

Gender Barriers to Knowledge Transfer and Exchange Among Vaccine Researchers in Low-, Middle- and High-Income Countries – An International Cross-Sectional Study in 44 Countries

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Research

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Abstract

Background: Globally, women constitute 30% of researchers. Despite an increasing proportion of women in research, they are still less likely to have international collaborations. Literature on barriers to knowledge transfer and exchange (KTE) between men and women, remain limited. This study aimed to elucidate perceived gender barriers to KTE activities in vaccination related research in low, middle- and high-income countries.

Methods: This was a cross-sectional data from a self-administered questionnaire distributed to researchers in the field of vaccination research. Structural factors to KTE were assessed using 12 statements measured with 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). An index ranging from 12 to 60 points was created to assess structural factors to KTE, with higher score indicating higher perceived barriers. Linear regression modelling was applied to examine the association between KTE barriers and gender.

Results: Regardless of gender, researchers experienced challenges with respect to KTE activities, particularly factors related to the availability of human and financial resources, and level of technical expertise among their target audience. We were also able to identify perceived facilitators among men and women, such as the presence of structures that link researchers and target audiences, the investment of target audiences in KTE efforts and the presence of stable contacts among target audience. Our linear regression analysis showed that women have a reduction of 1.069 in their scores in comparison with men ($R^2=0.014$; $B=-1.069$; 95%CI -4.035;1.897).

Conclusions: Men and women shared common perspectives on barriers to KTE. KTE activities could be strengthened by improving structural efforts to reduce gender differences and increase collaborations between researchers and their target audience.

Background

As one of the most cost-effective interventions in global health (1), vaccination has prevented approximately three million deaths annually (2). Despite the benefits in decreasing mortality and reducing costs to healthcare providers and families, inadequate vaccination remains a challenge in low- and middle-income countries (LMIC) (3).

Even though an estimated number of 1.5 million deaths could be prevented through overall improvement of global vaccination coverage, the global burden of vaccine-preventable diseases (VPD) remains high (2). To address these challenges, an advancement in evidence-informed decision by bridging research, policy and practice is warranted (4).

Knowledge Transfer and Exchange (KTE) can be used to link the three pillars of research, policy and practice in which knowledge can be converted into policy through an iterative process (5). Additionally, the process is an exchange of knowledge between research producers and research users (6). KTE related activities can be classified into four models, namely push efforts (7, 8), pull efforts (9, 10), exchange efforts and integrated efforts (7). Push efforts is defined as the efforts of knowledge dissemination where researchers seek policy-relevant research questions (7, 8), while pull efforts is defined as seeking information in order to support decision makers in developing informed choices (9, 10). With respect to exchange and integrated efforts, these are defined as collaboration between various actors and cooperation of different stakeholders to conduct KTE-related activities (7). Context plays a vital role in the effectiveness of KTE processes. For instance, in LMIC, evidence generated at a local level is often ignored due to power imbalances or inadequate data quality (11). Therefore, translation of extensive knowledge into relevant policies remains underutilized (12). The documentation of KTE activities in the field of vaccination research remains limited as well (13–15). This could be due to having integrated KTE activities on the national policy and international initiatives levels to the point that the concept is not visible per se (16), or alternatively that KTE activities have not been carried out due to inadequate structures to support KTE (11).

Structural barriers to KTE activities among health researchers, such as limited access to databases and research findings, financial limitations, limited administrative and infrastructural capacity, and emergence of other priorities within the health system have been identified in previous studies (17–21). However, little has been documented on structural barriers to vaccination related research.

While there are some studies on structural barriers that health researchers face in KTE, literature on structural barriers to KTE between men and women, remain limited as well (22). Women constitute 30% of the world's researchers (23). Despite an increasing proportion of women researchers globally, they are still less likely to collaborate internationally (24). Men publish more research papers on average than women (24). Men are also more represented when it comes to first authorships. For every 1 article with a woman as first author, there are around 1.93 articles first-authored by a man (25).

Methods

This study aimed to elucidate perceived gender barriers to KTE activities in vaccination related research in low, middle- and high-income countries.

Our specific objectives were to (1) compare perceived structural barriers and facilitators to KTE activities among men and women in vaccine-related research; and (2) investigate the association between gender and structural factors to KTE activities in low, middle- and high-income

countries.

This study was based on a cross-sectional data from a self-administered questionnaire distributed to researchers between 28 March and 22 April 2018. The questionnaire was developed and validated by the World Health Organization (WHO) and McMaster University, Canada (26).

Recruitment of participants

Participants were recruited based on identification of vaccination-related articles obtained from PubMed using the search terms “(vaccinate* [MeSH Terms]) OR (immunize* [MeSHTerms])”. The articles were screened for publication between 1 January and 31 December 2017, availability of abstract and unique e-mail addresses, included human subjects, and were written in English language.

Based on these criteria, articles were included if the study population included children (< 18 years) or those in the proximity (e.g. parents, paediatrics, policy/programs targeting children); conducted quantitative or qualitative analysis; and systematic reviews. Additionally, articles were excluded if articles were based on opinions, comments or a case report; did not discuss VPD; did not include human subjects; was not written in English; and if e-mail of corresponding author was not provided.

Authors were invited to participate in the study via the e-mail addresses obtained from the articles identified as relevant to the topic. In order to increase the response rate, reminders were sent on several occasions during a one-month period (once per week during the first two weeks; twice a week during the third week; daily during the fourth week).

During the recruitment process, a total of 717 researchers were identified and invited to participate in the survey. Of these, we included authors who had valid e-mail addresses, provided consent, and conducted research in vaccination-related field. This resulted in a total number of 158 participants (Fig. 1).

Data collection and measures

Structural factors to KTE were assessed using 12 statements measured with 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The statements included:

1.
The cost for translating research on the health topic into action was very low
2.
KTE activities could be paid for through research grants for which I was eligible to apply
3.
Structures and processes existed to link researchers and your target audiences
4.
Personal and organizational contacts among your target audiences were quite stable over time (e.g., low turnover among representatives and/or members of your target audiences)
5.
Perceived crises in the health system drew attention away from research on the health topic
6.
Target audiences lacked the expertise for translating research on the health topic into action
7.
Target audiences had access to technical support for translating research on the health topic into action
8.
Target audiences created opportunities to develop joint research initiatives with them
9.
Target audiences did not make decisions about the health topic on the basis of research
10.
Target audiences invested financial and/or human resources in joint research initiatives
11.
Target audiences created events for knowledge transfer and exchange related to the health topic (e.g., forums that bring researchers and target audiences together for discussion)
12.
Target audiences invested financial and/or human resources in knowledge transfer and exchange activities (e.g., hired staff to identify and make available relevant research).

The survey included gender (men; women), year of birth, country of primary affiliation, education (medical doctor; bachelor's degree; master's degree; doctoral degree), and area of specialization (biomedical research; population and public health; clinical research; other). Based on the

participants' country of primary affiliation, the countries were divided into two income levels based on the country's Gross National Income (GNI) per capita, according to the definition of the World Bank in 2018. Countries were categorized as LMIC if their GNI per capita was below or equal to 12,235 USD, while countries were categorized as high income countries (HIC) if their GNI per capita was above 12,235 USD (27). In addition, age was calculated as the difference between '2018' and 'year of birth'.

Statistical analysis

We tested the 12 statements for internal reliability using Cronbach's alpha. The results showed some inconsistencies between the statements (Cronbach's alpha = 0.504). In order to have consistent measure of the items, the following items were reverse coded: 'Target audience lacked the expertise for translating research on the health topic into action'; 'Target audience did not make decisions about the health topic on the basis of research', increasing the internal consistency of the 12 statements (Cronbach's alpha = 0.71). Further, we created an index with the 12 items, ranging from 12 to 60 points for KTE barriers, in which a lower score indicated more frequent experiences related to structural barriers regarding KTE activities.

To describe the study population, we computed descriptive statistics using Fisher's exact test for the variables 'country of primary affiliation', 'research specialization' and 'educational attainment'. For the variable 'structural factors to KTE', Mann-Whitney test was carried to compare differences among men and women.

Linear regression analysis was applied to test the association between perceived KTE barriers and gender. In our model, the outcome (dependent variable) was continuous variable on KTE score and our independent variable was gender. We also included age and country of primary affiliation as covariates. The variables gender and country of primary affiliation were treated as binary variables. Dummy variables were created and coded as follows male = 0, female = 1, HIC = 0 and LMIC = 1. Age was included as a continuous variable. Results are presented using beta coefficients and 95% confidence intervals (95% CI). We considered alpha $p < 0.05$ statistically significant. All statistical analyses were computed using SPSS statistical software version 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).

Results

Description of participants

In our study, the majority of the study participants were men ($n = 84$; 53.0%), aged 37–47 years (men: $n = 28$; 33%; women: $n = 30$; 40.5%), had their primary affiliation in HIC (men: $n = 61$; 72.6%; women: $n = 63$; 85.1%), had a medical degree (men: $n = 21$; 77.8%; women: $n = 15$; 60.0%), and had their research specialization in population and public health (men: 36.9%; women: $n = 29$ 39.1%). Both gender populations were comparable; no statistically significant differences were observed (Table 1).

Table 1
Descriptive statistics by gender

	Men (N = 84)		Women (N = 74)		Total (N = 158)	p-value
	n	(%)	n	(%)		
Age in years (N = 155)						
26–36	10	(11.9%)	13	(17.6%)	23	
37–47	28	(33.3%)	30	(40.5%)	58	
48–58	26	(31.0%)	20	(27.0%)	46	
59–69	16	(19.0%)	10	(13.5%)	26	
70+	2	(2.4%)	0	(0%)	2	0.44
Country of primary affiliation (N = 158)						
HIC	61	(72.6%)	63	(85.1%)	124	
LMIC	23	(27.4%)	11	(14.9%)	34	0.08
Educational Attainment (N = 52)						
Medical doctor*	21	(77.8%)	15	(60.0%)	36	
Bachelor	5	(18.5%)	5	(20.0%)	10	
Bachelor and Master	1	(3.7%)	2	(8.0%)	3	
Bachelor, Master and Doctorate	0	(0%)	3	(12.0%)	3	0.25
Area of research specialization (N = 81)						
Biomedical research	2	(2.4%)	1	(1.4%)	3	
Clinical research	8	(9.5%)	6	(8.1%)	14	
Population and Public Health **	31	(36.9%)	29	(39.1%)	60	
Other	3	(3.6%)	1	(1.4%)	4	0.71

* includes respondents who are Medical Doctors and hold masters and/or doctorate degrees/

** includes respondents with health policy and systems research as their area of research specialization

Structural factors to KTE

In our study we found structural factors perceived as barriers to KTE among men and women. More than half of men (n = 14; 53.9%) and women (n = 15; 53.6%) did not perceive their target audience to invest human and financial resources in KTE activities or in joint research initiatives (n = 11; 42.3% and n = 17; 60.7%). Another perceived barrier among men (n = 13; 50%) and women (n = 16; 57.2%) was lack of expertise among their target audience to translate research into action. In addition, 34.6% of men (n = 9) and 42.8% of women (n = 12) thought that their target audience lacked access to technical support to translate research into action. High costs for translating research into action was also a common perceived barrier among men (n = 12; 46.2%) and women (n = 14; 50%). Some structural factors were perceived differently according to men and women. While less than a quarter of men (n = 11; 42.3%) perceived that research grants for KTE activities were available, about half of the women

disagreed (n = 14; 50%). Less than half of men (n = 11; 42.3%) perceived crises in the health system as a barrier to KTE whereas, 42.9% of women (n = 12) disagreed (Table 2a).

Table 2
a. Perceived barriers KTE activities according to men and women

Barriers to KTE		Men		Women		p-value
		n	%	n	%	
Target audiences invested financial and/or human resources in knowledge transfer and exchange activities (e.g., hired staff to identify and make available relevant research)	Strongly disagree	4	15.4	5	17.9	0.83
	Disagree	10	38.5	10	35.7	
	Neither agree nor disagree	8	30.8	10	35.7	
	Agree	4	15.4	3	10.7	
Target audiences lacked the expertise for translating research on the health topic into action	Strongly disagree	0	0	1	3.6	0.73
	Disagree	8	30.8	3	10.7	
	Neither agree nor disagree	5	19.2	8	28.6	
	Agree	9	34.6	15	53.6	
	Strongly Agree	4	15.4	1	3.6	
The cost for translating research on the health topic into action was very low	Strongly disagree	6	23.1	6	21.4	0.67
	disagree	6	23.1	8	28.6	
	Neither agree nor disagree	10	38.5	6	21.4	
	Agree	4	15.4	6	21.4	
	Strongly agree	0	0	2	7.1	
Target audiences invested financial and/or human resources in joint research initiatives	Strongly disagree	3	11.5	8	28.6	0.14
	Disagree	8	30.8	9	32.1	
	Neither agree nor disagree	10	38.5	7	25.0	
	Agree	4	15.4	3	10.7	
	Strongly agree	1	3.8	1	3.6	
Target audiences had access to technical support for translating research on the health topic into action	Strongly disagree	2	7.7	3	10.7	0.50
	Disagree	7	26.9	9	32.1	
	Neither agree nor disagree	8	30.8	9	32.1	
	Agree	7	26.9	4	14.3	
	Strongly agree	2	7.7	3	10.7	
KTE activities could be paid for through research grants for which I was eligible to apply	Strongly disagree	1	3.8	5	17.9	
	Disagree	8	30.8	9	32.1	
	Neither agree nor disagree	6	23.1	4	14.3	
	Agree	10	38.5	9	32.1	

	Strongly Agree	1	3.8	1	3.6	0.25
Perceived crises in the health system drew attention away from research on the health topic	Strongly disagree	0	0	4	14.3	
	Disagree	8	30.8	8	28.6	
	Neither agree nor disagree	7	26.9	5	17.9	
	Agree	7	26.9	9	32.1	
	Strongly Agree	4	15.4	2	7.1	0.28
Target audiences created opportunities to develop joint research initiatives with them	Strongly disagree	1	3.8	6	21.4	
	Disagree	6	23.1	6	21.4	
	Neither agree nor disagree	11	42.3	7	25.0	
	Agree	8	30.8	9	32.1	0.35
Target audiences did not make decisions about the health topic on the basis of research	Disagree	9	34.6	4	14.3	
	Neither agree nor disagree	10	38.5	12	42.9	
	Agree	7	26.9	9	32.1	
	Strongly agree	0	0	3	10.7	0.06

We were also able to highlight some structural factors that men and women perceived as facilitators to KTE. About half of the men (n = 13; 50%) and women (n = 18; 64.2%) perceived the presence of stable contacts among their target audience as a facilitator to KTE. The presence of structures linking researchers to target audiences was also perceived as a facilitator among men (n = 12; 46.1%) and women (n = 12; 42.9%). The engagement of target audiences in KTE activities was perceived by some (n = 12; 46.1%) and women (n = 11; 39.3%) as a facilitator (Table 2b.).

Table 2
b. Perceived facilitators to KTE activities among men and women

Facilitators to KTE		Men		Women		p-value
		n	%	n	%	
Target audiences created events for knowledge transfer and exchange related to the health topic (e.g., forums that bring researchers and target audiences together for discussion)	Strongly disagree	2	7.7	5	17.9	0.38
	Disagree	4	15.4	5	17.9	
	Neither agree nor disagree	8	30.8	7	25.0	
	Agree	11	42.3	10	35.7	
	Strongly agree	1	3.8	1	3.6	
Structures and processes existed to link researchers and your target audiences	Strongly disagree	2	7.7	1	3.6	0.98
	Disagree	7	26.9	8	28.6	
	Neither agree nor disagree	5	19.2	7	25.0	
	Agree	11	42.3	11	39.3	
	Strongly agree	1	3.8	1	3.6	
Personal and organizational contacts among your target audiences were quite stable over time (e.g., low turnover among representatives and/or members of your target audiences)	Strongly disagree	1	3.8	1	3.6	0.51
	Disagree	3	11.5	4	14.3	
	Neither agree nor disagree	9	34.6	5	17.9	
	Agree	11	42.3	16	57.1	
	Strongly Agree	2	7.7	2	7.1	

Index on KTE structural Factors

The mean score of the variable structural factors to KTE was highest among men affiliated with HIC (33.94; min:23-max:42), and lowest among women affiliated with LMIC (33.0; min:30- max:35). In our sample, women affiliated with HIC (32.88; min:21- max:42) scored higher than women affiliated with LMIC but lower than men affiliated with LMIC (33.78; min:27- max:40). There were no statistically significant differences among the mean scores calculated ($p = 0.09$) (Fig. 2).

Association between perceived structural barriers for KTE activities and gender

A multivariable linear regression analysis was done to test if gender significantly predicted scoring. The results indicated that women have a reduction of 1.069 in their scores as compared to men ($R^2 = 0.014$; $B = -1.069$; $95\%CI = (-4.03; 1.89)$) but the difference was not statistically significant (Table 3).

Table 3
Linear Regression Analysis for score on KTE structural factors

	Unstandardized Coefficients		t	p-value	95% Confidence Interval for B	
	B	Std. Error				
(Constant)	32.735	3.332	9.823	.000	26.038	39.431
Age	.023	.061	.382	.704	-.099	.146
Gender	-1.069	1.476	-.724	.472	-4.035	1.897
Country of affiliation	.061	1.717	.035	.972	-3.391	3.512

Discussion

This study aimed to compare and investigate the association between perceptions of men and women to structural barriers and facilitators to KTE activities. We were not able to identify significant differences in the distribution of respondent characteristics.

The mean scoring of men and women shows that researchers regardless of gender and country of affiliation experience some challenges when it comes to KTE activities. Men and women perceived factors related to availability of human and financial resources as well as level of technical expertise among target audience as barriers. We were able to identify perceived facilitators among men and women, such as the presence of structures linking researchers and target audiences, the investment of target audiences in KTE efforts and the presence of stable contacts among target audience. To some extent these findings are in-line with studies conducted in other settings (28–30).

When we ran our linear regression model, we could see a relation, despite not being significant, between gender and a reduction in score. While we were not able to identify specific studies tackling gender barriers and KTE, it may be explained through the literature exploring challenges that women face in academia (23, 24, 31). A previous study indicated that men faculty members were able to positively engage in research and obtain funding while women found it harder to balance between undergraduate education and research efforts (32). Women not only publish less than men, they also still face challenges to get to decision making positions. Despite having more women in mid-management positions, men still dominate executive positions and full professor positions globally (24). This can be clearly seen in the field of health, where women still represent lower cadres of health workers despite being about 75% of the global health workforce (24).

In our study, papers on barriers to KTE, that have been conducted in different settings, were available (28–30, 33, 34). However, we were not able to find studies tackling barriers to KTE in vaccination and gender. To our knowledge, our study presents a novel idea in the field of KTE and vaccination. It investigates KTE from the perspective of the research community, drawing comparisons between genders. It also contributes to the growing research on KTE in vaccination, which may still be considered as limited. Our study may also serve as a foundation to future research as it encompasses a global scope.

We can identify some limitations in our study as well. Respondent withdrawal and missing data were observed in many sections across the questionnaire. Despite having 158 respondents in total, 65.8% did not respond to questions related to structural factors. We reason the lengthy questionnaire to be a contributing factor to this. Another limitation in our study may be attributed to our selection process. The study excluded researchers who did not speak English and/or published in grey literature due to our questionnaire administration criteria. The questionnaire also included only 2 options for the variable gender. While we did not have missing data for this variable, it may have been more convenient to not limit gender identities to man and woman only.

Conclusion

This study was not able to highlight statistically significant differences between men and women when it comes to vaccine related KTE. Men and women shared common perspectives on barriers to KTE. The findings of this study show that more efforts on a structural level need to be carried out to strengthen KTE activities. Based on the results, it is important to invest in financial and human resources in KTE activities. These efforts should not be the sole responsibility of researchers. The target audience and decision makers need to be more engaged in strengthening the implementation of KTE activities. Future research may examine the barriers and facilitators to KTE at an organization level.

List Of Abbreviations

KTE Knowledge Transfer and Exchange

LMIC Low, and -Middle, Income Countries

VPD Vaccine-preventable Diseases

WHO World Health Organization

GNI Gross National Income

HIC High Income Countries

CI Confidence Interval

Declarations

Ethics approval and consent to participate

For this study we received approval from the Stockholm regional ethics committee (Etikprövningsnämnden), Sweden (ID#: 2018/219-31).

Consent for publication

Informed consent was sought from all participants before they could fill in the survey. Respondents who did not fill in the informed consent were not included in the analysis.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

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Authors' contributions

RM, ZEK and BF conceived the study; RM conducted data collection with support from SEH; SEH and DE conducted the data analysis; SEH wrote the first draft of the manuscript; all authors contributed to the revision and writing of the manuscript; ZEK and BF supervised the project.

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Not applicable

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Figures

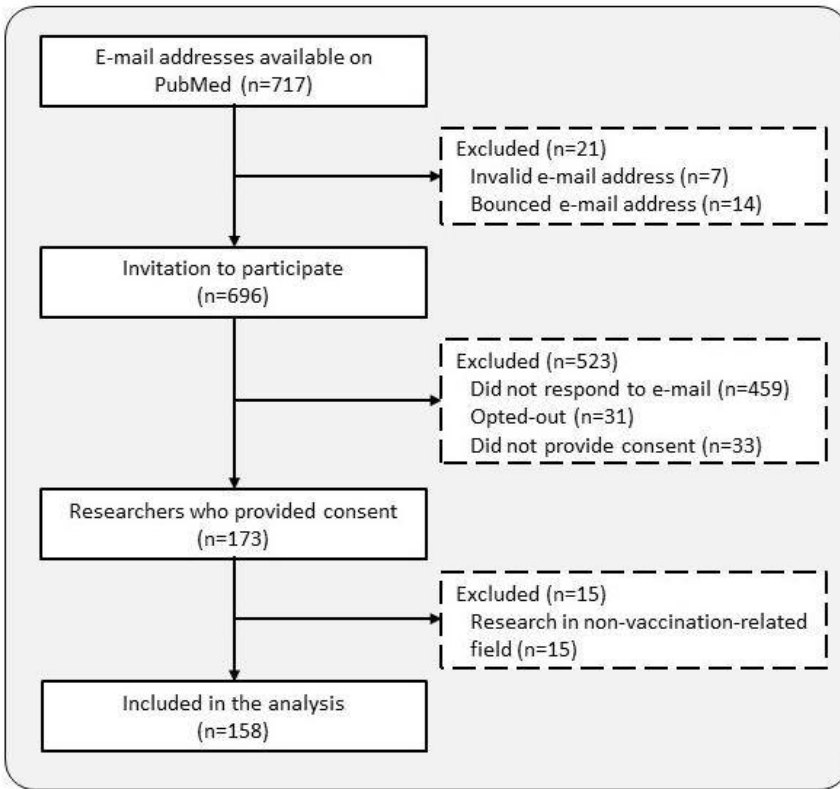


Figure 1

Schematic overview of recruitment of participants

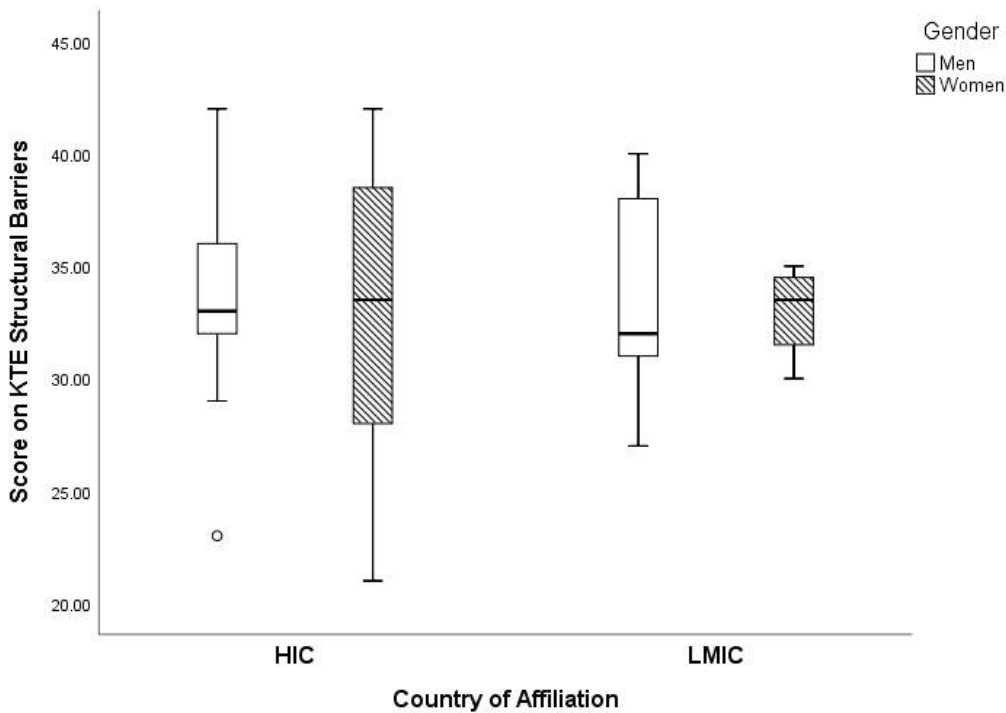


Figure 2

Score on KTE structural factors among men and women in HIC and LMIC