

Age-related factors associated with intention to initiate pre-exposure prophylaxis among cisgender women in Washington D.C.

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Abstract

Background: Pre-exposure prophylaxis (PrEP) utilization among cisgender women (subsequently 'women') is low across age groups, relative to their risk of HIV acquisition. We hypothesize that age-related differences in psychosocial factors also influence women's intention to initiate oral PrEP in Washington, D.C.

Methods: A secondary analysis of a cross-sectional survey data was performed to evaluate factors influencing intention to initiate oral PrEP among women seen at a family planning and a sexual health clinic. A bivariate analysis was performed to identify differences by age group in demographic characteristics, indications for PrEP, and attitudes toward PrEP; we then performed additional bivariate analysis to assess these variables in relation to PrEP intention.

Results: Across age groups, perceived risk of HIV acquisition was not significantly different and was not associated with intention to initiate PrEP. Awareness of and attitude toward PrEP, injunctive norms, descriptive norms, and self-efficacy were not different across age, however there were significant age-associated differences in relation to PrEP intention. Specifically, among 18–24-year-olds, intention to start PrEP was associated with support from provider ($p=0.03$), main sexual partner ($p<0.01$), and peers ($p<0.01$). For women 25–34 years old, having multiple sexual partners ($p=0.03$) and support from casual sexual partners ($p=0.03$) was also important. Among women 35–44 years old, prior awareness of PrEP ($p=0.02$) and their children's support of PrEP uptake ($p<0.01$) were associated with intention to initiate PrEP. Among 45–55 year-old women intention to initiate PrEP was positively associated with engaging in casual sex ($p=0.03$) and negatively associated with stigma ($p<0.01$).

Conclusion: Overall, there were more similarities than differences in factors influencing intention to initiate PrEP across age groups. Observed differences offer an opportunity to tailor PrEP delivery and HIV prevention interventions to increase awareness and uptake for cisgender women.

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Plain language summary

Research showing how women's age affects their decision to start pre-exposure prophylaxis to prevent HIV in Washington, DC

We know that many women need pre-exposure prophylaxis (PrEP) to prevent HIV infection in Washington, DC, yet the number of women who use PrEP is lower than expected. The study was done to determine whether a woman's age affects her decision to start PrEP.

This is important because providers need to know the factors affecting a woman's decision to start PrEP in order to increase PrEP use in at-risk patients. We re-analyzed a set of data that was generated from surveys given to women in a women's health clinic. The surveys asked women about their background, including risk factors for HIV infection, and their awareness of and attitudes toward PrEP. We also asked women questions that were meant to determine their belief in their own ability to make decisions as well as the degree to which other people in their life affect their own decisions. We wanted to know whether age affects the degree to which these characteristics affect women's decision to start PrEP. Overall, there were more similarities than differences between age groups when looking at how different factors affect the decision to start PrEP. Across age groups, there were no differences in how women view their risk of HIV infection. We found that 18-24-year-olds were more likely to start PrEP when they felt support from their provider, main sexual partner, and peers. 25-34-year-olds were more likely to start PrEP when they felt this same source of support and had had multiple sexual partners. 35-44-year-olds were more likely to start PrEP when they already had awareness of PrEP or had their children's support of their PrEP use. 45-55-year-olds were more likely to start PrEP when they had engaged in casual sex and were less likely to start PrEP if they expected negative judgement for it. Even though there were significant similarities between age groups, the differences that we found offer an opportunity to tailor PrEP awareness and interventions to promote PrEP use among women.

Keywords: age, female, HIV infections, intention, pre-exposure prophylaxis, surveys and questionnaires

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Introduction

Washington D.C. (DC) is an epicenter of the United States HIV epidemic, and improved HIV prevention measures designed for cisgender women (subsequently referred to as women) are imperative.¹ In DC new diagnoses of HIV among women occur across all age groups, with the largest proportion among women in their 30's (20.2%), 40's (22.3%) and 50's (22.3%).¹ Nationally, pre-exposure prophylaxis (PrEP) is underutilized by women relative to their risk based on geographic prevalence and behavioral exposure.²⁻⁴

Barriers to PrEP utilization include sociocultural factors (e.g. stigma, mistrust), structural barriers (e.g. lack of access), community factors (e.g. stigma surrounding PrEP due to associations with HIV and sexual activity, low awareness of PrEP), partner-level factors (e.g. partner power discordance and inter-partner trust) and individual-level factors (e.g. low perceived risk of HIV acquisition, medication and laboratory costs, lack of awareness

of PrEP, efficacy and safety concerns).⁵⁻²¹ The limited literature on age and age-related factors and PrEP uptake shows that while younger individuals reported more willingness to use PrEP, older individuals were more likely to actually start PrEP after discussions with a provider.^{22,23} Other research specifically surveying women showed that younger women reported a larger social influence on PrEP perception than older women, but did not report a stronger intention to initiate PrEP than older women.²⁴ To understand how age influences the relationship between psychosocial factors and intention to initiate PrEP (subsequently referred to as 'intention' for brevity), we completed a secondary analysis of cross-sectional survey data evaluating factors influencing intention to initiate oral PrEP among women in a tertiary care family planning clinic and a government-sponsored sexual health clinic in DC.²⁵ We hypothesized that there would be significant age-related differences in the association of psychosocial factors with intention that could inform the development of effective HIV prevention interventions.

Methods

Study design

Data used in this secondary analysis were previously collected using anonymous, tablet-based, cross-sectional survey data querying factors influencing PrEP uptake (IRB#s 2017-0870 and 2017-25), collected from September 2017 to March 2018 and July 2018 to March 2020. English-speaking women over 18 years old were invited to participate. We stratified by age group,²⁵ separating women into age groups of 18–24, 25–34, 35–44, 45–54, and 55+ years based on previous conventions.^{22,23,26} We excluded non-cisgender female respondents, as well as those with missing values for age or PrEP intention.

The survey tool and study protocol have been previously described in detail.^{20,25,27} The tool surveyed background factors, (i.e. race, marital status, education level, employment and housing status, average income, insurance status, transportation methods and length of travel to clinic, perceived risk of contracting HIV, prior awareness of oral PrEP as an HIV prevention measure), behavioral factors (i.e. shared injection, tattoo or piercing equipment, casual sex partner(s), consistency of condom use, number of sex partners, sexually transmitted infections (STIs), transactional sex), and psychosocial factors (i.e. attitudes, injunctive and descriptive norms, self-efficacy, intention).

We assessed PrEP intention with the question: ‘Which statement best reflects your thinking?’ with choices of ‘no intention of using PrEP for HIV prevention in the next 12 months’, ‘considering taking PrEP for HIV prevention in the next 12 months, but I’m not ready to take action’, ‘committed to taking PrEP for HIV prevention in the next 12 months’ and ‘ready to start PrEP as soon as possible’. We then collapsed responses into a dichotomous variable (i.e. ‘committed’ and ‘ready to start’ *versus* ‘no intention’ and ‘considering’).

Analysis

We compared demographic and behavioral factors, perceived risk, and awareness of PrEP by the aforementioned age groups, and repeated the analysis for all global measures, including attitude, self-efficacy, descriptive norms, and injunctive norms. Additional bivariate analysis was done

between these variables of interest and women’s intention with further stratification by age group. Bivariate analysis was performed using *t*-test, Chi-square test, and Fisher’s exact test, when appropriate. The level of significance was set at 0.05 for all statistical testing. All analysis was done with SAS Studio 3.8 Enterprise Edition.²⁸

This study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology statement.²⁹

Results

Sample characteristics

A total of 1321 women were included in the analysis and subdivided by age group: 18–24 ($n = 487$), 25–34 ($n = 583$), 35–44 ($n = 142$), 45–54 ($n = 64$), and 55+ years ($n = 45$).²⁵ The majority of participants across age groups were Black, single, publicly insured, full or part time employed, had completed some college, and had <30K household income (Table 1).

Inter-age group comparison

The majority of participants identified as Black across age groups, however there was a higher proportion of White and other-identifying participants in younger age groups (Table 1). There was a significantly higher proportion of single participants in younger age groups compared to older age groups ($p < 0.01$). Significantly higher proportions of women in the older age groups were on government-sponsored insurance ($p < 0.01$). Additionally, there were statistically significant demographic differences in education, employment, and income by age group, without clear trends by age.

Inconsistent condom-use, multiple sex partners, and STI(s) within the past year were all associated with younger age groups ($p < 0.01$, Table 1). In contrast, transactional sex was highest among the two oldest age groups ($p = 0.02$).

Perceived risk of acquiring HIV was low and not significantly different by age group. 40% of women had heard of PrEP; there were no significant differences in awareness by age group. Having received PrEP or a prescription for PrEP was low ($n = 34$, 2.6% overall), but more common

Table 1. Demographic characteristics, indication(s) for PrEP, PrEP awareness, and global measures by age group.

Variable	18–24 years (N=487)	25–34 years (N=583)	35–44 years (N=142)	45–54 years (N=64)	55+ years (N=45)	p Value
Demographic characteristics^a						
Race						<0.01
Black	329 (69.1)	435 (76.5)	94 (68.1)	59 (92.2)	37 (84.1)	
White	59 (12.4)	56 (9.8)	17 (12.3)	1 (1.6)	5 (11.4)	
Other	88 (18.5)	78 (13.7)	27 (19.6)	4 (6.3)	2 (4.6)	
Marital status						<0.01
Married or Living Together	38 (7.9)	67 (11.5)	41 (29.3)	13 (20.3)	11 (24.4)	
Divorce or Separated	2 (0.4)	24 (4.1)	22 (15.7)	18 (28.1)	16 (35.6)	
Single	444 (91.7)	491 (84.4)	77 (55.0)	33 (51.6)	18 (40.0)	
Education						<0.01
Less than high school degree	18 (3.7)	22 (3.8)	10 (7.1)	9 (14.1)	6 (13.6)	
High School or GED	152 (31.3)	149 (25.6)	22 (15.6)	25 (39.1)	15 (34.1)	
Some College	188 (38.8)	217 (37.3)	57 (40.4)	18 (28.1)	17 (38.6)	
Bachelor's	115 (23.7)	121 (20.8)	27 (19.2)	6 (9.4)	1 (2.3)	
Post Graduate	12 (2.5)	73 (12.5)	25 (17.7)	6 (9.4)	5 (11.4)	
Employment						<0.01
Full-time	170 (35.2)	308 (54.1)	76 (55.5)	22 (34.9)	9 (20.5)	
Part-time	151 (31.3)	95 (16.7)	17 (12.4)	11 (17.5)	2 (4.6)	
Student	81 (16.8)	37 (6.5)	3 (2.2)	2 (3.2)	1 (2.3)	
Unemployed/Other	81 (16.8)	129 (22.7)	41 (29.9)	28 (44.4)	32 (72.7)	
Income						<0.01
<15K	223 (54.3)	179 (33.7)	40 (30.3)	29 (48.3)	20 (51.3)	
15–30K	76 (18.5)	107 (20.2)	14 (10.6)	8 (13.3)	6 (15.4)	
30–50K	66 (16.1)	154 (29.0)	30 (22.7)	13 (21.7)	7 (18.0)	
>50K	46 (11.2)	91 (17.1)	48 (36.4)	10 (16.7)	6 (15.4)	
Medical insurance						<0.01
None	132 (27.4)	155 (27.1)	21 (15.8)	12 (19.4)	7 (15.9)	
Private	126 (26.2)	100 (17.5)	36 (27.1)	7 (11.3)	6 (13.6)	
Public	148 (30.8)	277 (48.4)	63 (47.4)	41 (66.1)	30 (68.2)	
Other	75 (15.6)	40 (7.0)	13 (9.8)	2 (3.2)	1 (2.3)	

(Continued)

Table 1. (Continued)

Variable	18–24 years (N=487)	25–34 years (N=583)	35–44 years (N=142)	45–54 years (N=64)	55+ years (N=45)	p Value
Indication(s) for PrEP^a						
Shared injection equipment or tattoo/ piercing equipment	19 (3.9)	29 (5.0)	5 (3.5)	5 (7.8)	1 (2.2)	0.52
Casual sex partner(s)	149 (30.6)	165 (28.3)	37 (26.1)	11 (17.2)	10 (22.2)	0.18
Inconsistent condom use	346 (71.1)	422 (72.4)	101 (71.1)	40 (62.5)	18 (40.0)	<0.01
>1 Sex partner	293 (60.2)	326 (55.9)	55 (38.7)	18 (28.1)	10 (22.2)	<0.01
STI(s) in the last 12 months	107 (22.0)	69 (11.8)	13 (9.2)	8 (12.5)	4 (8.9)	<0.01
Transactional sex	8 (1.6)	19 (3.3)	6 (4.2)	5 (7.8)	3 (6.7)	0.02
Perceived Risk of HIV acquisition^b						
Lifetime perceived risk of HIV acquisition (1–5)	1.7 ± 0.7	1.6 ± 0.7	1.7 ± 0.6	1.6 ± 0.8	1.6 ± 0.7	0.70
Perceived risk of HIV acquisition in next 12 months (1–5)	1.4 ± 0.6	1.4 ± 0.6	1.5 ± 0.6	1.3 ± 0.7	1.5 ± 0.7	0.49
PrEP awareness^a						
Heard of people who do not have HIV taking PrEP to reduce the risk of getting HIV	187 (39.9)	245 (43.0)	57 (42.2)	22 (36.1)	15 (36.6)	0.70
Heard about PrEP from Doctor	54 (28.9)	66 (26.9)	14 (24.6)	6 (27.3)	3 (20.0)	0.92
Discussion with a healthcare provider about taking PrEP in the past 12 months	35 (18.8)	58 (23.7)	14 (25.0)	8 (36.4)	5 (33.3)	0.27
Received PrEP or a PrEP prescription in the past 12 months	8 (22.9)	12 (21.7)	8 (57.1)	2 (25.0)	4 (80.0)	<0.01
Global measures^b						
Attitude	4.2 ± 0.9	4.0 ± 1.0	3.9 ± 1.1	4.0 ± 1.0	4.1 ± 1.0	0.03
Using daily PrEP to prevent HIV would make me feel in control of my health	3.8 ± 1.1	3.7 ± 1.2	3.7 ± 1.3	3.7 ± 1.4	3.7 ± 1.4	0.43
PrEP is a safe way to prevent HIV infection	4.1 ± 1.0	4.0 ± 1.0	4.0 ± 1.1	4.0 ± 1.1	4.2 ± 1.2	0.45
PrEP is an effective tool to prevent HIV infection	4.1 ± 1.0	4.0 ± 1.0	4.0 ± 1.0	4.0 ± 1.1	3.9 ± 1.3	0.72
Injunctive norms	4.0 ± 1.1	3.8 ± 1.2	3.9 ± 1.2	3.6 ± 1.5	3.8 ± 1.5	0.07
Descriptive norms	3.3 ± 1.2	3.1 ± 1.3	3.4 ± 1.2	3.3 ± 1.5	3.5 ± 1.4	0.13
People would shame me if they learned that I was taking PrEP	2.0 ± 1.1	2.0 ± 1.1	2.0 ± 1.2	1.8 ± 1.2	2.0 ± 1.2	0.73

(Continued)

Table 1. (Continued)

Variable	18–24 years (N=487)	25–34 years (N=583)	35–44 years (N=142)	45–54 years (N=64)	55+ years (N=45)	p Value
Self-efficacy	4.0 ± 1.1	4.0 ± 1.1	4.0 ± 1.2	3.5 ± 1.6	3.6 ± 1.6	<0.01
If I really wanted to, I could remember to take the pill every day	4.0 ± 1.1	4.0 ± 1.2	4.0 ± 1.2	3.9 ± 1.4	4.1 ± 1.4	0.87
If I really wanted to, I could take the pill every day, even if it gave me a stomach ache	3.0 ± 1.3	3.0 ± 1.4	3.2 ± 1.4	2.9 ± 1.5	3.2 ± 1.6	0.60
I could use PrEP for HIV prevention, even if my main partner didn't want me to	4.2 ± 1.0	4.2 ± 1.1	4.1 ± 1.2	3.9 ± 1.4	4.1 ± 1.3	0.49
I just can't take pills	1.9 ± 1.2	1.9 ± 1.2	2.1 ± 1.4	2.2 ± 1.4	2.0 ± 1.4	0.25

^aCategorical data are presented as n(% of participants n represents within each age group).
^bNumerical data are presented as mean ± SD. Scores range from +1 to +5.
PrEP, Pre-exposure prophylaxis.

among women in older age groups ($p < 0.01$, Table 1).

Although overall attitude toward PrEP was statistically significantly different by age group ($p = 0.03$), there were no significant differences in endorsement of specific beliefs (Table 1). There were also no significant age differences in injunctive or descriptive norms.

Intention to initiate PrEP stratified by age, behavioral and psychosocial factors

The following tables demonstrate the association of PrEP intentions, stratified by age group, with PrEP indication (Table 2), PrEP awareness and risk perceptions (Table 3), attitudes (Table 4), injunctive and descriptive norms (Table 5), and self-efficacy (Table 6).

18–24-year-olds. 18–24-year-olds who reported shared injection, tattoo, or piercing equipment were more likely to signal intention than those who did not ($p = 0.02$; Table 2); there were no associations with other indications for PrEP. Receipt of a prescription for PrEP (or a 1-month supply of PrEP) from a medical provider was associated with intention ($p < 0.01$, Table 3), but intention was not associated with having heard about PrEP from or discussed PrEP with a medical provider alone. Intention was associated with positive attitudes toward PrEP, namely that daily

usage of PrEP ‘is a good thing’ ($p < 0.01$), would ‘make (them) feel in control of (their) health’ ($p < 0.01$), and that ‘PrEP is a safe way to prevent HIV infection’ ($p < 0.01$, Table 4). Perceived support for PrEP from people who are important to them was associated with intention ($p < 0.01$), specifically their doctor ($p = 0.03$), their main sex partner ($p < 0.01$), and their best friend ($p < 0.01$) (Table 5). Additionally, PrEP intention was significantly associated with the belief that people close to them would be likely to use PrEP for HIV prevention ($p < 0.01$, Table 5) as was the belief that they could use PrEP daily for HIV prevention – even if it gave them a stomachache or if their partner did not want them to ($p < 0.01$, Table 6).

25–34-year-olds. 25–34-year-olds who reported shared injection, tattoo or piercing equipment ($p = 0.049$) or multiple sex partners ($p = 0.03$) were also more likely to report intention (Table 2). Both communication with ($p = 0.01$) and discussion of PrEP with ($p < 0.01$) a medical provider and receipt of PrEP or a prescription for PrEP from a medical provider ($p < 0.01$) were associated with intention in this age group. A priori knowledge of PrEP for HIV risk reduction alone was not associated with intention (Table 3). Individuals who endorsed positive attitudes toward PrEP were more likely to report an intention to initiate PrEP in this age group ($p < 0.01$, Table 4). Perceived support for PrEP

Table 2. Comparison of Indication(s) for PrEP by age group.

Variable	Age group (n1, n2)	No-intention	Intention	p Value
Indication(s) for PrEP ^a		n1	n2	
Shared injection equipment or tattoo/piercing equipment	18–24 (n1 = 443, n2 = 44)	14 (3.2)	5 (11.4)	0.02
	25–34 (n1 = 527, n2 = 56)	23 (4.4)	6 (10.7)	0.049
	35–44 (n1 = 123, n2 = 19)	5 (4.1)	0 (0)	>0.99
	45–54 (n1 = 59, n2 = 5)	4 (6.8)	1 (20.0)	0.34
	55+ (n1 = 37, n2 = 8)	0 (0)	1 (12.5)	0.18
Casual sex partner(s)	18–24 (n1 = 443, n2 = 44)	134 (30.2)	15 (34.1)	0.61
	25–34 (n1 = 527, n2 = 56)	143 (27.1)	22 (39.3)	0.06
	35–44 (n1 = 123, n2 = 19)	31 (25.2)	6 (31.6)	0.58
	45–54 (n1 = 59, n2 = 5)	8 (13.6)	3 (60.0)	0.03
	55+ (n1 = 37, n2 = 8)	9 (24.3)	1 (12.5)	0.66
Inconsistent condom use	18–24 (n1 = 443, n2 = 44)	317 (71.6)	29 (65.9)	0.49
	25–34 (n1 = 527, n2 = 56)	379 (71.9)	43 (76.8)	0.53
	35–44 (n1 = 123, n2 = 19)	85 (69.1)	16 (84.2)	0.28
	45–54 (n1 = 59, n2 = 5)	37 (62.7)	3 (60.0)	>0.99
	55+ (n1 = 37, n2 = 8)	14 (37.8)	4 (50.0)	0.69
>1 Sex partner	18–24 (n1 = 443, n2 = 44)	267 (60.3)	26 (59.1)	0.87
	25–34 (n1 = 527, n2 = 56)	287 (54.5)	39 (69.6)	0.03
	35–44 (n1 = 123, n2 = 19)	46 (37.4)	9 (47.4)	0.45
	45–54 (n1 = 59, n2 = 5)	15 (25.4)	3 (60.0)	0.13
	55+ (n1 = 37, n2 = 8)	8 (21.6)	2 (25.0)	>0.99
STI(s) in the last 12 months	18–24 (n1 = 443, n2 = 44)	93 (21.0)	14 (31.8)	0.12
	25–34 (n1 = 527, n2 = 56)	62 (11.8)	7 (12.5)	0.83
	35–44 (n1 = 123, n2 = 19)	7 (5.7)	6 (31.6)	<0.01
	45–54 (n1 = 59, n2 = 5)	7 (11.9)	1 (20.0)	0.50
	55+ (n1 = 37, n2 = 8)	4 (10.8)	0 (0)	>0.99
Transactional sex	18–24 (n1 = 443, n2 = 44)	7 (1.6)	1 (2.3)	0.53
	25–34 (n1 = 527, n2 = 56)	16 (3.0)	3 (5.4)	0.41
	35–44 (n1 = 123, n2 = 19)	4 (3.3)	2 (10.5)	0.18
	45–54 (n1 = 59, n2 = 5)	4 (6.8)	1 (20.0)	0.34
	55+ (n1 = 37, n2 = 8)	1 (2.7)	2 (25.0)	0.08

^aCategorical data are presented as n(% of participants n represents within each age group). The n1, n2 in the second column indicates the number of subjects answering the question without intention and with intention to use PrEP, respectively. PrEP, Pre-exposure prophylaxis.

Table 3. Comparison of perceived risk and awareness by age group.

Variable	Age group (n1, n2)	No-intention	Intention	p Value
		n1	n2	
Perceived risk^a				
Lifetime perceived risk of HIV acquisition (1–5)	18–24 (n1 = 434, n2 = 42)	1.7 ± 0.7	1.6 ± 0.8	0.79
	25–34 (n1 = 507, n2 = 55)	1.6 ± 0.7	1.6 ± 0.5	0.97
	35–44 (n1 = 114, n2 = 18)	1.7 ± 0.6	1.6 ± 0.8	0.77
	45–54 (n1 = 56, n2 = 5)	1.5 ± 0.8	2.2 ± 0.4	0.06
	55+ (n1 = 35, n2 = 7)	1.7 ± 0.7	1.3 ± 0.5	0.20
Perceived risk of HIV acquisition in next 12 months (1–5)	18–24 (n1 = 432, n2 = 42)	1.4 ± 0.6	1.4 ± 0.7	0.88
	25–34 (n1 = 508, n2 = 54)	1.4 ± 0.6	1.3 ± 0.5	0.48
	35–44 (n1 = 115, n2 = 18)	1.5 ± 0.6	1.6 ± 0.6	0.29
	45–54 (n1 = 57, n2 = 5)	1.3 ± 0.7	1.6 ± 0.9	0.39
	55+ (n1 = 33, n2 = 7)	1.5 ± 0.8	1.3 ± 0.5	0.53
Awareness^a				
Heard of people who do not have HIV taking PrEP to reduce the risk of getting HIV	18–24 (n1 = 427, n2 = 42)	170 (39.8)	17 (40.5)	>0.99
	25–34 (n1 = 516, n2 = 54)	224 (43.4)	21 (38.9)	0.57
	35–44 (n1 = 118, n2 = 17)	45 (38.1)	12 (70.6)	0.02
	45–54 (n1 = 57, n2 = 4)	21 (36.8)	1 (25.0)	>0.99
	55+ (n1 = 34, n2 = 7)	13 (38.2)	2 (28.6)	>0.99
Heard about PrEP from Doctor	18–24 (n1 = 170, n2 = 17)	46 (27.1)	8 (47.1)	0.10
	25–34 (n1 = 224, n2 = 21)	55 (24.6)	11 (52.4)	0.01
	35–44 (n1 = 45, n2 = 12)	7 (15.6)	7 (58.3)	<0.01
	45–54 (n1 = 21, n2 = 1)	6 (28.6)	0 (0)	>0.99
	55+ (n1 = 13, n2 = 2)	3 (23.1)	0 (0)	>0.99
Discussion with a healthcare provider about taking PrEP in the past 12 months	18–24 (n1 = 170, n2 = 16)	29 (17.1)	6 (37.5)	0.09
	25–34 (n1 = 224, n2 = 21)	47 (21.0)	11 (52.4)	<0.01
	35–44 (n1 = 44, n2 = 12)	7 (15.9)	7 (58.3)	<0.01
	45–54 (n1 = 21, n2 = 1)	7 (33.3)	1 (100)	0.36
	55+ (n1 = 13, n2 = 2)	3 (23.1)	2 (100)	0.10
Received PrEP or a PrEP prescription in the past 12 months	18–24 (n1 = 29, n2 = 6)	3 (10.3)	5 (83.3)	<0.01
	25–34 (n1 = 47, n2 = 11)	4 (8.5)	8 (72.7)	<0.01
	35–44 (n1 = 7, n2 = 7)	3 (42.9)	5 (71.4)	0.59
	45–54 (n1 = 7, n2 = 1)	2 (28.6)	0 (0)	>0.99
	55+ (n1 = 3, n2 = 2)	2 (66.7)	2 (100)	>0.99

^aCategorical data are presented as n(% of participants n represents within each age group). The n1, n2 in the second column indicates the number of subjects answering the question without intention and with intention to use PrEP, respectively. PrEP, Pre-exposure prophylaxis.

Table 4. Comparison of attitudes towards PrEP by age group.

Variable	Age group (n1, n2)	No-intention n1	Intention n2	p Value
Overall, using PrEP daily to prevent HIV is a good thing	18–24 (n1 = 442, n2 = 44)	4.1 ± 0.9	4.6 ± 0.9	<0.01
	25–34 (n1 = 527, n2 = 56)	4.0 ± 1.0	4.4 ± 1.0	<0.01
	35–44 (n1 = 122, n2 = 19)	3.8 ± 1.0	5.0 ± 0.0	<0.01
	45–54 (n1 = 59, n2 = 5)	3.9 ± 1.0	4.4 ± 0.9	0.31
	55+ (n1 = 37, n2 = 8)	4.0 ± 1.0	4.8 ± 0.7	0.051
Using daily PrEP to prevent HIV would make me feel in control of my health	18–24 (n1 = 435, n2 = 43)	3.8 ± 1.1	4.5 ± 1.0	<0.01
	25–34 (n1 = 526, n2 = 55)	3.7 ± 1.2	4.4 ± 1.0	<0.01
	35–44 (n1 = 121, n2 = 19)	3.5 ± 1.3	4.6 ± 0.9	<0.01
	45–54 (n1 = 59, n2 = 5)	3.7 ± 1.4	3.8 ± 1.3	0.83
	55+ (n1 = 36, n2 = 8)	3.6 ± 1.3	4.1 ± 1.6	0.34
PrEP is a safe way to prevent HIV infection	18–24 (n1 = 438, n2 = 43)	4.1 ± 1.0	4.5 ± 0.9	<0.01
	25–34 (n1 = 525, n2 = 55)	3.9 ± 1.0	4.7 ± 0.8	<0.01
	35–44 (n1 = 121, n2 = 19)	3.9 ± 1.1	4.7 ± 0.7	<0.01
	45–54 (n1 = 58, n2 = 5)	4.0 ± 1.1	3.6 ± 1.1	<0.40
	55+ (n1 = 36, n2 = 8)	4.2 ± 1.0	3.9 ± 1.8	0.61
PrEP is an effective tool to prevent HIV infection	18–24 (n1 = 435, n2 = 43)	4.1 ± 1.0	4.4 ± 1.0	0.07
	25–34 (n1 = 526, n2 = 55)	4.0 ± 1.0	4.6 ± 0.9	<0.01
	35–44 (n1 = 122, n2 = 19)	4.0 ± 1.0	4.3 ± 1.3	0.18
	45–54 (n1 = 58, n2 = 5)	4.1 ± 1.1	3.6 ± 1.1	0.35
	55+ (n1 = 36, n2 = 8)	4.0 ± 1.2	3.5 ± 1.9	0.31

^aNumerical data are presented as mean ± SD. Scores range from +1 to +5. The n1, n2 in the second column indicates the number of subjects answering the question without intention and with intention to use PrEP, respectively. PrEP, Pre-exposure prophylaxis.

from people who are important to them was associated with intention ($p < 0.01$), specifically their doctor ($p < 0.01$), main sex partner ($p < 0.01$), casual sex partner ($p = 0.03$), and best friend ($p < 0.01$), but not their children (Table

5). Additionally, women in this age group who believed that people close to them would take PrEP were more likely to intend to start PrEP ($p < 0.01$), whereas women who feared they would be shamed for taking PrEP were

Table 5. Comparison of norms by age group.

Variable	Age group (n1, n2)	No-intention	Intention	p Value
Injunctive norms				
Perceived sources of support for PrEP use ^a	18–24 (n1 = 442, n2 = 44)	3.9 ± 1.1	4.5 ± 0.9	<0.01
	25–34 (n1 = 526, n2 = 55)	3.8 ± 1.2	4.3 ± 1.0	<0.01
	35–44 (n1 = 121, n2 = 19)	3.8 ± 1.3	4.6 ± 0.7	<0.01
	45–54 (n1 = 59, n2 = 5)	3.5 ± 1.5	4.6 ± 0.9	0.13
	55+ (n1 = 37, n2 = 8)	3.6 ± 1.5	4.4 ± 1.4	0.21
Medical provider	18–24 (n1 = 420, n2 = 43)	6.6 ± 3.9	7.9 ± 3.9	0.03
	25–34 (n1 = 496, n2 = 52)	6.3 ± 4.3	9.1 ± 2.3	<0.01
	35–44 (n1 = 111, n2 = 18)	5.2 ± 4.7	8.3 ± 3.2	<0.01
	45–54 (n1 = 58, n2 = 5)	6.3 ± 5.0	7.8 ± 3.0	0.53
	55+ (n1 = 29, n2 = 8)	6.8 ± 4.8	8.8 ± 2.1	0.11
Main sexual partner	18–24 (n1 = 381, n2 = 35)	5.2 ± 4.6	7.6 ± 4.0	<0.01
	25–34 (n1 = 450, n2 = 52)	4.9 ± 5.0	8.2 ± 3.0	<0.01
	35–44 (n1 = 107, n2 = 19)	3.6 ± 5.5	6.7 ± 4.1	0.02
	45–54 (n1 = 52, n2 = 5)	5.3 ± 5.0	8.2 ± 2.0	0.21
	55+ (n1 = 23, n2 = 8)	5.7 ± 6.2	7.3 ± 4.0	0.50
Casual sexual partner	18–24 (n1 = 264, n2 = 25)	3.7 ± 4.2	5.3 ± 4.6	0.08
	25–34 (n1 = 311, n2 = 39)	4.1 ± 4.4	5.7 ± 4.5	0.03
	35–44 (n1 = 66, n2 = 12)	4.0 ± 4.2	4.7 ± 4.8	0.64
	45–54 (n1 = 27, n2 = 3)	5.0 ± 4.7	8.7 ± 1.2	0.19
	55+ (n1 = 18, n2 = 4)	5.8 ± 4.9	2.5 ± 5.3	0.24
Best friend	18–24 (n1 = 408, n2 = 39)	4.8 ± 4.1	7.1 ± 4.0	<0.01
	25–34 (n1 = 499, n2 = 47)	4.2 ± 4.6	7.1 ± 3.4	<0.01
	35–44 (n1 = 107, n2 = 18)	3.2 ± 4.7	5.8 ± 4.5	0.03
	45–54 (n1 = 52, n2 = 5)	5.1 ± 4.5	5.6 ± 4.3	0.81
	55+ (n1 = 29, n2 = 8)	4.1 ± 5.0	5.8 ± 4.1	0.41
Children	18–24 (n1 = 223, n2 = 26)	4.5 ± 4.8	5.8 ± 4.8	0.18
	25–34 (n1 = 339, n2 = 41)	4.6 ± 5.0	6.0 ± 4.8	0.08

(Continued)

Table 5. (Continued)

Variable	Age group (n1, n2)	No-intention	Intention	p Value
Injunctive norms				
	35–44 (n1 = 90, n2 = 15)	3.2 ± 5.2	7.1 ± 3.9	<0.01
	45–54 (n1 = 52, n2 = 4)	6.0 ± 5.0	3.8 ± 4.8	0.39
	55+ (n1 = 24, n2 = 8)	5.0 ± 5.1	6.6 ± 4.1	0.42
Descriptive norms				
Perceived likelihood of similar peers to use PrEP for HIV prevention in the next 12 months	18–24 (n1 = 441, n2 = 44)	3.2 ± 1.1	4.2 ± 1.1	<0.01
	25–34 (n1 = 527, n2 = 56)	3.1 ± 1.2	4.0 ± 1.2	<0.01
	35–44 (n1 = 121, n2 = 19)	3.2 ± 1.2	4.4 ± 0.8	<0.01
	45–54 (n1 = 59, n2 = 5)	3.3 ± 1.5	3.8 ± 0.8	0.45
	55+ (n1 = 36, n2 = 8)	3.3 ± 1.4	4.1 ± 1.5	0.15
People would shame me if they learned that I was taking PrEP	18–24 (n1 = 439, n2 = 43)	2.0 ± 1.1	1.7 ± 1.0	0.20
	25–34 (n1 = 525, n2 = 55)	2.0 ± 1.1	1.7 ± 1.1	0.04
	35–44 (n1 = 121, n2 = 19)	2.0 ± 1.1	1.9 ± 1.4	0.79
	45–54 (n1 = 59, n2 = 5)	1.9 ± 1.2	1.0 ± 0.0	<0.01
	55+ (n1 = 36, n2 = 8)	2.1 ± 1.2	1.8 ± 1.5	0.46

^aScores range from –10 to +10. Others without notes range from +1 to +5. Categorical data are presented as n(%). Numerical data are presented as mean ± SD. The brackets before age group indicate the rank of person important to the subjects at each age group. The n1, n2 in the second column indicates the number of subjects answering the question without intention and with intention to use PrEP, respectively. PrEP, Pre-exposure prophylaxis.

significantly less likely to intend to do so ($p = 0.04$, Table 5). 25–34-year-olds who believed that they could use (<0.01) and remember to take ($p < 0.01$) oral PrEP daily – even if it gave them a stomachache ($p < 0.01$) or their partner didn't want them to ($p < 0.01$) – were more likely to report intention, whereas those who did not want to take pills were significantly less likely to express intention ($p < 0.03$, Table 6).

35–44-year-olds. The only indication for PrEP that was significantly associated with PrEP intention in this age group was having had an STI in the past year ($p < 0.01$, Table 2). Women who had heard of people taking PrEP to reduce HIV risk ($p = 0.02$), heard about PrEP from their doctor ($p < 0.01$), and discussed PrEP with their

provider ($p < 0.01$) were significantly more likely to intend to initiate PrEP (Table 3), however women who received PrEP or a prescription for PrEP from a provider were not more likely to report intention to initiate. The belief that daily PrEP use is a good thing, makes one feel in control of their health and is a safe way to prevent HIV infection ($p < 0.01$, Table 4) was significantly associated with intention. Those who indicated perceived social support of PrEP use were more likely to report intent to initiate PrEP, specifically from their medical provider ($p < 0.01$), main sexual partner ($p = 0.02$), best friend ($p = 0.03$), and children ($p < 0.01$), but not from a casual sex partner. Additionally, the belief that people close to them would also take PrEP was associated with PrEP intention ($p < 0.01$, Table 5). Finally,

Table 6. Comparison of PrEP self-efficacy by age group.

Variable	Age group (n1, n2)	No-intention	Intention	p Value
Self-efficacy ^a				
If I really wanted to, I could use PrEP daily for HIV prevention	18–24 (n1 = 439, n2 = 43)	4.0 ± 1.1	4.4 ± 0.9	<0.01
	25–34 (n1 = 526, n2 = 55)	4.0 ± 1.1	4.4 ± 1.0	<0.01
	35–44 (n1 = 121, n2 = 19)	3.9 ± 1.2	4.8 ± 0.5	<0.01
	45–54 (n1 = 59, n2 = 5)	3.5 ± 1.6	4.6 ± 0.5	0.11
	55+ (n1 = 36, n2 = 8)	3.5 ± 1.6	4.0 ± 1.4	0.42
If I really wanted to, I could remember to take the pill every day	18–24 (n1 = 439, n2 = 43)	3.9 ± 1.1	4.3 ± 1.1	0.08
	25–34 (n1 = 526, n2 = 55)	4.0 ± 1.2	4.6 ± 1.0	<0.01
	35–44 (n1 = 120, n2 = 19)	3.9 ± 1.2	4.6 ± 0.8	0.02
	45–54 (n1 = 59, n2 = 5)	3.9 ± 1.5	4.4 ± 0.5	0.44
	55+ (n1 = 36, n2 = 8)	4.0 ± 1.4	4.4 ± 1.4	0.53
If I really wanted to, I could take the pill every day, even if it gave me a stomachache	18–24 (n1 = 439, n2 = 43)	2.9 ± 1.3	3.8 ± 1.4	<0.01
	25–34 (n1 = 525, n2 = 55)	2.9 ± 1.4	4.0 ± 1.3	<0.01
	35–44 (n1 = 121, n2 = 18)	3.0 ± 1.4	4.4 ± 1.0	<0.01
	45–54 (n1 = 59, n2 = 5)	2.9 ± 1.5	3.6 ± 1.1	0.31
	55+ (n1 = 36, n2 = 8)	3.0 ± 1.5	3.9 ± 1.8	0.15
I could use PrEP for HIV prevention, even if my main partner didn't want me to	18–24 (n1 = 438, n2 = 43)	4.2 ± 1.0	4.6 ± 0.8	<0.01
	25–34 (n1 = 525, n2 = 55)	4.1 ± 1.2	4.7 ± 0.9	<0.01
	35–44 (n1 = 121, n2 = 19)	4.1 ± 1.2	4.6 ± 1.0	0.053
	45–54 (n1 = 59, n2 = 5)	3.9 ± 1.5	4.4 ± 0.9	0.45
	55+ (n1 = 36, n2 = 8)	4.1 ± 1.2	4.4 ± 1.4	0.52
I just can't take pills	18–24 (n1 = 438, n2 = 43)	1.9 ± 1.2	1.7 ± 1.3	0.27
	25–34 (n1 = 526, n2 = 55)	2.0 ± 1.2	1.6 ± 1.2	0.04
	35–44 (n1 = 121, n2 = 19)	2.1 ± 1.4	1.9 ± 1.4	0.55
	45–54 (n1 = 59, n2 = 5)	2.2 ± 1.4	1.6 ± 0.9	0.36
	55+ (n1 = 36, n2 = 8)	2.1 ± 1.4	1.9 ± 1.5	0.74

^aNumerical data are presented as mean ± SD. Scores range from +1 to +5. The n1, n2 in the second column indicates the number of subjects answering the question without intention and with intention to use PrEP, respectively. PrEP, Pre-exposure prophylaxis.

women in this age group who endorsed that they could use PrEP daily for HIV prevention ($p < 0.01$) – even if it gave them a stomachache ($p < 0.01$) – as well as remember to take the pill every day ($p = 0.02$) were more likely to intend to initiate PrEP. There was no association between beliefs about whether one can take a pill every day, and beliefs about partner support were not significantly associated with intentions for this group. (Table 6).

45–54-year-olds. 45–54-year-olds who reported casual sex partners were more likely to express intention ($p = 0.03$, Table 2). Aside from this, 45–54-year-olds did not show any significant association between indications for PrEP, perceived risk, awareness, or attitudinal factors and intention. Injunctive norms were not significantly associated with intention in this age group; however, women who anticipated experiencing stigma in relation to PrEP were significantly less likely to report intention to start PrEP ($p < 0.01$, Table 5). Self-efficacy measures were not significantly associated with intention amongst 45–54-year-olds.

55+ Age group. Women aged 55 years and older did not show a significant association between any of the variables measured and intention.

Discussion

Overall, we found more similarities than differences in factors influencing intention to initiate PrEP in women by age group. Across age groups, perceived risk of HIV acquisition was low, relative to geographical and behavioral exposure, and was not associated with intention to start PrEP. Furthermore, we did not observe differences in awareness of or attitudes toward PrEP, injunctive norms, descriptive norms, or self-efficacy. There was, however, age-related variation in the way that these factors may shape PrEP intention, which has some important clinical implications for how to increase PrEP uptake in cisgender women at different life stages.

Behavioral exposure and perceived risk

We found a positive association in 18–24-year-olds between using shared injection, tattoo or piercing equipment and intention. 25–34-year-olds showed the same association as well as a positive association between PrEP intention and having multiple sexual partners. 35–44 year-olds

showed a significant association between having had an STI and intention, and 45–54 year-olds instead demonstrated increased intention when reporting a casual sex partner.

Evaluation of how perception of certain risk behaviors differ by age group is especially important given that no age group differences were seen in the analysis of perceived risk and intention. These findings replicate previous research that has demonstrated underestimated self-risk approximation by women who are at high risk for HIV,^{30,31} which is a barrier to PrEP uptake.^{10,15,25} These findings also suggest that different kinds of outreach and communication strategies may be effective for reaching and resonating with women in different age groups. For example, younger women may need reinforcement that casual sex is a risk factor for HIV, whereas older women may benefit from further education surrounding the HIV risk conferred by shared injection, tattoo, or piercing equipment. Such education could be offered in the form of educational videos or other visual aids in clinic waiting rooms. Alternatively, physicians could take a more direct role in education by addressing age-specific indications for PrEP.

Awareness

More similarities than differences could be observed for women's awareness of PrEP and resulting PrEP intention across age groups. Notably, amongst the 18–24-year-old age group, the association between awareness and intention was only significant when the women had received PrEP or a prescription for PrEP from their providers underscoring the importance of medical providers and PrEP counseling by providers in engaging women who could benefit from biomedical HIV prevention in the PrEP cascade.

Attitude and self-efficacy

Similarities predominated across age groups when examining the association between different measures of attitude and self-efficacy and intention. Positive attitudes toward PrEP and self-efficacy were associated with intention in all but women over 45 years old. Additionally, a prior study demonstrated that attitude and self-efficacy were reliable predictors of intention and spoke to a potential additive effect between attitude and self-efficacy in influencing intention.³² Neither

attitude nor self-efficacy was significantly associated with intention in women 45 years and older, which may be due to sample size and lack of variability in response.

Injunctive norms

18–24 year-olds were more likely to find support for intention from their main sexual partner, provider and peers. As women became more mature, they also identified casual sex partners, and ultimately their children, as important factors in decision making surrounding PrEP uptake. 35–44 year-olds likely have older children compared to younger age groups, which could explain why value placed on their children's support of PrEP use is particularly salient in this group. Perceived support for PrEP was not associated with intention in 45–54 year-olds and women 55 and older, which may be due to sample size and lack of variability in response. Previous research has demonstrated the importance of various forms of social support for PrEP uptake among cisgender women,^{19,33} but this is the first time that sources of social support have been evaluated according to relative importance to PrEP intention amongst different age groups. Clinicians may use this knowledge to draw on these support networks as a guide for conversations surrounding PrEP uptake with their patients in different age groups.

Descriptive norms

Our findings present a more nuanced interpretation of prior literature, which suggested that compared to older women, younger women have a stronger assumption that their peers take or would take PrEP which, in turn, increases their likeliness to take PrEP themselves.³⁴ The results support that there is actually no difference in conception of peer use of PrEP by age group; however, belief of peer PrEP use is only significantly associated with intention in women under 45 years old. These findings support that descriptive norms may be more important for younger age groups given the social context that they present in. Thus, it may be important for providers to have discussions with their patients regarding what social norms exist for their patients surrounding PrEP. Johnson *et al.*³⁴ proposed that some social and normative contexts can inhibit, as well as foster, PrEP uptake, so it would be important to be aware of these norms in the context of young

women especially, who seem to show a stronger association between descriptive norms and PrEP intention. Planned next steps include utilization of age-stratified focus groups to gain further insight into the factors influencing PrEP intention. In parallel, we are operationalizing our findings through the development of clinic-wide PrEP trainings and tools to address the barriers identified in this analysis.

Limitations

Women over 45 years old showed few significant associations between psychosocial factors and PrEP intention. Although it is possible that the factors examined are not as important to PrEP intention for women in these two age groups, it is more likely that the interpretation of results is limited by sample size (45–54: $n=64$; 55+: $n=45$). Additionally, we did not include adolescents in this study, as it was a secondary analysis of data from adult PrEP-eligible women, and there may be some age-related differences in the factors shaping adolescent PrEP uptake. The findings of this study would best be generalized to an urban population with similar demographic characteristics.

Lastly, as the data collection was conducted from 2017 to 2020, the data are limited to oral PrEP, as long-acting PrEP methods were not yet approved. Long-acting PrEP methods, such as the bi-monthly Cabotegravir injection, likely obviate some notable barriers, such as pill burden, daily adherence, and side effects such as stomach upset. Many of the barriers of facilitators of PrEP uptake are likely universal to oral and long-acting PrEP. Additional research is indicated to understand the potential impact of long-acting PrEP options on the barriers of stigma and on injunctive and descriptive norms.

Conclusion

There were more similarities than differences in factors influencing PrEP utilization across age groups, but observed differences offer an opportunity to tailor HIV prevention interventions for cisgender women at different ages. Patient education, early prescription of PrEP and integration of patients' social support systems into motivational conversations surrounding PrEP would serve as the main methods of implementing this research

clinically, and we have shown that age has a significant effect on the preferred areas of focus in these interventions.

Declarations

Ethics approval and consent to participate

The experimental protocols were approved by the Institutional Review Board (IRB) of the MedStar Washington Hospital Center (No. 2017-0870 and 2017-25). All research activities complied with all relevant ethical regulations and were performed in accordance with relevant guidelines and regulations of the hospital. Informed consent to use participant demographic and survey data had previously been obtained from all participants prior to participation and an opportunity for refusal to participate in research was guaranteed by an opt-out manner. Informed consent to participate was obtained from participants *via* written consent forms that preceded questionnaires.

Consent for publication

Not applicable.

Author contributions

Jennifer L. Zack: Conceptualization; Formal analysis; Investigation; Writing – original draft; Writing – review & editing.

Shawnika J. Hull: Conceptualization; Data curation; Formal analysis; Investigation; Supervision; Writing – review & editing.

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Patricia Moriarty: Investigation; Methodology; Writing – review & editing.

Rachel K. Scott: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Writing – review & editing.

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Competing interests

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Availability of data and materials

Not applicable.

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Supplemental material

Supplemental material for this article is available online.

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