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**DEMOGRAPHIC FACTORS ASSOCIATED WITH HIV-RELATED
KNOWLEDGE AMONG TRANSGENDER ADULT:
EVIDENCE FROM MALAYSIA**

¹Yong Kang Cheah, ²Anita Suleiman, ³Masliza Ramly, & ⁴Ming Pey Lu
^{1&4}School of Economics, Finance and Banking, Universiti Utara Malaysia, Malaysia
^{2&3}HIV/STI/Hepatitis C Sector, Ministry of Health Malaysia, Malaysia

¹*Corresponding author: yong@uum.edu.my*

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ABSTRACT

The incidence of human immunodeficiency virus (HIV) is a major public health concern. Knowledge is a protective factor for the spread of HIV. However, there remains a lack of research exploring sociodemographic determinants of HIV knowledge among transgender adults. The objective of this study is to examine the influences of demographic factors on HIV-related knowledge based on a dataset of transgender adults. Cross-sectional data derived from the Integrated Biological and Behavioral Surveillance Survey (IBBS) 2017 (n = 888) were utilised. HIV-related knowledge was used as the outcome variable comprising three categories: poor, moderate and high knowledge. The independent impacts of age, income categories, education levels, ethnic groups and employment status on levels of HIV-related knowledge were assessed using ordered probit regression. Findings from this study revealed that a large proportion of transgender adults possessed high knowledge about HIV. Older transgender adults were more probable to possess high knowledge related to HIV compared to younger ones. The likelihood of acquiring poor knowledge surrounding HIV was lower in transgender adults earning incomes of Ringgit Malaysia (RM) ≥ 2000 per month compared to those making less than RM 499. Transgender adults had a higher likelihood of possessing high knowledge about HIV if they attained a tertiary academic qualification. Age, income and education are seen as key contributing factors of HIV-related knowledge in the transgender adult population. Particularly, transgender adults having poor HIV-related knowledge tend to be in younger age groups, be low-income earners and have a low educational background. Intervention measures aimed at safeguarding people from transmitting HIV should therefore pay special attention to transgender people's demographic traits. The suggested policies include use of social apps to disseminate HIV-related information, improving accessibility of educational resources in low-income transgender people, and advertising the risk of HIV in the mass media.

Keywords: Demographic factors, HIV, information, knowledge, transgender adults.

INTRODUCTION

The rapid rise in HIV cases has become more and more alarming. It is viewed as a worrying public health issue throughout the world (Cheah et al., 2024b). Data in 2023 showed that almost 40 million people across the globe were living with HIV, and this figure was accompanied with 1.3 million new cases (UNAIDS, 2024). In terms of death incidence, about 630,000 mortalities were related to HIV, accounting for 42.3 million accumulated cases (UNAIDS, 2024). In Malaysia, approximately 86,471 people in 2022 were infected with HIV, with 3,721 newly detected cases (Ministry of Health, 2024). Considering the economic burden, the Malaysian government allocates approximately RM 90 million to HIV treatment annually (Ministry of Health Malaysia, 2019a).

Transgender people are known as a high-risk population of HIV. An empirical study showed that in 2021, two out of every ten transgender adults were diagnosed with HIV. This clearly exceeded the prevalent figure in the overall population, which was less than 1% (Stutterheim et al., 2021; World Health Organization, 2024). Based on the findings provided by the United Nations, HIV cases in transgender adults were 14 times greater than those in ordinary adults (UNAIDS, 2023). Furthermore, empirical research showed that transgender people had more than 60 times higher chances to be diagnosed with HIV as compared with normal people (Stutterheim et al., 2021). There are numerous factors contributing to the risk of HIV among transgender people. These include healthcare discrimination, the lack of exposure to health-related information and participation in high-risk behaviour (Villines, 2022). Due to discrimination, transgender people are unlikely to consume sufficient amount of health and medical services. Moreover, transgender people are underserved populations; thus, they tend to encounter inadequate access to essential health-related data and information. Because of social exclusion, stigma and economic hardship, transgender adults are likely to engage in risky health behaviours, for example, injection drug use, participation in high-risk sex and being involved in business of sex.

Considering the important role of HIV-related knowledge in safeguarding people from HIV, providing transgender adults with adequate information about HIV is seen as an effective strategy directed towards lowering HIV transmission (Cheah et al., 2024a). In 2022, approximately 6% of transgender adults in Malaysia were infected with HIV (Ministry of Health, 2024). While this number is not as high as the prevalence of HIV worldwide, it should be given serious attention as it is predicted to rise in the future if appropriate preventive plans are not adopted. Transgender people should seek knowledge about HIV. If transgender people possess adequate knowledge surrounding HIV, they will know how to do proper prevention. Enhancing knowledge regarding HIV in transgender population is the focus of policymakers, but little is understood about how demographic factors affect HIV knowledge within this high-risk population. Numerous studies pertaining to HIV-related knowledge primarily concentrated on women at reproductive age and young adults (Dessie, 2020; Najmah et al., 2020; Shamu et al., 2020; Youssef et al., 2021; Yang et al., 2021; Wondimu et al., 2021; Teshale et al., 2022), but none had given consideration to the transgender population. In Malaysia, there are two cross-sectional studies examining demographic factors associated with HIV-related knowledge. One focused on female sex workers (Cheah et al., 2024a), while another one concentrated on male drug users (Cheah et al., 2024b). It appears, therefore, that research surrounding factors determining information on HIV possessed by transgender adults is still lacking. The primary aim of this study is to throw light on the relationships between HIV-related knowledge and demographic characteristics within Malaysian transgender adults. Results from this study can serve as a platform for the formulation of more efficient HIV-related policies and as a guideline for forthcoming research on HIV.

This study attempts to generate two significant contributions to the existing literature. First, this is the first in-depth study to provide empirical findings regarding the influences of demographic variables on knowledge regarding HIV with particular attention on Malaysian transgender adults. Second, past studies often formatted HIV knowledge variable as a binary variable (sufficient vs. insufficient knowledge) and used binary regression to generate results. In this study, we advance the statistical approach using ordered probit to analyse factors determining the probability of having poor, moderate and high HIV-related knowledge. How HIV-related knowledge varies by demographic factors can thus be better understood, and this will be beneficial to allocation of resources and future policy planning.

LITERATURE REVIEW

The associations between demographic factors and HIV-related knowledge were widely examined in past studies across the globe. However, their populations of interest were mostly general adults or women of childbearing age, instead of transgender adults. The variables that were commonly found to be significant included age, income, education, employment status and marital status. Although variables other than demographic factors, such as lifestyle and health variables may affect HIV-related knowledge as well, they were not the variables of interest of the present study. Hence, their effects on HIV-related knowledge were not discussed.

Using cross-sectional data collected in Nigeria, Abiodun et al. (2014) examined HIV-related knowledge among young adults. The authors found age differences in HIV-related knowledge with older adults being more knowledgeable than younger ones. This finding was shared by Shokoohi et al. (2016), who devoted their attention to young people in Iran. Based on a bivariate analysis, the authors found that age was positively associated with knowledge of HIV. The cited reason was that older people were more interested in acquiring health information and had better exposure to HIV-related education compared to their younger counterparts. In Lebanon, Youssef et al. (2021) explored knowledge of HIV among patients who lived with HIV and suffered from AIDS. The authors estimated linear regression and found that age was correlated with increased knowledge score. Other dated studies that focused on China and South Africa also showed a significant relationship between age and HIV knowledge (Lau et al., 2002; Peltzer et al., 2009). Specifically, older individuals had better HIV-related knowledge than younger individuals. However, Tan et al. (2024), focusing on transgender adults in China, found that older individuals had poorer knowledge of HIV than younger individuals. It can therefore be concluded that although findings from the majority of previous studies are in agreement with the health capital theory that age is positively associated with the tendency to gain health knowledge, some have suggested otherwise.

Previous studies consistently found income as a significant explanatory factor of HIV-related knowledge among adults in various countries. Drawing from a survey dataset collected in Uganda, Ankunda and Asiimwe (2017) used logistic regression to provide insight into demographic factors affecting HIV-related knowledge within a dataset of women. The authors observed that higher income recipients were more knowledgeable than their lower income peers because they had better access to health information from various sources. Consistent with this finding, Yang et al. (2021) devoted their attention to women in low- and middle-income countries and found low-income quantiles to be associated with poor knowledge of HIV. In a more recent empirical study, Teshale et al. (2022), using a health survey sample in sub-Saharan Africa and binary regression, also observed that the likelihood of having comprehensive information about HIV was higher among higher income women than those of lower income as they tended to have better educational opportunities. Similar findings were shared

by Tan et al. (2024), who found higher income transgender people to have better knowledge of HIV than those with lower incomes. Surprisingly, the studies by Dessie (2020) and Najmah et al. (2020) showed contradictory findings. The former showed that higher incomes were associated with poorer knowledge of HIV among young adults in Ethiopia, whilst the latter suggested income to be an insignificant contributing factor to HIV-related knowledge in Indonesian women. It appears, therefore, that past findings are usually consistent with the health capital theory that income and health knowledge are positively correlated, despite some have found opposite outcomes.

Education was consistently found to be an important factor affecting knowledge surrounding HIV. Hong et al. (2012) based their study on Kenya, and their population of interest was HIV patients. They found high educational levels to be correlated with high knowledge of HIV. Agyemang et al. (2012) utilised a dataset in Ghana to explore factors associated with knowledge about HIV in the young adult population. Although age was found to be insignificant, education was positively correlated with HIV-related knowledge. Similar findings were shared by Ravi and Kulasekaran (2014), who suggested that higher educated women exhibited higher odds of having comprehensive knowledge of HIV than less educated women in India. Yaya et al. (2016) examined the determinants of knowledge about HIV with a focus on men in Bangladesh. Holding other demographic factors constant, the authors likewise found that education improved HIV-related knowledge. Furthermore, a cross-sectional study, utilising data in Southwest Ethiopia, examined the determining factors of HIV prevention knowledge among adults (Wondimu et al., 2021). The study performed logit analysis and found that adults with tertiary-level education were more probable to acquire adequate knowledge regarding HIV prevention relative to those having no formal education. Using a small sample of transgender adults, Samsul et al. (2016) also found the significant role of education in HIV-related knowledge improvement. Therefore, the health capital theory that education is positively associated with health knowledge is strongly supported by findings from past studies.

Although not a common demographic factor, the association between employment status and depression was considered in previous studies. However, the findings were mixed. On one hand, Najmah et al. (2020) found that employment status was associated with HIV knowledge with employed individuals being more likely to have comprehensive information about HIV than the unemployed. Similar findings were observed by an earlier study (Peltzer et al., 2009). The study found that employed individuals exhibited higher odds of having complete knowledge of HIV compared to those of unemployed in South Africa. On the other hand, finding from the study by Agyemang et al. (2012) suggested otherwise. Using Pearson chi-squared test of independence, the authors found no significant relationship between employment status and HIV knowledge. Likewise, Samsul et al. (2016) found that HIV knowledge did not vary across employment status within the sample of transgender people.

It was noteworthy that marital status was known to have a significant effect on HIV-related knowledge, but it is not important in this study because same-sex marriage is not allowed in Malaysia. The research by Shamu et al. (2020) was one of the cross-sectional studies that took into consideration of the effect of marital status on HIV knowledge. Its findings suggested that being married improved knowledge of HIV among adults in South Africa. In line with these, Mekonnen et al. (2020) observed that married individuals were more probable to possess good knowledge of HIV compared to their single peers. Controlling for other demographic factors, results from Peltzer et al. (2009) likewise showed that being married was positively associated with HIV-related knowledge. Furthermore, Tan et al. (2024) stressed that being divorced was associated with poor knowledge of HIV among transgender adults in China. Surprisingly, however, there was also evidence showing that marital status was not associated with HIV-related knowledge (Ankunda & Asiimwe, 2017; Najmah et al., 2020; Teshale et al., 2022).

The influence of ethnicity on HIV may be imperative but was seldom given consideration by previous studies due to homogeneous nature of population. Nevertheless, there were two studies making efforts to provide insights into the association between ethnicity and HIV-related knowledge among female sex workers and male drug users in Malaysia (Cheah et al., 2024a; Cheah et al., 2024b). Using large data and a strong analytical approach, these studies found that levels of HIV-related knowledge vary by ethnic groups with Malays being more knowledgeable compared to non-Malays. The authors pointed to language barrier explaining their findings. Since the Malay language was the national language in Malaysia and often used to disseminate health-related information, it was unsurprising that Malays knew more about HIV than non-Malays. Another reason provided by the authors was pertaining to cultural and religious factors, but the authors did not look into the effects of these factors in detail. The religious factor was considered by Samsul et al. (2016), but its impact on HIV knowledge among transgender people was insignificant. Collectively, previous findings do not seem to fully lend support to the information seeking theory that the roles of cultural and environmental factors in gaining health knowledge are pivotal.

Theoretical Bases

So far, there appears to be no relevant theory that helps explaining factors determining HIV-related knowledge in transgender people. Nevertheless, information seeking behaviour is used as the underpinning theory of this study (Ahmat & Kamarudin, 2014). Information is seen as a necessity which people actively look for when they engage in learning. However, the behaviours of seeking information are different across individuals because of different environments and learning capabilities. When individuals face uncertainty, they will make attempt to seek for valuable information. Information seeking may take place until individuals obtain the desired amount of knowledge about the unknown matters. When information is being acquired to meet the requirement of knowledge of a certain matter, the process is called information seeking behaviour. This behaviour is seen as a necessity requested by information users, who tend to demand for both formal and informal information sources in an attempt to satisfy their need for knowledge. The result of this behaviour is either successful or unsuccessful information search. Individuals will utilise the information that they have successfully obtained. However, if individuals fail to gain the amount of information that they require, they will reinitiate the information seeking process. Individuals may feel unsatisfied when they could not obtain desirable information. Information seeking behaviour can be influenced by perspectives and thoughts. Hence, cultural and environmental factors play an important role in influencing the decisions of individuals to indulge in information seeking behaviour. In this study, acquiring HIV-related knowledge is considered an information seeking behaviour and is expected to be affected by demographic factors.

Another underpinning theory used in this study is the demand for health capital theory developed by an economist (Grossman, 2000). Since acquiring information about HIV is somewhat like a healthy behaviour that can improve health outcomes or avoid illnesses, the demand for health capital theory is appropriate to this study. According to the Grossman (2000), people can determine their own health, even though health is mainly affected by genetics. People who live a healthy lifestyle and make use of medical care will have a better health outcome than those who do not. Health can be seen as a capital. If individuals invest in it, they will reap returns of investment. People will be more productive and encounter less absenteeism if they are healthy. While healthy behaviour is beneficial to health, not every individual engages in it as it involves costs. This means that not every transgender adult will seek information about HIV, even though it is important. This is simply attributed to the fact that some individuals may have the perception that the costs of seeking information on HIV are greater than its benefits.

Grossman (2000) argues that several demographic factors, such as age, income and education can affect health behaviour. Therefore, in this study, we hypothesise that demographic factors are important determinants of HIV-related knowledge. The justifications provided by Grossman (2000) are numerous. Firstly, older individuals face greater deterioration in health condition than younger individuals; thus, they tend to make more efforts to engage in healthy behaviour and gain health knowledge. Age is therefore anticipated to be positively associated with the amount of HIV-related knowledge. Secondly, since higher income individuals face a higher opportunity cost of being ill compared to their lower income counterparts, they are more devoted to a healthy lifestyle so that their risk of diseases will be minimised. Hence, this study expects a positive relationship between HIV-related knowledge and income. Lastly, people tend to know more about the importance of healthy behaviour if they are better educated because they tend to possess better comprehension skills and exhibit a lower rate of time preference. Given this argument, this study hypothesises that a high education level is associated with good HIV-related knowledge.

METHODOLOGY

The Data

Cross-sectional analysis of secondary data derived from the Integrated Biological and Behavioral Surveillance Survey (IBBS) 2017 were performed (Ministry of Health Malaysia, 2019b). Data of IBBS 2022 were the latest but were not used because they were unavailable for research during this study. Despite IBBS 2017 was carried out by the Ministry of Health Malaysia a long time ago, it was comprehensive and contained detailed data on HIV-related knowledge and demographic profiles in the underserved key populations, including transgender people and sex workers, in Malaysia. However, only the data for transgender people were used in our study. The main aim of IBBS 2017 was to provide significant findings that would be beneficial to anti-HIV policy formulation. The survey began in March 2017, lasting for about three months.

In order to recruit a large number of respondents, respondent driven sampling (RDS) was employed. RDS was deemed suitable as transgender adults were marginalised populations and hard to be located. A link-tracing network with numerous waves was utilised to seek respondents. In each wave, selected respondents were given incentives to invite their peers to participate in the survey. Initially, approximately 3 to 5 participants were identified and interviewed. Next, these participants were asked to kick-start the recruitment process. If the process was ended or showed the sign of slowdown, new batches of respondents had to be recruited. When the desired sample size was obtained, the recruitment procedure was terminated. At the end of the survey, 889 transgender adults were gathered and interviewed. This sample size was considered large enough, especially in light of the fact that transgender adults were not easy to reach.

The Family Health International Guidelines for Repeated Behavioural Surveys in Population at Risk of HIV were used as the guideline for designing the questionnaires. The questionnaires were written in both Malay and English languages. However, interviewers were allowed to use other languages, such as Chinese and Tamil to conduct the interview if the respondents could not comprehend Malay or English. This was to prevent a low response rate. Before the interview was conducted, informed consent from the eligible respondents must be obtained. Those who failed to give their consent could not be involved in the study. National Research Committee of Malaysia approved the survey and provided ethical clearance.

Outcome Variable

The outcome variable used in this study, levels of HIV-related knowledge, was formatted as a limited dependent variable with three outcomes: poor, moderate and high knowledge of HIV. It was formed based on the answers for the five HIV-related questions asked in the questionnaire: i) ‘Would it be possible for an individual to lower his/her risk of HIV by having only one faithful and uninfected sex partner?’ ii) ‘Would it be possible for an individual to reduce his/her risk of HIV by making use of condoms?’ iii) ‘Would it be possible for a healthy-looking person to be infected with HIV?’ iv) ‘Would it be possible for a person to acquire HIV through mosquito bites?’ v) ‘Would it be possible for a person to be infected with HIV by sharing his/her meal with people who have HIV?’ For every correct answer, a value of 1 was assigned, whereas 0 was given to each incorrect answer. Thereby, the highest score of the outcome variable was 5, and the lowest score was 0. Poor, moderate and high knowledge of HIV comprised the values of 0–2, 3–4 and 5, respectively. This categorisation was determined considering the distribution of HIV-related knowledge in the survey. Around 47.2% of respondents scored 5, whilst only 9.5%, 2.8% and 0.3% scored 2, 1 and 0, respectively. Similar operationalisation was adopted by Cheah et al. (2024a), who focused on female sex workers.

Explanatory Variables

Respondents’ demographic characteristics were used as the explanatory variables in this study. Since there was a paucity of empirical studies regarding knowledge pertaining to HIV among transgender people, these variables were selected by referring to the findings from past studies that paid attention to factors determining HIV-related knowledge in a normal population (Yaya et al., 2016; Ankunda & Asiiimwe, 2017; Dessie, 2020; Youssef et al., 2021; Yang et al., 2021; Teshale et al., 2022).

The role of age in HIV-related knowledge was highlighted in numerous studies (Lau et al., 2002; Peltzer et al., 2009; Shokoohi et al., 2016; Youssef et al., 2021). Findings consistently showed that age was positively with knowledge. Therefore, respondents’ age was included in this study and categorised into four ranges: ≤ 29 , 30–39, 40–49 and ≥ 50 years. The relationship between income and HIV-related knowledge was well-evidenced in previous studies across the globe (Ankunda & Asiiimwe, 2017; Yang et al., 2021; Teshale et al., 2022). In particular, higher income indicated better HIV-related knowledge. Considering this finding, the present study took account of respondents’ monthly individual incomes and divided them into five segments: RM ≤ 499 , RM 500–999, RM 1000–1499, RM 1500–1999 and RM ≥ 2000 . In addition to age and income, respondents’ highest academic qualification was included as one of the explanatory variables. It comprised three categories: primary, secondary and tertiary levels. Findings from previous studies consistently showed that education was an important determining factor of HIV-related knowledge with educational levels being positively associated with knowledge about HIV prevention (Hong et al., 2012; Agyemang et al., 2012; Ravi & Kulasekaran, 2014; Yaya et al., 2016; Wondimagegn et al., 2021).

In light of the findings from two recent cross-sectional studies conducted in Malaysia that significant relationships existed between ethnicity and knowledge of HIV among female sex workers and male drug users (Cheah et al., 2024a; Cheah et al., 2024b), respondents’ ethnic backgrounds were taken into account and grouped into four groups: Malay, Chinese, Indian and other ethnicities. In terms of employment status, previous studies suggested that being employed improved knowledge about HIV (Peltzer et al., 2009; Agyemang et al., 2012; Najmah et al., 2020). Hence, to explore the employment status differences in HIV-related knowledge, data for respondents’ employment status were used for analysis. They were obtained from a question: ‘What is your source of income in the past 30 days?’. If the respondents answered ‘student’, ‘unemployed’ or ‘retiree’ to this question, they were categorised as the unemployed.

Statistical Analyses

One participant with incomplete data was removed, leaving a total of 888 respondents being included in the statistical analyses. Before running the regression, descriptive statistics of all the outcome and explanatory variables were calculated. The outcome variable used in this study had ordinal outcomes; thus, ordered probit regression was employed, assuming the current model was normally cumulative distributed (Cameron & Trivedi, 2005). In brief, ordered probit regression can be expressed as:

$$\begin{aligned}\Pr(y_i = 1|x_i) &= \Phi(\tau_1 - \alpha - \beta x_i) \\ \Pr(y_i = 2|x_i) &= \Phi(\tau_2 - \alpha - \beta x_i) - \Phi(\tau_1 - \alpha - \beta x_i) \\ \Pr(y_i = 3|x_i) &= 1 - \Phi(\tau_3 - \alpha - \beta x_i)\end{aligned}$$

where Pr is the probability, y is the outcome variable (1 = poor knowledge; 2 = moderate knowledge; 3 = high knowledge), x is the explanatory variable, Φ is the cumulative distribution function, τ is the threshold, α is the constant, and β is the coefficient.

Considering the central limit theorem (CLT), a normal function was assumed. Since the dataset used in this study comprised a huge sample size, the distribution of means approximated normal distribution (Wooldridge, 2010). The partial effects of explanatory variables were computed and interpreted as percentage point (pp). Therefore, the effects of demographic factors on the probability of having poor, moderate and high knowledge about HIV could be identified. Nevertheless, robust standard errors were estimated in order to generate precise estimates. To ensure that the regression was free from model specification error, a link test introduced by Pregibon (1980) was performed. Additionally, variance inflation factors (VIFs) for all the explanatory variables were estimated with the aim of diagnosing plausible multicollinearity. A p-value of less than 0.05 was considered significant. Stata was used to conduct all the statistical tests (StataCorp, 2019).

RESULT

Descriptive statistics for all the outcome and explanatory variables are presented in Table 1. Approximately 12.6%, 40.2% and 47.2% of all the respondents had poor, moderate and high knowledge, respectively. In the total sample and sample of moderate knowledge, nearly half of respondents were 29 years old or younger (41.7%; 44.8%), followed by respondents with the age of 30–39 (34.9%; 32.5%), 40–49 (14.8%; 15.7%) and ≥ 50 years (8.7%; 7%). The age variations in the samples of poor and high knowledge were, however, dissimilar. More than one-fourth of respondents in the overall (26.6%), moderate (27.2%) and high knowledge samples (27.2%) earned monthly incomes between RM 1000 and RM 1499, whilst only a few earned less than RM 499 (8.8–23.2%). The majority in all the samples attained secondary-level education (63.4–72.3%) and were employed (87.5–95.7%). Only a small proportion of transgender people were Chinese (1.7–3.6%), compared to 54.5–65.8% of Malays.

Table 1

Descriptive Statistics of Outcome and Explanatory Variables (n = 888)

Variables	Total	Knowledge		
		Poor	Moderate	High
Knowledge				
Poor	112 (12.6)	–	–	–
Moderate	357 (40.2)	–	–	–
High	419 (47.2)	–	–	–
Age (years)				
≤29	370 (41.7)	56 (50.0)	160 (44.8)	154 (36.8)
30–39	310 (34.9)	30 (26.8)	116 (32.5)	164 (39.1)
40–49	131 (14.8)	11 (9.8)	56 (15.7)	64 (15.3)
≥50	77 (8.7)	15 (13.4)	25 (7.0)	37 (8.8)
Income (RM)				
≤499	119 (13.4)	26 (23.2)	56 (15.7)	37 (8.8)
500–999	187 (21.1)	33 (29.5)	87 (24.4)	67 (16.0)
1000–1499	236 (26.6)	25 (22.3)	97 (27.2)	114 (27.2)
1500–1999	142 (16.0)	11 (9.8)	41 (11.5)	90 (21.5)
≥2000	204 (23.0)	17 (15.2)	76 (21.3)	111 (26.5)
Education				
Primary	140 (15.8)	32 (28.6)	54 (15.1)	54 (12.9)
Secondary	618 (69.6)	71 (63.4)	258 (72.3)	289 (69.0)
Tertiary	130 (14.6)	9 (8.0)	45 (12.6)	76 (18.1)
Ethnicity				
Malay	559 (63.0)	61 (54.5)	235 (65.8)	263 (62.8)
Chinese	19 (2.1)	4 (3.6)	6 (1.7)	9 (2.2)
Indian	122 (13.7)	20 (17.9)	53 (14.9)	49 (11.7)
Others	188 (21.2)	27 (24.1)	63 (17.7)	98 (23.4)
Employment status				
Employed	835 (94.0)	98 (87.5)	336 (94.1)	401 (95.7)
Unemployed	53 (6.0)	14 (12.5)	21 (5.9)	18 (4.3)

Notes. The entries refer to frequencies. Column percentages in parentheses.

Source. IBBS 2017.

Table 2 presents the results for ordered probit regression. The Wald test was statistically significant, and this indicated that all the demographic variables were equally significant in explaining knowledge surrounding HIV. The model may not exhibit any specification errors because the prediction squared was highly insignificant. Also, multicollinearity did not exist given that all the VIFs fell within the acceptable range of below 10 (Wooldridge, 2010). Compared to individuals aged ≤29 years, those who were in the age groups of 30–39, 40–49 and ≥50 years were 9.9, 10.7 and 11.3 pp more likely to possess high knowledge about HIV, respectively. These people were also 4.8–5.5 pp less probable to possess poor knowledge. The probabilities of acquiring high knowledge about HIV amongst respondents with monthly incomes of RM 1000 or more were greater compared to those earning RM 499 or less, ranging from 14.6 to 25.4 pp. Holding other demographic variables constant, respondents having tertiary-level educational attainments were 9.2 pp less probable and 18.9 pp more probable to possess poor and high knowledge of HIV, respectively, compared to the ones with primary-level educational attainments.

With regard to predicted probabilities, an average transgender adult was about 12.6%, 40.2% and 47.2% likely to have poor, moderate and high knowledge regarding HIV. These percentages were identical to those of the respondents with poor, moderate and high knowledge, demonstrating that the ordered probit regression used in this study had an acceptable prediction.

Table 2

The Effects of Demographic Variables on Levels of HIV-related Knowledge (n = 888)

Variables	Overall	Knowledge		
		Poor	Moderate	High
Age (years)				
≤29	Ref.	Ref.	Ref.	Ref.
30–39	0.250* (0.092)	-0.048* (0.018)	-0.051* (0.019)	0.099* (0.037)
40–49	0.270* (0.119)	-0.052* (0.023)	-0.055* (0.025)	0.107* (0.047)
≥50	0.284* (0.162)	-0.055* (0.031)	-0.059 (0.034)	0.113* (0.063)
Income (RM)				
≤499	Ref.	Ref.	Ref.	Ref.
500–999	0.056 (0.141)	-0.011 (0.027)	-0.012 (0.029)	0.022 (0.056)
1000–1499	0.368* (0.140)	-0.071* (0.027)	-0.075* (0.030)	0.146* (0.056)
1500–1999	0.639* (0.163)	-0.123* (0.031)	-0.130* (0.036)	0.254* (0.065)
≥2000	0.460* (0.149)	-0.089* (0.029)	-0.094* (0.032)	0.183* (0.059)
Education				
Primary	Ref.	Ref.	Ref.	Ref.
Secondary	0.211 (0.116)	-0.041 (0.023)	-0.043 (0.024)	0.084 (0.046)
Tertiary	0.476* (0.155)	-0.092* (0.030)	-0.097 (0.033)	0.189* (0.062)
Ethnicity				
Malay	Ref.	Ref.	Ref.	Ref.
Chinese	-0.098 (0.306)	0.019 (0.059)	0.020 (0.062)	-0.039 (0.122)
Indian	-0.133 (0.118)	0.026 (0.023)	0.027 (0.024)	-0.053 (0.047)
Others	0.171 (0.105)	-0.033 (0.020)	-0.035 (0.022)	0.068 (0.042)
Employment status				
Employed	0.150 (0.186)	-0.029 (0.036)	-0.031 (0.038)	0.060 (0.074)
Unemployed	Ref.	Ref.	Ref.	Ref.
Predicted probabilities	–	0.126	0.402	0.472
Wald test	69.500			
<i>p</i> -value	<0.001			
Prediction squared	0.036			
<i>p</i> -value	0.913			
Maximum VIF	2.870			

Notes. For the overall outcome, the entries refer to estimated coefficients. For poor, moderate and high knowledge outcomes, the entries refer to partial effects. Robust standard errors in parentheses. Ref refers to a reference category. **p* < 0.05.

Source. IBBS 2017.

DISCUSSION

It is clearly evident that transgender adults are often discriminated and encounter high risk for HIV transmission but HIV-related studies that devote their attention to transgender people are lacking. This may be because of data limitation. It cannot be denied that recruiting transgender people as survey respondents is difficult, especially given that they are underserved population. Therefore, gaining an in-depth understanding of how HIV-related knowledge differs across demographic factors is important in the sense that it can provide policymakers and stakeholders with useful information for developing intervention measures. Which cohorts of transgender people are probable or unlikely to possess high, moderate or poor HIV-related knowledge can be better understood. In this study, we attempt to be the first to comprehensively investigate demographic factors affecting HIV-related knowledge with a focus on Malaysian transgender adults. Of all the demographic factors examined in this study, age, income and education were identified as important predictors of HIV-related knowledge.

This study found that age was significantly associated with HIV-related knowledge with older transgender adults knowing more about HIV infection compared to their younger peers. This is perhaps attributed to the fact that older people in general are exposed to more health education and programmes (Shokoohi et al., 2016). Furthermore, since older adults are prone to diseases, they are more concerned about their health. This finding not only supports the health capital theory that age is positively associated with health knowledge, but our hypothesis about age and is also in agreement with previous studies conducted elsewhere (Dessie, 2020; Youssef et al., 2021; Teshale et al., 2022). Drawing from a survey dataset collected in Ethiopia, Dessie (2020) identified a positive association between age and the likelihood of possessing adequate knowledge surrounding HIV. In an empirical study that focused on countries in Africa, Teshale et al. (2022) found older women to be more probable to acquire sufficient information pertaining to HIV transmission when compared with younger ones. Youssef et al. (2021), employing linear regression, likewise revealed that age was positively correlated with the magnitudes of HIV-related knowledge. An essential practical implication of the finding of this study is that the government is advised to take age factor into consideration when formulating preventive measures aimed at encouraging transgender adults to gain knowledge about HIV. Specific concentration should be given to those who fall within the age group of below 30. Using social apps that are often accessed by young adults, such as Facebook, Instagram and Threads to disseminate HIV-related information is worthy of consideration. Since policy evaluation was beyond the scope of this study, future research may want to evaluate the cost-effectiveness of this recommended policy before the implementation.

In this study, income was associated with increased HIV-related knowledge. Compared to transgender adults with incomes of less than RM 500, those earning RM 2000 and above were more probable to possess high knowledge of HIV and less likely to have poor knowledge. This finding lends support to the prior hypothesis and the health capital theory that health knowledge improves with income. We rationalise this finding by the notion that the opportunity to access media and educational services is better among adults with good socioeconomic status than those having a poor economic background (Teshale et al., 2022). Past studies showed similar findings. For instance, Ankunda and Asiimwe (2017) observed women to have a higher likelihood of possessing comprehensive knowledge pertaining to HIV if they were high-income recipients, and Yang et al. (2021) pointed out that being poor was the main barrier to gaining HIV-related knowledge amongst young women. Based on this finding, it is worth policymakers' while to focus more on improving HIV-related knowledge among low-income transgender adults. Additional efforts should be made to monitor those making less than RM 500 per month. Public health authorities have to warrant that this low-income group of population have adequate access to educational resources that can help them seek information pertaining to HIV.

The important role of education in HIV-related knowledge was identified in this study. Specifically, the likelihood of having better HIV-related knowledge was higher among transgender adults with higher educational attainment. The plausible explanation for this outcome is that better educated individuals have better health conscious and access to health-related information than less-educated ones; hence, they tend to understand better the risk of HIV (Teshale et al., 2022). This finding is in line with numerous studies carried out in other countries as well as the health capital theory that education improves health knowledge. The anticipation of this study. As Ravi and Kulasekaran (2014) highlighted, highly educated people in India were more probable to acquire adequate knowledge about HIV than their less educated counterparts. A cross-sectional study in Bangladesh suggested higher educational attainment to be correlated with better HIV-related knowledge (Yaya et al., 2016). Utilising survey data collected in Ethiopia, Wondimu et al. (2021) found that well-educated individuals exhibited higher odds of acquiring comprehensive HIV prevention knowledge relative to those of poor educational backgrounds. In Kenya and Ghana, Hong et al. (2012) and Agyemang et al. (2012) found that high educational attainments were correlated with good knowledge about HIV. In terms of policy implication, forthcoming nationwide public health-related educational programmes regarding HIV prevention should not only concentrate on highly educated people but also those with poor educational backgrounds. These include advertising the fact and figures regarding the risk of HIV as well as providing education about HIV prevention. Additionally, public health administrators have to ensure that all transgender people can easily access HIV-related information via mass media regardless of their education levels. In essence, media plays a key role in providing people with essential information on HIV prevention. The information must be prepared in multiple languages so that individuals of different ethnic groups can easily comprehend.

In contrast to the findings from previous Malaysian studies and the information seeking theory, there were no ethnic or cultural differences in knowledge of HIV (Cheah et al., 2024a; Cheah et al., 2024b). Although HIV is related to casual sex, which is a sensitive issue in Islamic religion, Malays do not seem to have poorer HIV-related knowledge compared to non-Malays. This implies that religion and culture may not be barriers to acquiring HIV information in transgender population. To supplement this conclusion, a future study can consider examining the mediating effects of cultural and religious factors on the associations between ethnicity and HIV-related knowledge when more data are available. Given the finding of this study, it seems crucial for public health authorities to put efforts into using mass media, such as television, radio and newspaper to deliver multilingual messages reminding people of all ethnicities about the risk of HIV and its prevention methods.

Surprisingly, employment status did not play a role in determining HIV prevention knowledge. In other words, there were no variations in HIV-related knowledge between employed and unemployed individuals. This finding contradicts the evidence from the studies by Peltzer et al. (2009) and Najmah et al. (2020), who found employed people to have better HIV-related knowledge than the unemployed. It can, therefore, be concluded that while employed individuals may have exposure to workplace health promotion programmes, they do not necessarily possess more information about HIV than their unemployed counterparts. As such, equal policy attention must be given to those of employed and unemployed. For example, health-related programmes that aimed at providing information on HIV prevention and risk can be more equally reach out to the employed and unemployed segments of the population.

Even though this study offers insightful findings regarding the associations between demographic factors and HIV-related knowledge, it has several shortcomings. Firstly, since respondents were requested to self-declare their knowledge regarding HIV, reporting bias may arise. Secondly, due to

cross-sectional data, the causal relationship between knowledge of HIV and HIV transmission could not be revealed. Thirdly, the data used for this study were collected numerous years ago; thereby, their findings may not represent the latest situation in Malaysia. Lastly, the sample is not nationally representative because it was collected using non-probability sampling. RDS may influence the generalisability of findings from the present study. Nevertheless, use of a robust analytical method and large data to generate novel and accurate findings is the strength of this study. In addition, this study is the first of its kind to examine HIV-related knowledge among transgender adults, which is the population that researchers and stakeholders are interested in. by elites to consolidate power.

CONCLUSION

Although HIV is not as serious as non-communicable diseases, it remains a major public health concern. This study, using a rigorous methodological approach, examined how transgender adults' HIV-related knowledge varied by their demographic traits. Age, education as well as income were found to be significant determining factors of levels of HIV-related knowledge. Specifically, transgender people having poor knowledge regarding HIV were more probable to be younger, be low-income recipients and have a low educational background. There were, however, no associations between knowledge regarding HIV and ethnic backgrounds, and employment status. Findings of this study can guide interventions aimed at reducing the incidence of HIV in the at-risk population in Malaysia. Forthcoming studies can utilise a nationwide panel dataset to explore the causal impact of HIV-related knowledge on HIV transmission.

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