Network Structure Characterization of Meeting Sex Partners by Men Who Have Sex with Men by Using Social Network Analysis

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Abstract

Background: Men who have sex with men (MSMs) comprise a worldwide community most affected by HIV and may provide a bridge between several at-risk groups. Identifying the sexual network structure is key to uncovering patterns of potential risk involving people carrying an infectious agent such as HIV. The objective of this study was to determine the networking structure of meeting sex partners among MSMs in Chiang Mai and its influence on HIV spread. **Methods:** We performed a demographic and behavioral assessment among 194 MSMs who aged ≥ 18 and underwent voluntary counseling and testing at an MPlus foundation mobile facility during February 2020 to December 2020. An affiliation network graph was generated to visualize connectedness of MSMs and identify online meeting places that linked participants. **Results:** The majority were students, the median age was 21 years (IQR = 19 to 25) and less than half always used condoms (46.4%). 194 MSMs provided information on ≥1 sex partner meeting place, 17 venues were reported; three venues were strongly influenced for network meeting partners (Line, Facebook, and Twitter). Blued was a component hookup application with a major influence on the network (centralization degree = 94). MSMs who always use condoms had been intimate with only one partner in the past three months and their HIV knowledge was fair whereas MSMs who sometimes used condom were more likely to engage in sexual activity with 2–5 concurrent partners and had low HIV knowledge. **Conclusions:** The majority of Chiang Mai MSMs use social networks to seek sex partners and are likely to engage in unsafe sex. Blued and Tinder are the two core online sites/apps most used to connect with other MSMs. Understanding the pattern of how MSMs meet sex partners is important for identifying risk behavior and prioritizing HIV testing, care, and prevention.

Keywords: MSM, Social Network Analysis, HIV

1. **Introduction**

Men who have sex with men (MSMs) comprise a worldwide community most affected by HIV and are approximately 27 times more at risk of contracting HIV than the general population [1]. MSM contact accounted for 69% of the 38,000 new HIV infections in the US in 2018 and 57% in Western Europe and North America in 2017 [2]. Likewise, the HIV transmission rate in the Thai MSM community is disproportionate (41%). 12.1% of young Thai MSMs aged 15–24 years old are living with HIV and the prevalence of the disease in Thailand's major cities (Bangkok, Chiang Mai, and Phuket) is worrisome [3]. To reduce the rate of HIV transmission in the community, testing as many MSMs as possible and offering education, care, and treatment is paramount [4].

Several factors contribute to an increased risk of HIV transmission and acquisition among MSMs, such as versatile sexual positioning, condomless anal intercourse, having multiple concurrent sexual partners, engaging in casual or one-night stands, and limited access to prevention and care services [5]. Interestingly, overlapping social and sexual networks are also associated with a higher rate of HIV transmission among MSMs and may provide a bridge between several at-risk groups and the general population [6]. Identifying the key sexual networks involving one person with another and subsequently, the community with others in the community is key to uncovering patterns of potential risk involving people carrying an infectious agent such as HIV [6, 10, 11, 12]

When evaluating the network structure (e.g., density, centrality) of sex-partner meeting venues reported by newly diagnosed HIV-infected MSMs in Baltimore City, Maryland, Brantley et al. [7] found that 26 venues in the network reported at least one HIV case linked to four venues where MSMs had been newly diagnosed with HIV. In addition, Young et al. [8] performed a study of the relationship between online social networking and sexual risk behaviours among MSMs; they found that the number of sexual partners who meet via online social networking was associated with exchanging sex for food, drugs, or a place to stay; and the frequency of engaging in oral sex within the past 3 months. Hence, understanding the relationship between social networking and sexual risk behaviours among MSMs could lead to new strategies for HIV prevention and treatment intervention.

The aim of the present study is to determine the networking structure of meeting sex partners among MSMs in Chiang Mai and its influence on HIV spread and prevalence by using social networking analysis to help lower the risk of HIV infection in this community and improve HIV knowledge, prevention, and care services.

2. **Research Methodology**

2.1   Study population

To identify the network structure of sex-partner meeting places by the MSM community, we conducted a cross-sectional study of MSMs who underwent voluntary counseling and testing (VCT) at an MPlus foundation mobile facility from February 2020 to December 2020. This

information was re-validated before being compiled and used for statistical analysis. Ethical approval was obtained from the Research Ethics Committee, Faculty of Medicine, Chiang Mai University.

2.2   Data collection

The characteristic variables included in this study were age, education, occupation, sex-partner meeting places, number of sex partners, use of condoms, perception of pre-exposure prophylaxis (PrEP), and HIV knowledge. The subjects from the core of Chiang Mai's LGBTQ civil society were engaged through activities of exhibition booth in general and university, and sports competitions and interviewed using instruments that we developed. We also focused on the social networking places that they might have been to, such as nightclubs, pubs, restaurants, etc.

2.3   Sample size

The sample size was calculated based on the formula developed by Punnee,2011 [9] to determine the minimum number of participants for the study using the following parameters settings: $\alpha = 0.05$, power $= 0.80$, and effect size $= 0.2$, which were calculated according to Brantley [7]. Thus, at least 194 participants were required for this study.

2.4   Statistical analyses

All of the continuous variable values are reported as medians and interquartile ranges (IQRs), and the categorical variable values are reported as numbers and percentages. For the social networking analysis of the MSMs, we separated their activities into two distinct characteristics: online applications to meet sex partners and reported sex-partner meeting places. An affiliation network graph was generated to visualize the extent to which MSMs were connected with each online application/meeting place. Multiple correspondence analysis (MCA) was used to evaluate the relationships between all variables. All analyses were performed using the STATA program and SPSS

3.   Results

The study was conducted between February 2020 to December 2020 by the MPlus foundation, the core of Chiang Mai's LGBTQ civil society. A total of 194 MSMs who had willingly attended activities arranged by the MPlus foundation were the participants in the study. Their median age was 21 years old (Interquartile range (IQR): 19 – 25 years), 171 (88.1%) held a bachelor's degree, and the majority were students (Table 1). More than three-quarters of the participants (87.1%) reported having 1–3 concurrent sex partners in the last 3 months and less than half always used condoms (46.4%). A total of 122 MSMs reported knowing about PrEP and 102 (52.6%) had previous experience of using PrEP. MSMs reported meeting their partners most

frequently online through Line, Facebook, and Twitter (60.3%, 57.7%, and 51.0%, respectively), although only 68 of them (35.1%) had the intention of using online sites/applications to make new friends. Of these participants, the knowledge of HIV level was low (52.1%) (Table 1).

The two-mode affiliation network of MSMs who met their partners through apps/online websites is illustrated in Figure 1. Each line represents a connection between a participant and a venue or online platform used to meet their sex partners. Seventeen affiliations were evident among the 194 participants. The top three sexual affiliation network venues were Line, Facebook, and Twitter; the network centralization degrees of these three were extremely high (117, 112, and 99, respectively), indicating that they strongly influenced the network (Figure 1). Blued is a component hookup application with a major influence on the network (centralization degree = 94) (Figure 2). In addition, Bar9 is the place where most of the MSMs go to meet their sex partners (centralization degree = 32) (Figure 3).

A two-dimensional MCA solution was considered the most adequate in this study. Discriminate measures for age, number of sex partners, and HIV knowledge scores are reported in Table 3, with the highest values of 0.605 and 0.579 (both for age) for the first and second dimensions, respectively. The joint plot of age, number of sex partners, and HIV knowledge scores indicates that MSMs aged 35–44 years old had good HIV knowledge and over three times more sex partners (> 10 persons in the last 3 months) compared to MSMs aged under 35 years old with 2–3 sex partners in the last 3 months and a lower level of HIV knowledge. Table 4 reports the discriminate measures for condom use, the number of sex partners, and HIV knowledge scores; the highest value was for the number of sex partners in dimensions 1 and 2 (0.572, and 0.529, respectively). In the graphical visualization of condom use, the number of sex partners, and HIV knowledge scores (Figure 5), MSMs who always use condoms had been intimate with one partner in the past three months and their HIV knowledge was fair whereas MSMs who sometimes used condom were more likely to engage in sexual activity with 2–5 concurrent partners and had low HIV knowledge.

4.   Discussion and Conclusion

A cross-sectional study of MSMs who were HIV negative was conducted to evaluate the network structure for meeting sex partners at venues and to analyse the relationships between associated factors of acquiring HIV was conducted at a stand-alone center and mobile care units of the MPlus foundation in Chiang Mai, Thailand. We applied a novel methodology, namely social network analysis. The findings show that Line is a central component of the affiliation network connecting MSM individuals. The majority of the study population comprised students aged 21 years (IQR = 19–25 years). Furthermore, 169 (87.1%) MSMs reported having 1-3 concurrent sex partners in the last three months, with only half of them always using a condom (46.4%). Our results show individual-level risk behaviour depends on age and HIV knowledge level: MSMs aged 35–44 years old had a better understanding of HIV even though they tended to engage with multiple concurrent sexual partners, while those who regularly use condoms only engaged with one sex partner at a time.

Specific online hookup sites/ applications such as Blued, Tinder, etc. were found to be the main component in the affiliation network for seeking a boyfriend, a friend with benefits, or one-night stands. The use of these websites/geosocial networking mobile apps might increase the risk of infection by HIV and other sexually transmitted infections (STIs) among MSMs [6]. These individuals were up to seven times more likely than non-MSMs to have sex with a partner they met online [6], which is consistent with our findings that the majority of MSMs (n = 142) were linked with up to 13 hookup sites/apps in the affiliation network. The centrality metrics indicate that young MSMs meet sex partners within a tight network, with two core hookup sites (Blued and Tinder) accounting for the majority of connections among the MSMs. Similar to network analysis of STIs and online hookup sites among MSMs on Rhode Island, 78% reported meeting a partner online in the last 12 months while the most commonly used hookup sites included Grindr (78%), Scruff (35%), and Tinder (22%) [6]. Hence, identifying venues most centrally connected within a sexual network may help to identify MSMs most at risk of contracting HIV.

The results from several studies demonstrate that MSMs who on social networking sites are more likely to engage in high-risk behaviour than seek sex MSMs who do not [6, 11, 12, 13]. For instance, the results of a study in the US indicate that MSMs who meet others via geosocial networking phone (GSN) apps are at greater risk of contracting STIs such as gonorrhea and chlamydia. Thus, engaging in risky behaviours such as unsafe sex, multiple concurrent sex partners, and a low HIV knowledge is more likely to lead to contracting HIV or other STIs [11]. This is consistent with our findings from the MCA of the association between risk behaviours of MSMs in Chiang Mai. We found relationships between age and risk factors such as HIV knowledge, the number of concurrent sex partners, and condom use. Indeed, younger MSMs engage with more concurrent sex partners, do not always use condoms, and their HIV knowledge is poor, thereby placing them at a higher risk of contracting HIV. A better understanding of the demographics and behaviours of MSMs who meet partners on these sites can facilitate the development and targeting of effective public health promotion messages [6].

This study had some limitations. First, the sample size was small and data collection was hampered by the ongoing COVID-19 pandemic. Thus, some venues could have been missed, which might have affected the analysis. Second, more associated factors are needed for a more thorough exploration of risk behaviours. Last, our study only recruited MSMs who were HIV negative, thus it could be useful to include HIV positive participants to help identify HIV transmission affiliation networks.

Our results emphasize that the majority of Chiang Mai MSMs use social networks to seek sex partners and are likely to engage in unsafe sex. Blued and Tinder are the two core online sites/apps most used to connect with other MSMs. Understanding the pattern of how MSMs meet sex partners is important for identifying risk behaviour and prioritizing HIV testing, care, and prevention.

5.   References

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Tables

Table 1 Characteristics of MSMs in Chiang Mai, Thailand, from February 2020 to December 2020 (*n* = 194).

Characteristics	N	%
Demographic characteristics		
Age in years		
Median (IQR)	21	(19, 25)
Education		
Lower than a bachelor's degree	8	4.13
Bachelor's degree	171	88.14
Higher than a bachelor's degree	15	7.73
Current occupation		
Student	127	65.46
Employee	61	31.45
Others	6	3.09
Venues for meeting sex partners		
Social networks and online applications		
Line	117	60.31
Facebook	112	57.73
Twitter	99	51.03
Blued	94	48.45
Tinder	80	41.24
Instagram	79	40.72
Hornet	34	17.53
Grindr	31	15.98
Jack'd	22	11.34
Beetalk	18	9.28
Skout	8	4.12
Growlr	8	4.12

Characteristics	N	%
Guyspy	5	2.58
Planetromeo	3	1.55
Omi	2	1.03
Boyahoy	1	0.52
Intention of finding a sex partner		
Looking for a new friend	68	35.05
Looking for a boyfriend	60	30.93
Looking for a friend with benefits	52	26.80
Selling/ buying sex	14	7.22
Sexual behaviours		
Number of sex partners in the last 3 months		
1–3	169	87.12
> 3	25	12.88
Condom use		
Always	90	46.39
Sometimes/never	104	53.61
PrEP		
Knowledge		
No	72	37.11
Yes	122	62.89
Ever used		
No	92	47.42
Yes	102	52.58
HIV knowledge		
Low	85	43.81
Middle to high	109	56.19

Table 2 Discrimination measures: age, number of sex partners, and HIV score.

	Dimension		Mean
	1	2	
HIV score	0.579	0.360	0.469
Age	0.605	0.461	0.533
Number of sex partners	0.416	0.445	0.430
Active total	1.600	1.265	1.432
Variance %	53.324	42.174	47.749

Table 3 Discrimination measures of condom use, number of sex partners, and HIV score.

	Dimension		Mean
	1	2	
Number of sex partners	0.572	0.529	0.550
Condom use	0.533	0.377	0.455
HIV score	0.327	0.355	0.341
Active total	1.431	1.262	1.347
Variance %	47.708	42.059	44.883

Figures
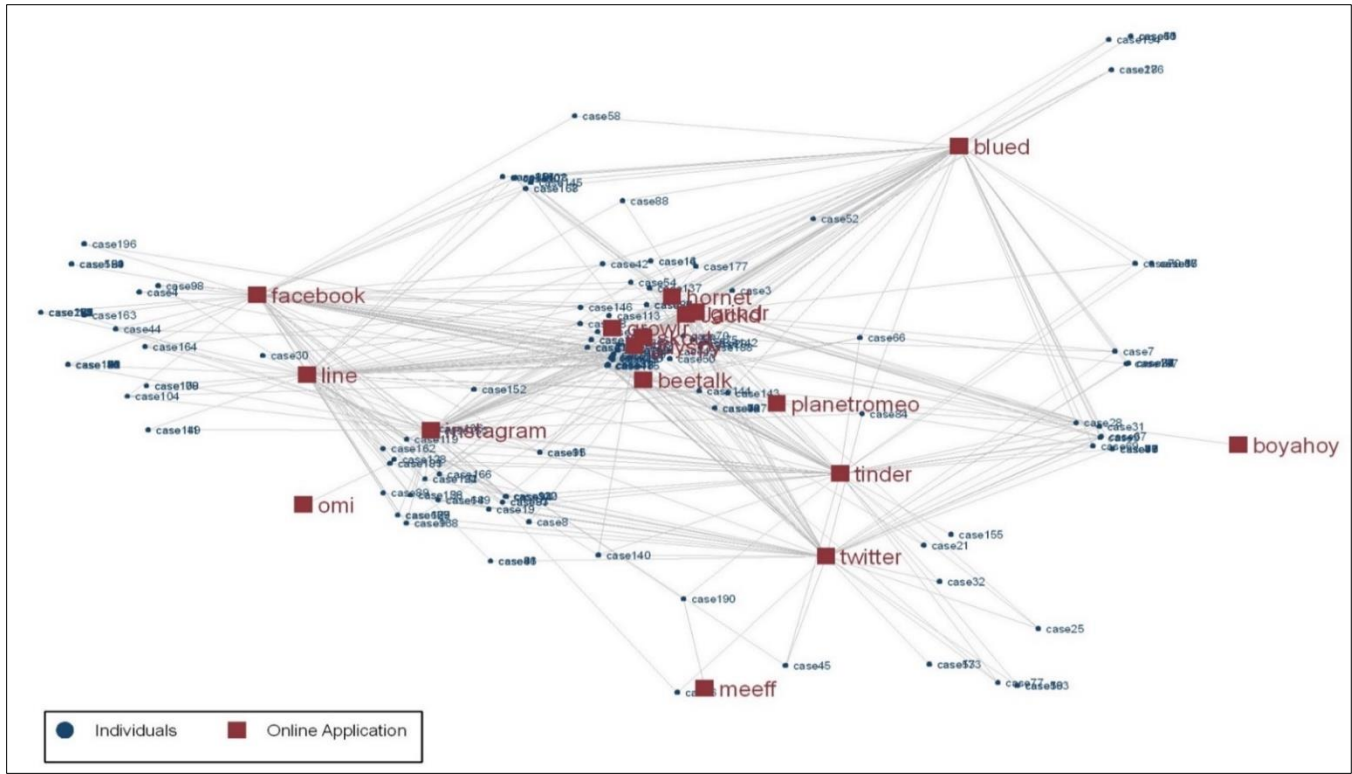
Figure. 1. The affiliation network of MSMs meeting sex partners through online websites from February 2020 to December 2020 in Chiang Mai, Thailand.
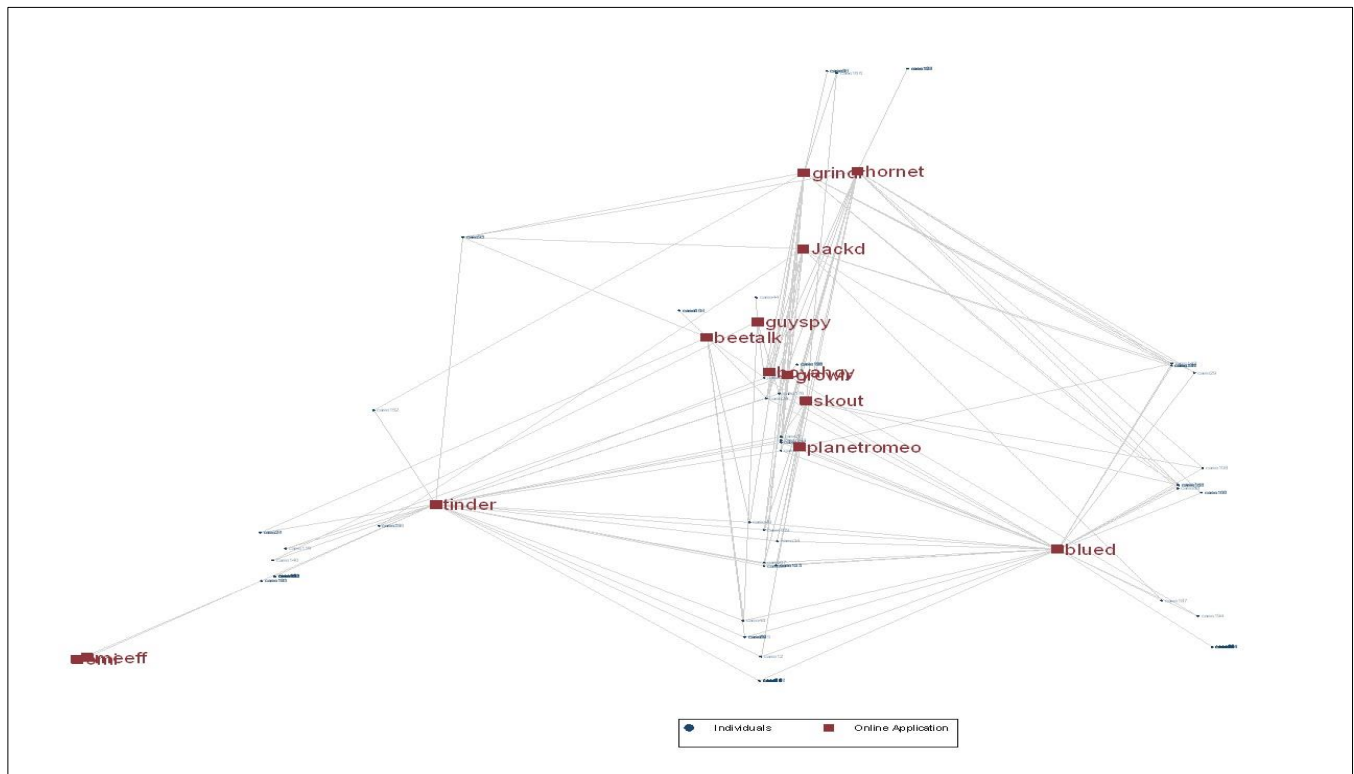
Figure 2. The affiliation network of MSMs and sex partners meeting via hookup applications from February 2020 to December 2020 in Chiang Mai, Thailand.
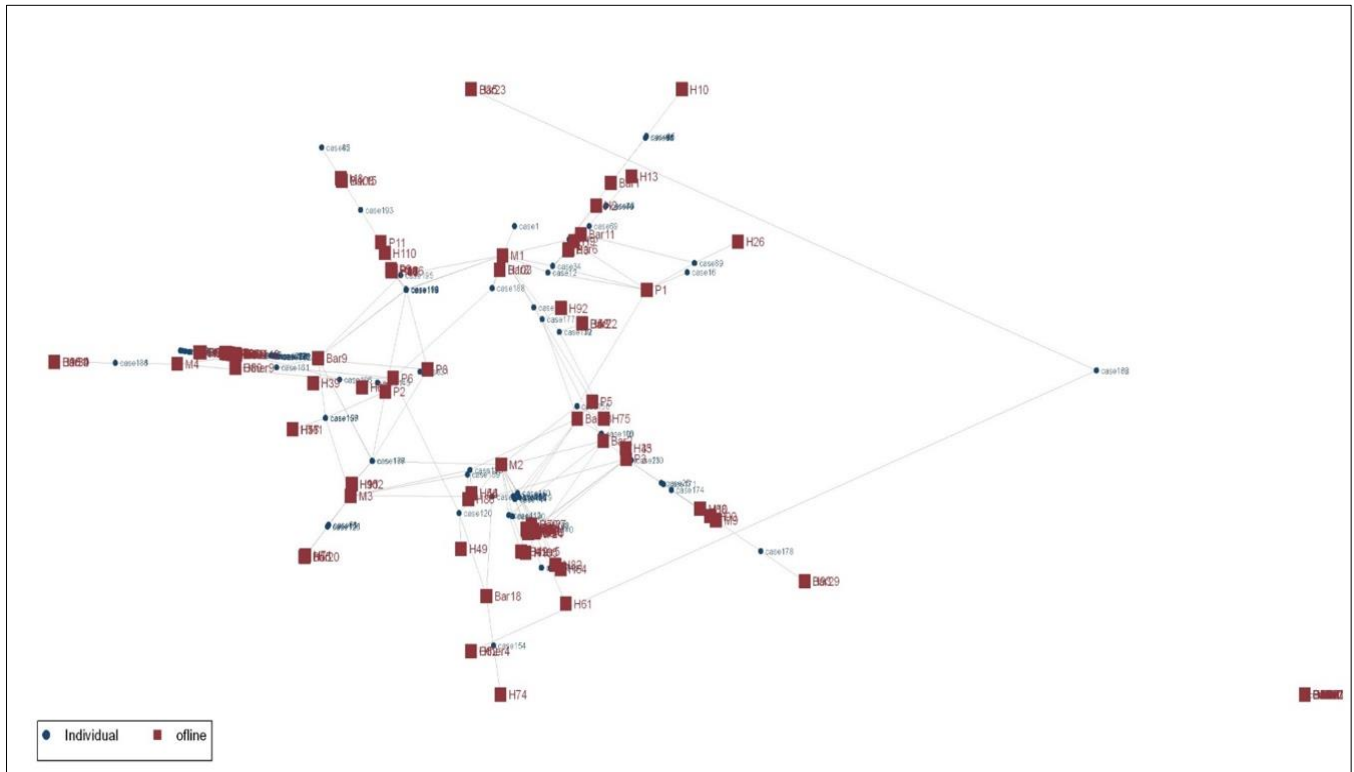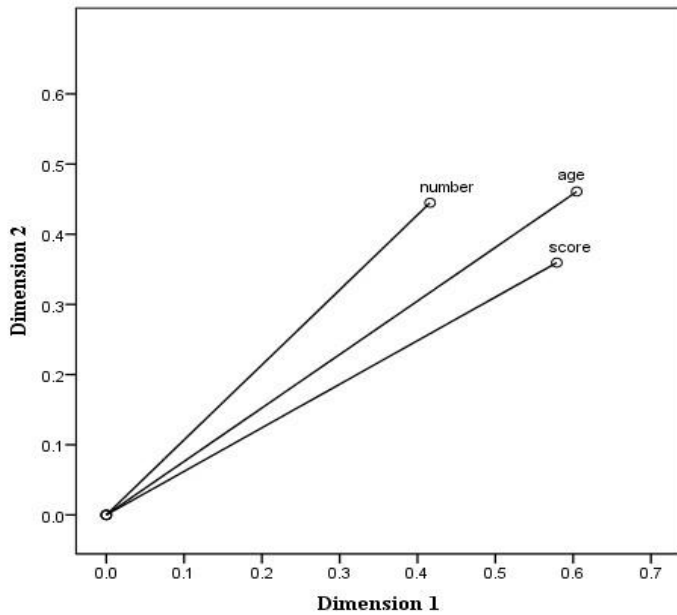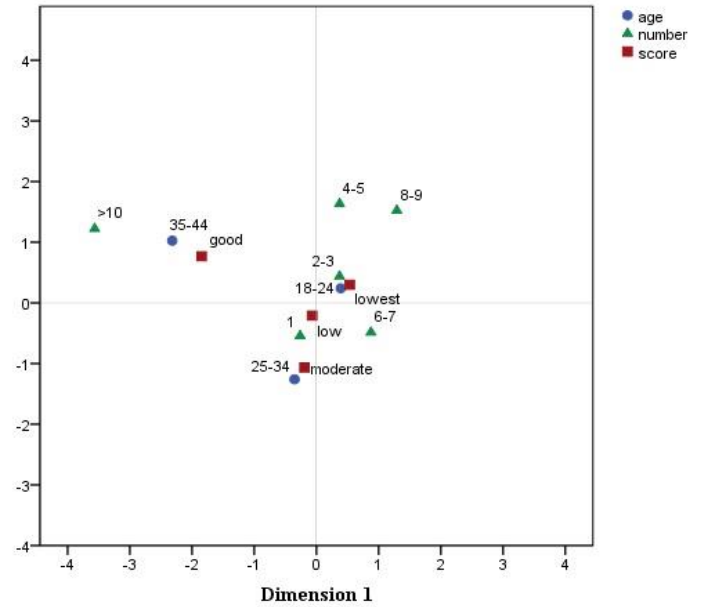
Figure 3. The affiliation network of MSM and sex-partner meeting places in Chiang Mai,
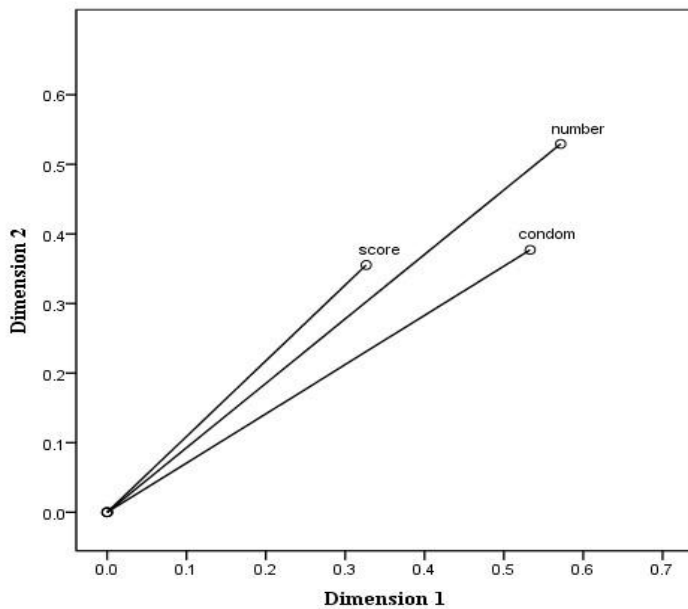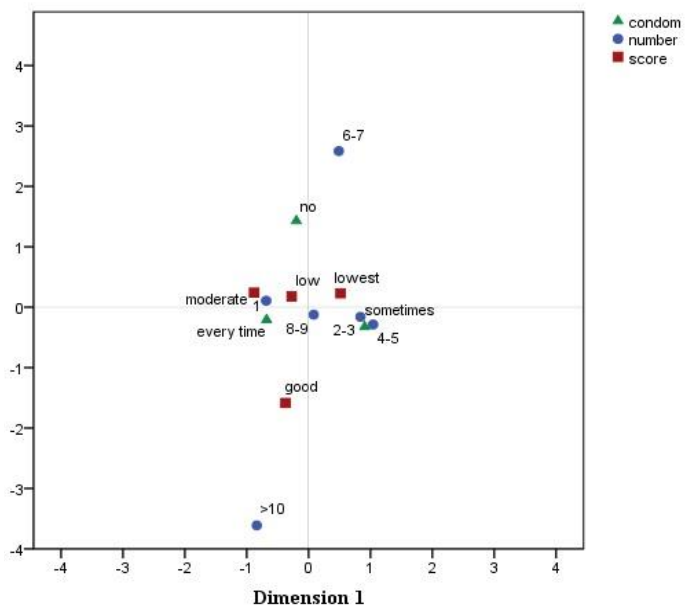Thailand, from February 2020 to December 2020.

(a)

(b)

Figure 4. Plots of MCA dimensions for (a) discrimination measures and (b) joint category of age, number of sex partners, and HIV score.

(c)

(d)

Figure 5. Plots of MCA dimensions for (c) discrimination measures and (d) joint category of condom use, number of sex partners, and HIV score.