervical Cancer, 2021). As a result of public health interventions, such as Human Papilloma Virus (HPV) vaccination and routine cervical cancer screening, the number of deaths from cervical cancer have declined over the last decade (Arbyn, 2020; National Cancer Institute. Large Study Confirms that HPV Vaccine Prevents Cervical Cancer., 2020). Within the United States, Healthy People 2030 reports the cervical cancer screening rate among women aged 21–65 to be 81 % (Healthy People 2030, 2030). Compared to many other cancers (e.g., lung, breast and colorectal), higher screening rates for cervical cancer are evidence of successful public health efforts (Smith, 2019; American Cancer Society, 2020).

Despite past efforts, however, there now exists a decreasing trend in the number of women who are undergoing screening and an increasing incidence of cervical cancer diagnoses among women aged 35–44 (Yu et al., 2019; Fleming, 2018; Miller, 2021; Knoff, 2013; Haviland, 2020;

Suk, 2022; United States Cancer Statistics Working Group. U.S. Cancer Statistics Data Visualizations Tool, based on, 2019; Institute, 2019; National Cancer, 2022; Suk, 2022). Previous reports found that up-to-date cervical cancer screening rates lag specifically for various subgroups by race/ethnicity (Asians vs non-Hispanic Whites), sexual identity (LGBTQ + vs heterosexual adults), and geographic area (rural vs urban residents). Although several reasons for not undergoing cervical cancer screening exist, primary reasons uncovered through research include limited health knowledge and not receiving a referral from a healthcare provider (Suk, 2022).

Building on previous research designed to leverage existing healthy lifestyle behaviors and cancer screening intention among a diverse and physically active, young-to-middle aged adult population for design of an asset-based approach to promoting and increasing age-eligible cancer screenings (Ewing, 2022), this study was designed to examine influences of cervical cancer screening behavior among a sample of women ages 21-49 and living in the U.S.

2. Methods

This study is part of a larger study in the U.S. that was reviewed by the University of South Florida Institutional Review Board and classified as exempt from the federal regulations as outlined by 45 CFR 46.101(b). Informed consent was obtained from all participants included in the study. The larger study was conducted between January and April 2019 and involved a cross-sectional, web-based survey of both men and women recreational sport participants ages 18–49 (Ewing, 2022). For this study, participants included only women who met the following eligibility criteria: 1) 21–49 years of age; 2) reported participation in at least one recreational sporting event on average per month; and 3) had never been diagnosed with cancer. Participants previously reported the number of days they engaged in physical activity of at least moderate intensity. Women who had a cancer diagnosis were excluded based on the presumption that they were abiding by healthcare recommendations, including cancer screening frequency.

2.1. Cervical cancer screening

As a method of secondary prevention, cervical cancer screenings are currently recommended by the United States Preventive Services Task Force (USPSTF) for women as often as every 3 years starting at age 21 until age 65 (United States Preventive Services Task Force. A and B Recommendations., 2021). Therefore, the dependent variable of interest was assessed by an original item asking participants "*Which cancers have you been screened for?*" Women could select "*cervical cancer*" from the list of cancers.

2.2. Psychological variables

Items on the survey assessing *Knowledge of Cancer-Related Risk Behaviors* were adapted from a previous study (Merten, 2017). Each of the 12 items are listed in Table 2. Items were highly reliable (α = 0.801). Knowledge questions assessed the association of certain risk factors (e. g., smoking, obesity, and alcohol consumption) with cancer. For example, participants were asked "*Do you think that smoking can increase a person's chance of developing cancer?*" Response options for each of the knowledge questions included "*Yes it could*", "*No it couldn't*" and "*Don't know/not sure*". All items were recoded so that the correct response of "*Yes it could*" was assigned a value of one. All other response options were coded as "No" and assigned a value of zero. A higher score corresponded with higher cancer related risk behavior knowledge. The proportion of participants who answered each question correctly was also reported in Table 2. A mean scale score for *Knowledge* was computed for regression analyses (Table 2).

Items comprising the *Perceived Cancer Risk* scale were adopted from the Health Information National Trends Survey (HINTS) (Survey, 2014).

Items were reliable (α = 0.715). Items were reverse coded, so a higher score corresponded with a higher perceived risk for developing cancer. A mean scale score variable was computed for regression analyses.

2.3. Cancer-Related risk behaviors

Cancer-related risk behavior variables included family history of cancer, cervical cancer screening history, current smoking status, and binge-drinking status.

2.4. Sociodemographic variables

Sociodemographic variables included age, race, ethnicity, education, income, healthcare coverage, healthcare provider, marital status, employment, routine doctor's visit within the past two years, and the type of sport participation (individual vs team-based).

2.5. Data analysis

All data were analyzed using SAS 9.4 (SAS Inc., Cary, NC). Descriptive statistics were calculated to characterize the entire sample (Table 1). Specifically, mean (M) and standard deviation (SD) were reported for age, knowledge of cancer-related risk factors, and perceived cancer risk. Frequencies and proportions were reported for all other sociodemographic variables. The final analytic sample for regression analyses included only those participants who completed the entire survey and had no missing data for the outcome variable (i.e., complete case analysis) (White and Carlin, 2010).

Logistic regression was utilized to assess the relationship between predictor variables and cervical cancer screening (Table 3). Purposeful selection was used to identify significant predictors starting with univariable regression analyses with significance set at $P < 0.20$ (Hosmer and Lemeshow, 2021). This step was followed by testing multivariable models with all the significant predictors at $P < 0.05$. However, predictor variables were kept in the multivariable model if its removal caused a coefficient estimate change by more than 20 %. We then proceeded to add predictors excluded from the first step (univariable analyses) to the multivariable model, one at a time, with statistical significance set at $P < 0.05$. Final model summary statistics were evaluated based on significance levels ($P < 0.05$), beta coefficients, odds ratios and t values for each independent variable and change statistics.

3. Results

Demographics of the entire sample (N = 394) are reported in Table 1. On average, women were 31 years of age. Participants self-identified as Black (n = 185, 51.3 %), White (n = 146, 40.4 %), or some other race (n = 30, 8.3 %) and primarily non-Hispanic (n = 287, 90.3 %).

3.1. Cervical cancer screening

Upon complete case analysis, the outcome variable (i.e., cervical cancer screening) was positively reported by only 30.7 % (n = 121).

3.2. Knowledge of Cancer-Related risk behaviors

The proportion of correct responses for *Knowledge of Cancer-Related Risk Behaviors* is presented in Table 2. The mean score on the knowledge scale was 53 % (SD = 0.30). Whereas 93 % of participants correctly associated smoking with increasing a person's chance of developing cancer, only 68.4 % of participants correctly associated infection with HPV as an increased risk factor for developing cancer. Knowledge scores were significantly correlated with screening for cervical cancer (M = 0.66; SD = 0.29, *P < 0.001*).

Table 1
Descriptive Characteristics of Study Participants by History of Cervical Cancer Screening (N = 394).

	Ever screened for cervical cancer				P-value†
	No (N = 273)		Yes (N = 121)		
	N	%	N	%	
Race					0.443
White	105	42.68	41	35.65	
Black	121	49.19	64	55.65	
Other	20	8.13	10	8.70	
Missing	27		6		
Ethnicity					0.369
Non-Hispanic	190	89.20	97	92.38	
Hispanic	23	10.80	8	7.62	
Missing	60		16		
Education					0.044
Less than high school or high school graduate	33	12.09	7	5.79	
Some college	48	17.58	18	14.88	
2-year degree	18	6.59	9	7.44	
4-year degree	69	25.27	37	30.58	
Professional/graduate/ doctorate degree	43	15.75	34	28.10	
Missing	62		16		
Healthcare coverage					0.033
No	20	9.48	3	2.86	
Yes	191	90.52	102	97.14	
Missing	62		16		
Routine doctor visit					<0.001
No	46	18.85	3	2.86	
Yes	198	81.15	102	97.14	
Missing	29		6		
Income					0.259
Less than $40,000	80	39.60	34	33.33	
$40,000 - $79,999	91	45.05	45	44.12	
$80,000 or more	31	15.35	23	22.55	
Missing	71		19		
Marital status					0.877
Never married	124	58.22	58	55.24	
Married	65	30.52	34	32.38	
Other	24	11.27	13	12.38	
Missing	60		16		
Employment					0.002
No	51	24.17	10	9.52	
Yes	160	75.83	95	90.48	
Missing	62		16		
Family history of cancer					0.136
No	138	50.55	71	58.68	
Yes	135	49.45	50	41.32	
Current smoking status					0.092
No	199	78.97	101	86.32	
Yes	53	21.03	16	13.68	
Missing	21		4		
Binge drinking					0.693
No	85	36.32	42	38.53	
Yes	149	63.68	67	61.47	
Missing	39		12		
Team-based sport participation					0.001
No	154	56.41	46	38.02	
Yes	119	43.59	75	61.98	
	Mean	**SD**	**Mean**	**SD**	
Age	30.83	7.08	34.37	7.64	<0.001
Perceived cancer risk	1.89	0.56	1.87	0.56	0.714

† p value for Chi^2 test for categorical variables. Two-sample t-test was used for continuous variables.

3.3. Perceived cancer risk

The mean score on the *Perceived Cancer Risk* scale was 1.89 (out of 3) among women not reporting screening (SD = 0.56) and 1.87 among women reporting screening (SD = 0.56). Results are reported in Table 1. Perceived cancer risk scores were not significantly correlated with screening for cervical cancer.

Table 2
Knowledge of Cancer Risk Factors (n = 394).

Overall Knowledge of Cancer Risk Factors	Mean (SD)	Yes (%)
Never Screened	0.53 (0.30)	
Ever Been Screened	0.66 (0.29)	
Item		
1. Do you think that smoking can increase a person's chance of developing cancer?		93.0
2. Do you think that exposure to another person's smoking can increase a person's chance of developing cancer?		86.8
3. Do you think that getting sunburned can increase a person's chance of developing cancer?		86.5
4. Do you think that having a close relative with cancer can increase a person's chance of developing cancer?		80.1
5. Do you think that infection with HPV (human papillomavirus) can increase a person's chance of developing cancer? HPV is the virus that causes genital warts.		68.4
6. Do you think that being overweight can increase a person's chance of developing cancer?		60.7
7. Do you think that drinking alcohol can increase a person's chance of developing cancer?		55.8
8. Do you think that being older can increase a person's chance of developing cancer?		55.3
9. Do you think that not doing much physical activity can increase a person's chance of developing cancer?		53.0
10. Do you think that eating too much red or processed meat can increase a person's chance of developing cancer?		49.6
11. Do you think that not eating many fruits or vegetables can increase a person's chance of developing cancer?		42.7
12. Do you think that not eating enough fiber can increase a person's chance of developing cancer?		32.5

Table 3
Factors associated with cervical cancer screening behavior among physically active women ages 21–49.

	OR*	95 % CI		aOR†	95 % CI	
		LCL	UCL		LCL	UCL
Age	1.07	1.04	1.10	1.06	1.03	1.10
Knowledge of cancer risk factors	4.27	1.97	9.22	4.04	1.33	12.28
Employment						
No	Ref			Ref		
Yes	3.03	1.47	6.25	2.43	1.14	5.18
Routine doctor visit						
No	Ref			Ref		
Yes	5.11	1.97	13.24	4.25	1.56	11.54
Team-based sport						
No	Ref			Ref		
Yes	2.11	1.36	3.27	1.95	1.13	3.34

OR: Odds Ratio, aOR: adjusted Odds Ratio, CI: Confidence Interval, LCL: Lower Confidence Limit; UCL, Upper Confidence Limit.
*Estimates from univariable models.
†Estimates from the final model which included age, knowledge of cancer risk factors, employment, routine doctor visit, and team-based sport.

3.4. Logistic regression analyses

Logistic regression analyses were performed to examine the influence of sociodemographic, knowledge of cancer-related risk behaviors, perceived cancer risk, and cervical cancer screening behavior. The final model included the following variables: age, scores for knowledge of cancer related risk behaviors, employment status, routine doctor's visit, and type of sport participation (Table 3). In the final model, higher odds of undergoing cervical cancer screening were positively and significantly associated with an increase in age (OR = 1.06, 95 % CI = 1.03–1.10) and increasing scores for knowledge of cancer-related risk

behaviors (OR = 4.04, 95 % CI = 1.33–12.28). Compared to women who were not employed, significantly higher odds of undergoing cervical cancer screening were associated with employment (OR = 2.43, 95 % CI = 1.14-0.5.18). Higher odds of screening were also associated with having a routine doctor's visit within the past two years (OR = 4.25, 95 % CI = 1.56–11.54) and engaging in team-based sport participation (OR = 1.95, 95 % CI = 1.13–3.34).

4. Discussion

Our study highlights a unique segment of the population with potentially higher risk for cervical cancer based on reportedly lower cervical cancer screening rates in comparison to the general population (30.4 % vs 80.5 %) (Healthy People 2030, 2030). Nonetheless, we also present significant influences for increasing participation in cervical cancer screening among this unique sample of women that includes demographic (i.e., increased age), socioeconomic (i.e., employment), cognitive (higher knowledge of cancer related risk behaviors) and lifestyle behaviors (i.e., regular doctor's visit and engagement in team-based sports participation). Public health interventions should be tailored to address these determinants for increased adherence to cervical cancer screening among this unique population.

Although previous research has presented high cancer screening intention scores and higher cancer screening rates among women with higher levels of physical activity compared to women with lower levels of physical activity, our study suggests women who participate in recreational sports may be an exception (Ewing, 2022; Muus, 2012). Reportedly high cancer screening intention scores previously published (e.g., 8 out of 10) and our findings of low cervical cancer screening rates suggest that this subsample of women may be an ideal population for partnering to reach targeted Healthy People 2030 goals of increasing cervical cancer screening rates to 84.3 % (Healthy People 2030, 2030; Healthy People 2030, 2030).

Despite known effects of physical activity to reduce risk, recurrence and mortality for several different cancers, only a little more than half of Americans ages 18 or older report meeting the recommended levels of aerobic physical activity (Institute and Activity, 2020). However, even if recommended levels of physical activity are met, findings differ as to whether participants are more likely to engage in primary and secondary cancer prevention behaviors including not smoking, safer-sex practices to reduce HPV-risk, and cervical cancer screening (Conley and Rao, 2020). Our findings align with previous research suggesting physically active subgroups are still in need of education and interventions to promote cancer prevention behaviors, specifically cervical cancer screening (Muus, 2012; Christoph, 2016; Arana-Chicas, 2020). Furthermore, our findings suggest that healthcare professionals may prematurely assume reduced long-term cancer risks for patients reporting a healthy lifestyle behavior, such as physical activity, and neglect emphasizing the importance of secondary cancer prevention strategies such as screening. As presented in previous research, physically active adults are not strongly motivated by long-term disease prevention with their decision to engage in physical activity, but instead the immediate and gratifying effects of "looking better" or "feeling better now" (Nowicki et al., 2017; Grant et al., 2009; Sallis et al., 1992). Considering previous changes to cervical cancer screening recommendations by the USPSTF and in progress updates as of this publication, our findings suggest some women could even perceive "updates" as an opportunity to delay screening.

Our study also provides insight into the health knowledge profile of physically active women ages 21–49 as it relates to risks for cervical cancer. Most astounding, participants in our study that reported a higher knowledge of several cancer related risk behaviors were four times more likely to undergo cervical cancer screening. Behavioral risk factors, including smoking, poor diet, risky sexual behaviors, and coinfection with human immunodeficiency virus (HIV) are well-known factors related to increased risk for cervical cancer (Fonseca-Moutinho, 2011;

Feng, 2017; Siokos et al., 2019; Chen, 2020; Hair, 2017; Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance, 2018; Watkins et al., 2018; Soneji, 2017). Based on previous research, infection with HPV is the **strongest** known factor associated with cervical cancer diagnoses, yet knowledge of the association between HPV infection and cervical cancer was only moderate among this sample (68.4 %). This compares with previous research documenting participation in cancer-risk related behaviors among women engaging in sports and generally low cancer-risk related behavioral knowledge among young adults within this age range (American Cancer Society. Cervical Cancer Causes, Risk Factors,and Prevention., 2021; Gönenç, 2020; Moore et al., 2013; Mastroleo, 2013; Martin, 2021; Hingson, 2009; Turrisi, 2006; Nelson and Wechsler, 2001; Nardi et al., 2016; Christy, 2021; Nolan, 2014; Wearn and Shepherd, 2022; Fuzzell, 2021; Schrager et al., 2017; Han, 2018; Landy, 2016). Moreover, with half of our sample self-identifying as Black, reportedly low cervical cancer screening rates may be explained by previous research that suggests inadequate knowledge and perceived barriers as influential factors affecting the decision of minority women to not get screened for cervical cancer (Nardi et al., 2016). Black women have an increased likelihood of developing and dying from cervical cancer, compared to their white counterparts (Christy, 2021). Yet, evidence suggests that Black women have low engagement in cervical cancer screening for reasons such as low insurance coverage, distrust of the health care system, fear of test results, and lack of transportation to health care service (Nolan, 2014). Even when Black women have access to screening services, utilization remains low due to factors such as quality and experiences of care that fosters mistrust in the health care system (Christy, 2021; Wearn and Shepherd, 2022). Systemic racism also exposes Black women to discrimination while utilizing health care services, thereby influencing their uptake of the Pap test (Fuzzell, 2021). Our findings may provide further insight for healthcare professionals engaged in shared decision-making practices for promoting cervical cancer screening among this subgroup of the population (Schrager et al., 2017; Han, 2018).

4.1. Limitations and strengths

This study is not without limitations. Notable, our outcome variable of interest was a self-reported measure assessing "cervical cancer screening" and may therefore be unreliable due to recall bias or limited knowledge of the pap smear as cervical cancer screening. Furthermore, we did not screen our sample to exclude women unlikely to be recommended for cervical cancer screening (e.g., history of a hysterectomy). Another limitation of this study was the unclear temporal relation between the outcome and predictors due to the cross-sectional design of the study. Thus, results are not generalizable to the broader population of women.

There are several strengths of our study. Our findings contribute timely information on low cervical cancer screening rates among a unique population during the USPSTF topic update and downward trend in overall screening utilization. Furthermore, recruiting women outside of a clinic, in a non-traditional setting, carries implications for increasing reach to reduce disparities related to cervical cancer and screening. Lastly, the finding of an association between team-based sport participation and cervical cancer screening utilization highlights the importance and relevancy of *social support* as a construct to be included in the design of behavioral interventions for promoting cervical cancer screening in this population.

5. Conclusions

Cervical cancer screening uptake among this diverse sample of physically active women ages 21–49 who report engagement in recreational sports is much lower than national rates. However, women who reported a regular, routine doctor's visit within the past two years and a higher knowledge of cancer-related risk behaviors were four times more

likely to undergo cervical cancer screening among this study sample.

Cervical cancer screening is the most effective strategy for preventing death from cervical cancer (Landy, 2016). We identify modifiable determinants for the design and development of potentially effective interventions to increase cervical cancer screening participation among a diverse sub-group of women ages 21–49. Cancer screening interventions should be offered earlier in adulthood and via non-traditional settings to address the removal of barriers to cervical cancer screening including low knowledge of cancer-related risk behaviors (i.e., infection with HPV) and poor healthcare access for routine provider visits to promote access to cervical cancer screenings.

CRediT authorship contribution statement

A.P. Ewing: Conceptualization, Methodology, Validation, Writing – original draft, Visualization, Project administration, Funding acquisition. **M. Alalwan:** Formal analysis, Validation, Visualization. **J.A. Brown:** Writing – review & editing. **T.E. Adekunle:** Writing – review & editing. **N.D. Korley:** Writing – review & editing. **T.C. Nafiu:** Writing – review & editing. **E.C. Coughlin:** Writing – review & editing. **C.P. Parvanta:** Supervision, Writing – review & editing. **C.D. Meade:** Supervision, Writing-reviewing & editing. **C.K. Gwede** Supervision, Writing-reviewing & editing. **A.L. Best:** Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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