Cervical Cancer Screening Patterns Among Women Living with and without HIV in the US: An Analysis of the NIH *All of Us* Research Program

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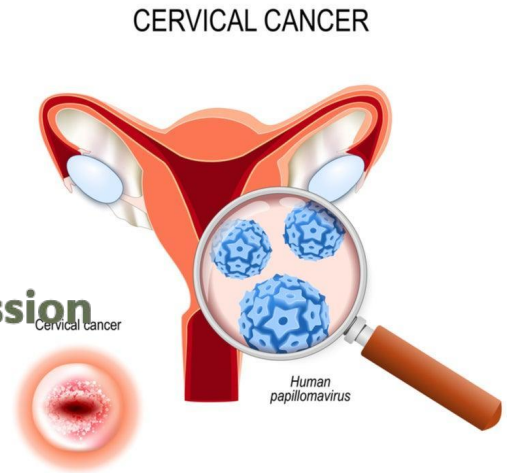
INTRODUCTION

- **Cervical Cancer**: one of the most prevalent cancers around the world
- **Human Papilloma Virus (HPV)** contributes to cervical cancer
- Prevent cervical cancer: routine screening of HPV and cervical cancer, and HPV vaccination
- **HIV-infected women** face an increased risk of getting infected by HPV → **immunosuppression**
- **Anti-retroviral therapy** improves life expectancy → risk of getting cervical cancer increased



- **Cervical cancer screening**: 1. Pap test (Cytology) 2. HPV test
- **Previous studies**: insufficient screenings for HIV-infected women, and patterns among general population are not satisfying
- **Significance**: 1. More general population in the US 2. Examine screening adherence and patterns by HIV status

INTRODUCTION

- Cervical cancer screening guidelines →
- Cytology (Pap smear), HPV testing
- HIV-infected women: receive Pap smear testing twice a year after HIV diagnosis, and annually thereafter

Population	Women aged 21 to 29 years	Women aged 30 to 65 years	Women younger than 21 years, women older than 65 years with adequate prior screening, and women who have had a hysterectomy
Recommendation	Screen for cervical cancer every 3 years with cytology alone. Grade: A	Screen for cervical cancer every 3 years with cytology alone, every 5 years with hrHPV testing alone, or every 5 years with cotesting. Grade: A	Do not screen for cervical cancer. Grade: D

Risk Assessment	All women aged 21 to 65 years are at risk for cervical cancer because of potential exposure to high-risk HPV types (hrHPV) through sexual intercourse and should be screened. Certain risk factors further increase risk for cervical cancer, including HIV infection, a compromised immune system, in utero exposure to diethylstilbestrol, and previous treatment of a high-grade precancerous lesion or cervical cancer. Women with these risk factors should receive individualized follow-up.
Screening Tests	Screening with cervical cytology alone, primary testing for hrHPV alone, or both at the same time (cotesting) can detect high-grade precancerous cervical lesions and cervical cancer. Clinicians should focus on ensuring that women receive adequate screening, appropriate evaluation of abnormal results, and indicated treatment, regardless of which screening strategy is used.
Treatments and Interventions	High-grade cervical lesions may be treated with excisional and ablative therapies. Early-stage cervical cancer may be treated with surgery (hysterectomy) or chemotherapy.

For a summary of the evidence systematically reviewed in making this recommendation, the full recommendation statement, and supporting documents, please go to https://www.uspreventiveservicestaskforce.org.

U.S. Preventive Services TASK FORCE

JAMA

SIGNIFICANCE & GAPS

1. The population will be more general and target the whole population in the US
2. Previous studies did not examine screening adherence and patterns by HIV status
    1. Analysis of the differences between groups can better guide future research to improve the guideline implementation and provide potential modifications.

RESEARCH QUESTION

- RQ:
  - What factors influence the cervical cancer screening guidelines adherence for women eligible for screening in the US, and are there any differences in cervical cancer screening patterns between HIV seronegative women and HIV seropositive women living in the US?
- Hypothesis:
  - There are significant differences in cervical cancer screening patterns between HIV seronegative women and HIV seropositive women living in the US

METHODS – Data Source, Study Design, Measures

Data source

- NIH All of US Research Program
  - Contains one of the largest genetic and health records data from over 1 million participants
  - Aims to promote health-related research and advancing disease prevention and treatment

Study design

- Parent study: A longitudinal cohort study
- Thesis project
  - A cross-sectional study

Measures

- **Sample** (N = 7608, HIV+ = 1268, HIV- = 6340)
  - First, identify those who are HIV-infected. Then match the HIV-positive group to the HIV-negative group based on age (continuous) Ratio: 1:5
- **HIV status** (Identified by SNOMED codes)
- **Cervical cancer screening status**
  - Identified by relevant procedure codes
- Other Covariates
  - Race/ethnicity, gender identity, educational level, annual household income, marital status, sexual orientation, type of health insurance, employment, cigarettes smoking

METHODS – Participants, Data Collection

Parent Study

- Participants
  - Inclusion: >18 yrs old, living in the US
  - Exclusion: prisoners
- Data collection
  - Questionnaires, EHRs, clinical setting at the time of enrollment, self-reporting at home

Thesis Project

- Participants
  - Biological sex women aged from 21 to 65 years old (according to screening guidelines recommendation)
- Variables will be obtained from surveys, EHRs, and physical measurements, from the controlled tier of the parent study

METHODS

- HIV status (ci
  - Identify SN
    Medicine) c
- Sample
  - First, identi
    the HIV-po
    on age (cor
- Outcome – C
  - Identify rele
    codes
  - 1 = Yes, Pap

tional level,
tus, sexual
employment

Table 2. Detailed list of codes for cervical cancer screening status variable

Vocabulary for

Table 3. Detailed list of SNOMED codes for the HIV status variable

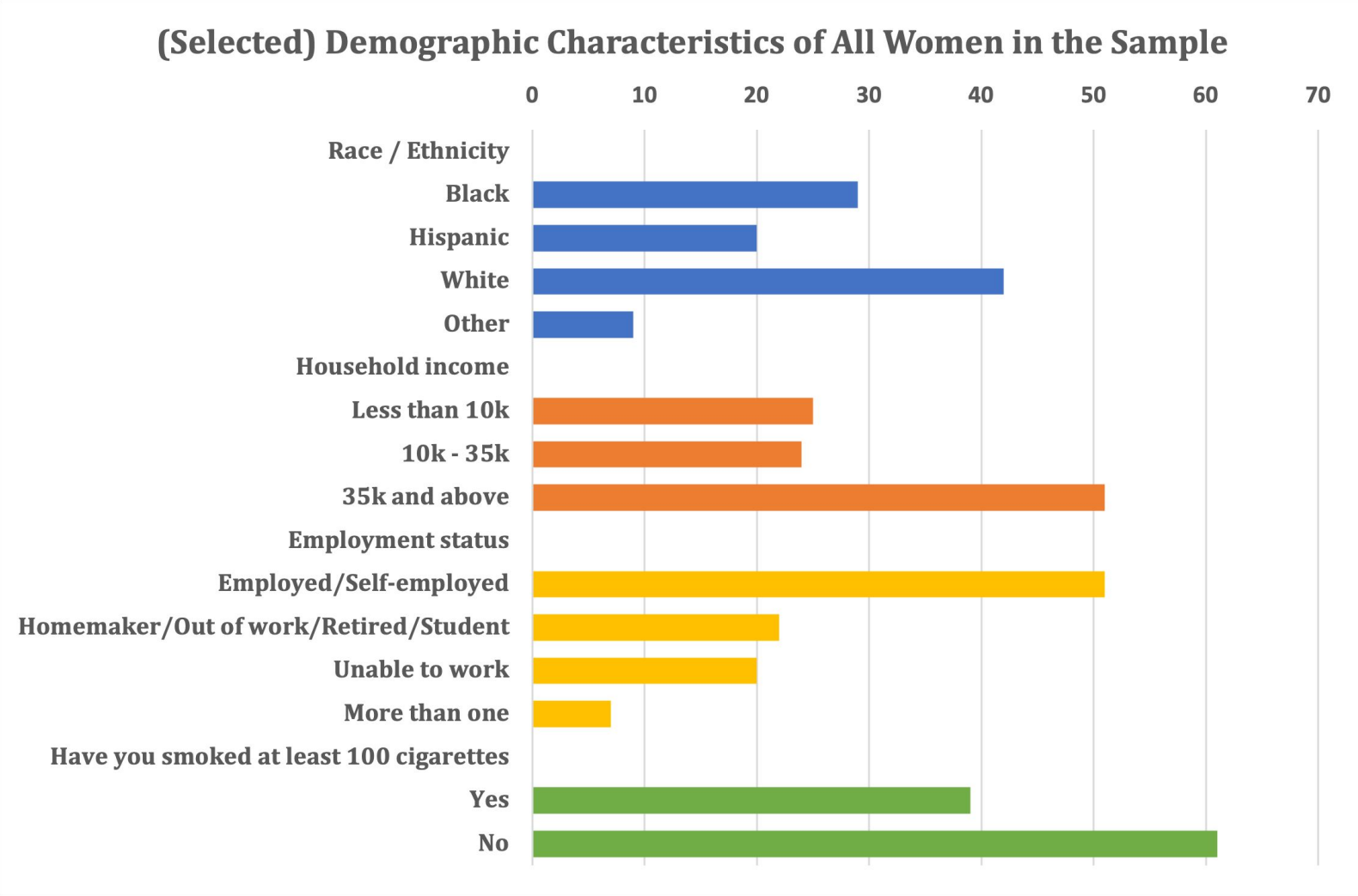
Name	Concept ID	Vocabulary for concept
Asymptomatic human immunodeficiency virus infection	424153	SNOMED
HIV positive	4013106	SNOMED
Human immunodeficiency virus II infection	432554	SNOMED
Human immunodeficiency virus infection	439727	SNOMED
Symptomatic human immunodeficiency virus (HIV) I infection	45769864	SNOMED
Symptomatic human immunodeficiency virus infection	43531586	SNOMED

METHODS – Statistical Analysis

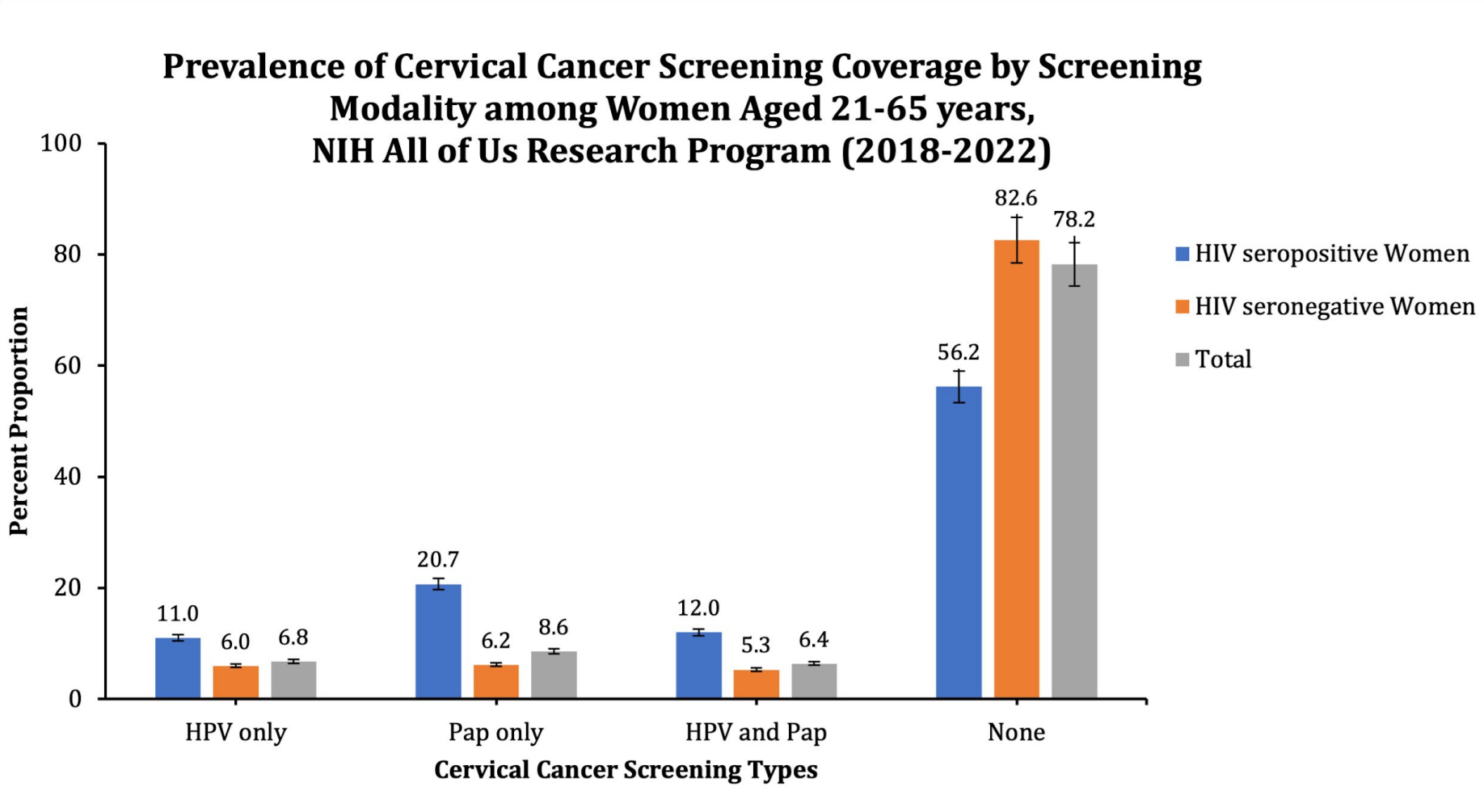
- Conducted on the All of Us Researcher Workbench using R software version 4.1
- Univariate analysis (**Categorical**: frequency, percentage. **Continuous**: mean, standard deviations)
- Bivariate analysis (**Categorical**: Chi-square test. **Continuous**: ANOVA on ranks)
- Multivariate analysis
  - Conditional logistic regression for matched data (Odds ratios, 95% Confidence interval, p-value)

RESULTS

- Univariate analysis
  - Almost half of participants reported to have less than 35k income
  - Over 20% of women were unable to work
- Bivariate analysis
  - Larger proportion of HIV positive women have screening records, compared with HIV negative women



RESULTS


Prevalence of Cervical Cancer Screening Coverage by Screening Modality among Women Aged 21-65 years, NIH All of Us Research Program (2018-2022)
Percent Proportion
100
80
60
40
20
0
11.0
6.0
6.8
20.7
6.2
8.6
12.0
5.3
6.4
56.2
82.6
78.2
HPV only
Pap only
HPV and Pap
None
Cervical Cancer Screening Types
HIV seropositive Women
HIV seronegative Women
Total

RESULTS

- Conditional logistic regression for Multivariable Analysis
- Statistically significant variables: HIV status, Race/Ethnicity, Employment status, Cigarettes smoking, type of health insurance

	Odds ratio (95%CI)	P-value
HIV status		
HIV positive ***	4.40 (3.41 - 5.68)	<0.001
Race / Ethnicity		
Hispanic *	0.62 (0.45 - 0.86)	0.003
White	0.84 (0.65 - 1.08)	0.179
Other	0.71 (0.49 - 1.03)	0.072
Employment status		
Homemaker/Out of work/Retired/Student ***	0.56 (0.42 - 0.77)	<0.001
Unable to work *	0.71 (0.51 - 0.99)	0.043
More than one	0.74 (0.52 - 1.06)	0.098
Have you smoked at least 100 cigarettes?		
Yes *	0.77 (0.63 - 0.94)	0.011

CONCLUSION

- HIV positive participants were more likely to receive cervical cancer screening compared with HIV negative participants
- Compared with results from previous studies, the proportion of HIV positive women getting screened in this sample was lower.
- Null hypothesis was rejected and suggested that there are significant differences in cervical cancer screening patterns between HIV seropositive and HIV seronegative women living in the US

CONCLUSION

Limitations:

- The number of screenings conducted in this sample might not reflect the actual screening situation
  - Participants recruited by their health providers or direct invitation → Selection Bias
- Most information comes from self-reported survey → Recall Bias

Implications:

- Access whether healthcare resources could influence screening by including more healthcare-related variables
- Stratification analysis for HIV positive and HIV negative groups
- Adopt longitudinal study design to examine screening pattern change overtime

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Images:

1. https://www.healthywomen.org/your-health/prevention--screenings/cervical-cancer-screening-save-life
2. https://www.medicaldevice-network.com/comment/cervical-cancer/

QUESTIONS?

THANK YOU FOR YOUR TIME!