The University of Tampere

School of Health Sciences

Master Thesis

The Association between Mahjong Playing and Metabolic Risk Factors: A Community-Based Study

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ABSTRACT

Playing mahjong is a popular hobby in Chinese community but the association between this habit and health is barely addressed. The objective of the study is to investigate the impact of playing mahjong on the metabolic risk factors. A questionnaire survey on the hobby of playing mahjong and its frequency and duration has been conducted in a community population. Logistic regression analyses were used to estimate the odds ratio of the association between playing mahjong and metabolic syndrome as well as its individual components, which were defined by the Adult Treatment Panel III.

The results showed that the prevalence of playing mahjong was 39.8% among 2076 responders. A lack of association between playing mahjong and the risk of metabolic syndrome was noted (odds ratio [OR]: 1.02, 95% CI: 0.77-1.35); however, different direction of association was noted between genders (OR: 0.93, 95% CI: 0.66-1.30 for male and OR: 1.50, 95% CI: 0.97-2.31 for female). By looking at five individual components of metabolic syndrome, lower high-density lipoprotein cholesterol (OR: 1.40, 95% CI: 1.03-1.91) and higher triglyceride level (OR: 1.33, 95% CI: 1.03-1.72) were noted in players when compared with non-players, even adjustment for age and gender. In conclusion, although there is a lack of association between playing mahjong and metabolic syndrome, this hobby adversely affects blood lipid components in this community population.

Keywords: mahjong, gambling, metabolic syndrome.

TABLE OF CONTENTS

INTRODUCTION

Mahjong is a popular Chinese hobby, a part of the traditional Chinese culture. Sitting for hours with being nervous and alternatively excited and depressed are common features. In addition, mahjong players commonly believe that it is unlucky, while they are consecutively winning the games, to stand up and go to toilet because these behaviors would interrupt their good luck. This belief pushes the players to remain sited for hours and be very reluctant to take a rest. Mahjong is one kind of gambling as well, which may affect the players' family members and neighborhoods.

Researchers have found that such an inactive style is associated with an increased risk of diabetes mellitus, and cardiovascular and cerebrovascular events. Owing to several risk behaviors shared with playing mahjong, we hypothesized that this hobby may increase the risk of metabolic disorders in our population. To elucidate this issue, we conducted a community-based study to evaluate the association between mahjong playing and metabolic disorders.

LITERATURE REVIEW

For the literature review, we concentrated on three concepts, the adverse effect of mahjong gambling, the pathogenesis of metabolic syndrome, and the relationship between the two entities.

First of all, mahjong playing was a life-style behavior and some social scientist defined such kind behavior as a contextual factors or environmental factors. We reviewed some topic related to environmental effects to the behaviors.

Secondary, fewer studies focus on such a specific object ‘mahjong’, we took some relative studies and traced any hint from this game, some gambling studies mentioned mahjong and some other gambling games, such as pokers, we might select them into the our reference review. Further, focus on the metabolic syndrome, particular follow some studies about what kinds life-style or behavior might increase incidence rate of metabolic syndrome. Otherwise, some behaviors related to coronary heart disease would be taken since metabolic syndrome might be a surrogate endpoint of coronary heart disease.

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Endocrine and gambling

In research on gambling in early times, researches always focus on the influence of problem gamblers. They provided evidence of higher heart rate (Meyer G, 2000) and some higher brain activities such autonomic arousal (Sharpe, 1995). Some other studies probed the gamblers endocrine. (Meyer G, 2000). Meyer argued that gambling activities elevated the heart rate if gamblers keep playing more than 30 minutes. Besides, Fiorillo found that rewards could stimulate

monkey's brain and neurons to secrete dopamine (Fiorillo, 2003). Further, Shizgal provided the other evidence of gambling game could raise the secretion of dopamine in the brain (Shizgal P, 2003).The former study took the game of poker, playing 'black jack' with their own money. Somehow black jack is a luck-based gambling game. Players could not control which cards they got but only could decide to have one more card or not. The features could be observed in mahjong gabling game as well, but it got also part of skilled-based and complicated than poker games. The bottom study offered the evidence of relationship between endocrine and gambling activity, dopamine was a key endocrine related to the emotion and that was an important finding for gambling research.

Researches utilized different way to measure the behavior, such as listening to videotape of horse racing, playing the slot machine or bingo, and using questionnaires. From observation and records, the studies need more manpower of data collection so that sample sizes of such studies usually are smaller. Without a large sample size, the study could not be extrapolated to general people. In other words, the external applicability might be limited.

Cultures and gambling

Countries with different cultures might influence their behaviors (Raluy and Oei, 2004). The review article have recruited many studies and compared with each other, the difference was observed. They argued that different cultures might play a role to the gambling or pathological gambling. Furthermore, ethics and customs were also factors to influence the behaviors, and the evidences suggested that Chinese culture got higher prevalence of gambling than other countries. Similar results were found in the Zheng's study (Zheng, 2009) (figure 1).

Table 1 Prevalence rates for ethnic minorities in the report to the Victorian Casino and Gaming Authority (2000)

Cultural groups	Percentage of SOGS scores of 5 or more
Chinese	10.7
Vietnamese	10.5
Greek	9
Arabic	7.2
General community	1.5

Figure 1, Zheng Wu yi, Journal of Gambling studies 2009.

This team investigated that Chinese culture group performed higher prevalence rate than other countries, and even seven times than the general community. The study followed the SOGS questionnaire which had usually used for gambling behaviors, the score higher than 5 could be defined as problem or psychological gamblers, one kind of substance abuse. Another research checked how much money did players would paid from different cultures, and the finding suggested that Chinese people culture group got the highest amount of money median when they playing gambling game. (Figure 2). (Cultural partners Australia consortium, 2000).

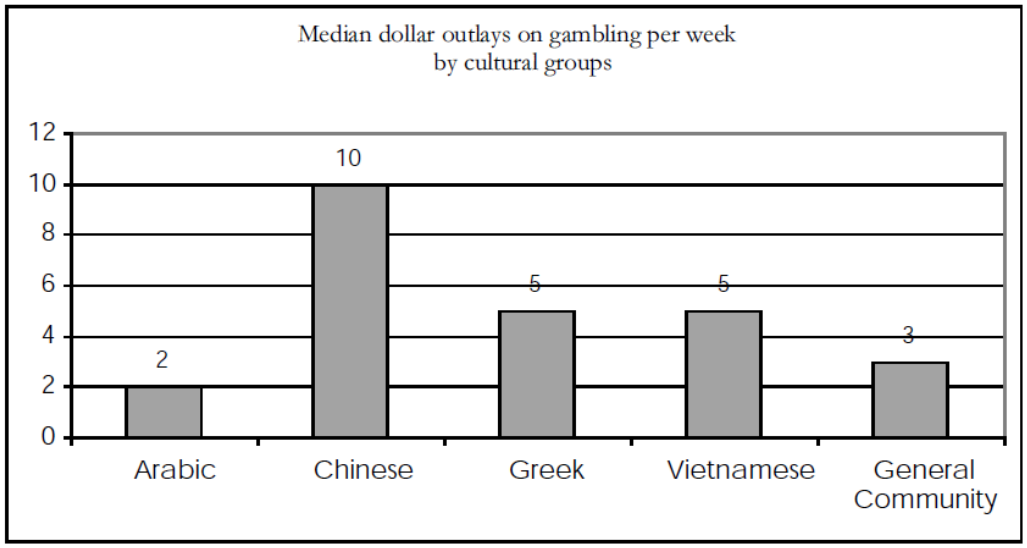

Figure 2, Cultural partners Australia consortium, 2000

Medical perspective

From medical perspective, playing mahjong was considered as the process of sensory stimulant to promote the brain activity. Previous research considers mahjong as a treatment. The patients with dementia were asked to play twice or four times a week. It did help patients to recover from damaged brain (Cheng, 2006). It suggested that playing mahjong was helpful for physical health.

Further, according to some case reports, epilepsy and stroke were happened to the patient when he/she was playing mahjong (Wan CL, 2005; Niwa Y, 2010). The report indicated that during playing mahjong, blood flushed into the brain cause by higher brain activities, nerve stimulant, and then stroke and epilepsy might be induced. However, rare researches were related to mahjong playing directly. Most of them were mentioned in the article with gambling issues, particularly for some migrant studies among oversea Chinese (Wong J, 2003; Zheng, 2009; Oei T, 2009). Besides, scientists were interested in problem gamblers but not for social gamblers. So far, no study was focused on the relationship between playing mahjong and other physical health effects within the general population. This is the first study collected data in Taiwan, and considered playing mahjong as the exposed variable, with specific locality.

Metabolic syndrome and life style

Metabolic syndrome was defined as a civilized disease in early days, it did not described as a real disease but a cluster of the risk factors to the coronary heart disease. Names ‘syndrome X’ by early scientist because the special property.

The problem of coronary heart disease became severer, researchers started to try to find the main risk factors related to the disease. They found that the risk factors for coronary heart disease were focus on the three main components:

hypertension, hyperlipidemia, and diabetes. The main three factors were defined as symptoms at early time. Some researchers paid more attention to the symptoms, and they have found the dietary and life style plays an important role for the factors.

In advanced, some other researches addressed that the components was influence by the life style and dietary patterns (Rintamaki R, 2008; Kwaśniewska M, 2009). While focus on the lifestyle, sedentary, inactive lifestyle, and lack of taking exercise are the crucial reasons. Further, other studies also focused on the environment risk factors such as smoking (Xia B, 2010; Hishida A, 2009; Takeutachi, 2009; Kim BJ, 2009), TV-watching (Eisenmann JC. 2002), and physical exercising (Chou ER, 2009; Trøseid M, 2009). They provided evidences to prove that inactive life style would affect the onset of metabolic syndrome.

For mahjong playing, the properties are quite similar to the main factors of the lifestyle, including setting for a long time, inactive, and fewer body exercises. That is the main reason for us to choose the metabolic syndrome as the outcome to our study.

Besides, researchers already conducted the association between some lifestyle and metabolic syndrome. Roberts found that moderate alcohol consumption could decrease risk of metabolic syndrome (Roberts, 2000), and subjects with light-to-medium drinking presented lower incidence of metabolic syndrome, and the similar result was also observed by Faccuini (Faccuini, 1994). Nevertheless, more alcohol consumption would increase the risk of metabolic syndrome was observed by Fan (Fan AZ, 2008). In addition, “western food” such as fried food, chips and cola, was addressed to raise incidence of Metabolis Syndrome (Lutsey PL, 2008). And, significant higher prevalence was observed in sedentary and

inactive lifestyle group (Chen X, 2008). Similar results were observed by US and French as well (Ford ES, 2005; Bertrais, 2005). They also found that spend 0 minute for physical exercise would increase almost two-fold risk of onset. On the other hand, television watching and video game playing were also subsumed into the analysis and addressed to increase the risk of metabolic syndrome (Ford ES, 2005). Risk factors between lifestyle and metabolic syndrome is undergoing, and the variable selection get closer and closer to our ordinary life such as online game for adolescent (Mark AE, 2010).

There was few researches focus on the associations between playing mahjong and body health. We are interested in the gambling of playing mahjong since that traditional Chinese game become more and more popular in Taiwan and other Chinese communities abroad, and more and more people spend time playing at leisure time and some people even become addicted unconsciously.

MANUSCRIPT

The association between mahjong playing and metabolic risk factors: A community-based study

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The authors report no conflict of interest.

Keywords:
mahjong, gambling, metabolic syndrome

ABSTRACT

Background: Playing mahjong is a popular hobby in Chinese community but the association between this habit and health is barely addressed. The objective of the study is to investigate the impact of playing mahjong on the metabolic risk factors.

Methods: A questionnaire survey on the hobby of playing mahjong and its frequency and duration has been conducted in a community population. Logistic regression analyses were used to estimate the odds ratio of the association between playing mahjong and metabolic syndrome as well as its individual components, which were defined by the Adult Treatment Panel III.

Results: The prevalence of playing mahjong was 39.8% among 2076 responders. A lack of association between playing mahjong and the risk of metabolic syndrome was noted (odds ratio [OR]: 1.02, 95% CI: 0.77-1.35); however, different direction of association was noted between genders (OR: 0.93, 95% CI: 0.66-1.30 for male and OR: 1.50, 95% CI: 0.97-2.31 for female). By looking at five individual components of metabolic syndrome, lower high-density lipoprotein cholesterol (OR: 1.40, 95% CI: 1.03-1.91) and higher triglyceride level (OR: 1.33, 95% CI: 1.03-1.72) were noted in players when compared with non-players, even adjustment for age and gender.

Conclusions: Although there is a lack of association between playing mahjong and metabolic syndrome, this hobby adversely affects blood lipid components in this community population.

INTRODUCTION

Mahjong is a popular Chinese hobby, similar to the poker playing in the western countries, and is a part of the traditional Chinese culture. Sitting for hours with being nervous and alternatively excited and depressed are common features. In addition, mahjong players commonly believe that it is unlucky, while they are consecutively winning the games, to stand up and go to toilet because these behaviors would interrupt their good luck[1]. This belief pushes the players to remain sited for hours and be very reluctant to take a rest. Furthermore, smoking is a common behavior accompanying mahjong. While four players sit around a small square table, even though there is only one person smoking, the rest players would be exposed to passive smoking. Mahjong is one kind of gambling as well, which may affect the players' family members and neighborhoods.

Researchers have found that such an inactive style [2-6] is associated with an increased risk of diabetes mellitus, and cardiovascular and cerebrovascular events[7-11]. Owing to several risk behaviors shared with playing mahjong, we hypothesized that this hobby may increase the risk of metabolic disorders in our population. To elucidate this issue, we conducted a community-based study to evaluate the association between mahjong playing and metabolic disorders.

MATERIALS AND METHODS

Study population

Our study population was the community residents residing on the Matsu Island, an offshore island locating between Taiwan Island and the mainland China. Matsu Island consists of five small islets, including Nan-Gang, Bei-Gang, East-Chu, West-Chu, and Dong-Ying islets (**Figure 1**). People who were aged above 30 years in Matsu Island had an annual health screening service, termed the Matsu Integrated Screening Program, which was administered by the Matsu Health Bureau since 2002. In addition to anthropometric measures (eg, height, weight, waist circumference, and blood pressure) and biochemical tests (eg, blood glucose and lipid profile), standardized questionnaires had been used to collect the

information about lifestyle factors (eg, smoking and drinking) and social habits (eg, mahjong playing). To record the habit of mahjong playing, participants were asked to answer the following questions: (1) do you play mahjong? and (2) if so, how often do you play?

Collection of metabolic profile

Based on data collected from the screening program, metabolic syndrome could be defined for each subject according to the criteria of Adult Treatment Panel III, which included the following five individual components: (1) enlarged waist circumference: larger than 90 cm for male gender or 80 cm for female gender, (2) increased triglyceride: equal or larger than 150 mg/dL, (3) lower high-density lipoprotein-cholesterol (HDL-C): lower than 40 mg for male gender and 50mg for female gender, (4) increased blood pressure: larger than 135 mmHg for systolic pressure or 85 mmHg for diastolic pressure, and (5) increased fasting glucose: equal or larger than 110 mg/dL. Subjects who fulfilled the above three or more criteria were defined as having metabolic syndrome.

Statistical analysis

The prevalence rates of mahjong playing among different demographic groups were compared using the Chi-square test. Characteristics between mahjong players and non-players were compared using the t-test or Chi-square test when appropriate. Logistic regression models were used to evaluate the associations between mahjong playing status and the risk of metabolic syndrome, as well as its individual components. Univariate analyses were performed firstly, which was followed by multivariate analyses by taking significant factors into the models. Interactions between different predictors were evaluated by adding the cross-product term into the multivariate model. The results were expressed as odds ratios (ORs) and the corresponding 95% confidence intervals (CIs). A p-value less than 0.05 was considered statistically significant. All statistic analyses were performed by using the statistical software package SAS system, version 9.1.

RESULTS

Prevalence rates of mahjong playing

Of 2297 screening participants, there was 2076 subjects (90.4%) who answered the question "do you play mahjong?" and the prevalence rate of playing mahjong was 39.5% after excluding 20 subjects who were less than 30 years of age. As shown in **Table 1**, male gender had a higher prevalence rate than female (48.6% vs. 31.5%, p <0.0001). Regarding the age, the highest prevalence rate of 46.8% was seen in the 40-49 age group, followed by 30-39, 50-59, and the lowest in the subjects aged 70 or older. Also shown in **Figure 1**, the higher prevalence rates of mahjong playing were noted in both Bei-Gang and Dong-Ying islets, where over than 40% residents were mahjong players. A higher prevalence rate of metabolic syndrome was noted in the Dong-Ying islet. However, a lower prevalence of mahjong but a higher prevalence of metabolic syndrome was noted in the Chu-Kuang islet.

Table 1 shows that the overall prevalence rates of mahjong players, however, did not show significant difference between subjects with and without metabolic syndrome (p=0.5811). Regarding other variables of interest, mahjong players had a lower consumption of vegetables (p=0.0239) but higher frequencies of smoking (p<0.0001) and alcohol drinking (<0.0001); however, their exercise frequency did not show statistical significant difference (p=0.4727).

Mahjong players versus non-players

The comparisons between mahjong players and non-players are shown in **Table 2**. Mahjong players were elder in age and more likely to be male, smokers, and alcohol users. Regarding metabolic risk factors, lower systolic blood pressure (p=0.0027), lower high-density lipoprotein cholesterol (p<0.0001) and higher triglyceride (p=0.0047) were noted in the mahjong players. We also evaluated the association between individual components of metabolic syndrome and the demographic characteristics (see Supplemental **Table S1-6**); similar results were seen. Furthermore, alcohol users had higher triglyceride level (OR: 1.88, 95% CI: 1.47-2.41), fasting glucose level (OR: 1.60, 95% CI: 1.25-2.04), and blood

pressure (OR: 1.76, 1.42-2.17). Smokers had higher blood pressure (OR: 1.29, 95% CI: 1.06-1.64) and higher triglyceride level (OR: 2.59, 95% CI: 2.01-3.35).

Gender difference in the risk of metabolic syndrome

Knowing that the prevalence rate of mahjong playing was substantial different between gender, we evaluated the potential gender difference in the association between mahjong playing and the risk of metabolic syndrome. As shown in **Table 3**, the logistic regression analyses indicated that there was no significant association between mahjong playing and the risk of metabolic syndrome among each gender. In the model adjusted for age, both male and female revealed similar findings to the overall subjects. Among males, there was lacking of association between metabolic syndrome and playing and mahjong. Only alcohol users in male players and elders in female players were significantly associated with metabolic syndrome. However, it should be noted that different directions of association were seen between genders (OR: 0.93, 95% CI: 0.66-1.30 for male and OR: 1.50, 95% CI: 0.97-2.31 for female) regarding the association between mahjong playing and the risk of metabolic syndrome.

Individual components of metabolic syndrome

As shown in **Table 4**, among subjects with one component of metabolic syndrome, only gender showed significant difference. While among subjects with two components of metabolic syndrome, elder age showed significant association (OR: 1.02, 95% CI: 1.01-1.04). Among subjects with three or more components, elder age (OR: 1.03, 95% CI: 1.02-1.04), male gender (OR: 1.85, 95% CI: 1.48-2.32), smoker (OR: 1.41, 95% CI: 1.04-1.92), and alcohol users (OR: 1.65, 95% CI: 1.24-2.19) shown significant association. Mahjong playing did not statistically significantly increase the risk of having more components of metabolic syndrome.

The associations between mahjong playing and 5 individual components of metabolic syndrome are shown in **Table 5**. It shows the result of the logistic regression by playing status. Univariate logistic regression analyses showed a higher risk of hypertriglyceridemia among mahjong players (OR: 1.46, 95% CI: 1.15-1.86). After adjustment for age and gender or for age, gender, and alcohol user,

lower HDL-C and higher triglyceride were significant associated with mahjong playing (see Table 5).

Among the 175 subjects with frequency information, we did the same analysis for every component. The results are shown in **Table 6**. It indicated that hypertension (adjusted OR: 1.16), low HDL-C (adjusted OR: 3.36), hypertriglyceridemia (adjusted OR: 1.20), and impaired fasting glucose (adjusted OR: 2.74) were all influenced by playing mahjong. Although the ORs were not statistically significant, higher odds could be found in higher frequency playing among all metabolic components. It seems higher frequency playing might have influence while the non-significant results were mainly attributable to the small sample size.

DISCUSSION

Major findings of this study

Playing mahjong is an old culture among Chinese people. However, whether this hobby leads to any harmful effect on the metabolic disorders has been barely investigated. Previous studies have evaluated other factors on metabolic disorder, such as smoking[12-15], TV-watching[16], and exercise[17-18]. We are interested in this gambling because mahjong is very popular in Chinese communities, numbers of people spend time playing mahjong at leisure time, and some may become addicted unconsciously. Based on this community setting, we found that lower HDL-C and higher triglyceride level were noted in players when compared with non-players, even adjusted for age and gender.

Biological plausibility of our findings

Regarding the biological plausibility, playing mahjong is well known to be involved in the process of sensory stimulation to evoke brain activity.[19] This mechanism supports the findings that mahjong players have been reported with a higher risk of epilepsy and stroke.[20-21] The classic features of playing mahjong—sedentary, nervous, excited, and stimulated—might increase blood

pressure and staying on the chair and keeping the nerve tension for a long time is potentially harmful for health. Consistently, our study clearly demonstrated that playing mahjong would decrease HDL-C level and increase the triglyceride level. Whether the two associations are mediated through the lack of physical activities[22] or the prevalent behaviors of smoking and alcohol drinking[13,23], remained unclear and should be elucidated in the future study.

Association between metabolic syndrome and lifestyle

Roberts found that moderate alcohol consumption could decrease the risk of metabolic syndrome[24] and similar results were reported by Faccuini[25]. Nevertheless, excessive alcohol consumption would increase the risk of metabolic syndrome[26]. In addition, western food such as fried food, chips and cola might increase the risk of metabolic syndrome[27]. Sedentary and inactive lifestyle was also an important factor accounting for the increasing prevalence of metabolic syndrome[28-30]; studies found that infrequent physical exercise would increase almost two-fold risk. Television watching and video game playing were also reported to increase the risk of metabolic syndrome. The association between lifestyle and metabolic syndrome is under extensive investigation, such as online game for adolescent[31] and shift work for some specific work group such as nurses and flight attendants.[32-33] However, the relationship between mahjong playing and physical activities is unclear. Our study showed that a higher but insignificant result in the group of taking exercise less than one hour per week, which supports the fact that mahjong players indeed spend a lot of time playing the game.

Strength of the present study

Our study was a community-based study to explore the association between mahjong playing and adverse health effects among general population. Our findings may be extrapolated to other Chinese communities. The result showed significantly higher serum lipid among players than non-players. Very few literatures have evaluated the impact of a specific social behavior (such as mahjong playing) on the metabolic disorder. In the study, we not only quantified the behavior of playing but also tried to find out the impacts of mahjong playing on health. Our findings may throw light on further intervention trials to improve the

style of playing of this game.

Limitation of this study

There were some limitations in this study. First, the data collected from Matsu screening program might be at risk of selection bias since subjects who had better health conception and knowledge than the general population who were willing to join the health check-up. The health conception, knowledge and attitude of attenders may be different from non-attenders. Furthermore, playing mahjong is a contextual factor that would be affected by companions including family members and neighborhood. The above issues should be considered in the future studies. Second, some people considered mahjong as gambling game; therefore, information about playing mahjong could not be very accurately assessed, particular for the older people. This gambling behavior was generally believed to accompany with some other negative habits such as smoking and drinking. Therefore, the prevalence rate of playing mahjong may be underestimated under the situation. Third, we used the simple question: 'do you play mahjong?' by yes/no as the instrument to evaluate the mahjong playing behaviors. Simple and single question encouraged subjects' willing to answer at sacrifice of some information lost. South Oaks Gambling Screen (SOGS) and Canadian Problem Gambling Index (CPGI) were two commonly used in the questionnaires for gambling research. The former one defined by some psychiatrists which was used more for pathological gamblers[36-37] and the latter was more suitable for general population to measure gambling behavior. These scoring systems can classify problem gambling and leisure gambling behavior into different categories. Further studies based on more valid questionnaires are therefore warranted.

Conclusions

In conclusion, our study showed that playing mahjong would lead to higher triglyceride and lower HDL-C level. Such information provides an insight into offering health-promotion for the mahjong players.

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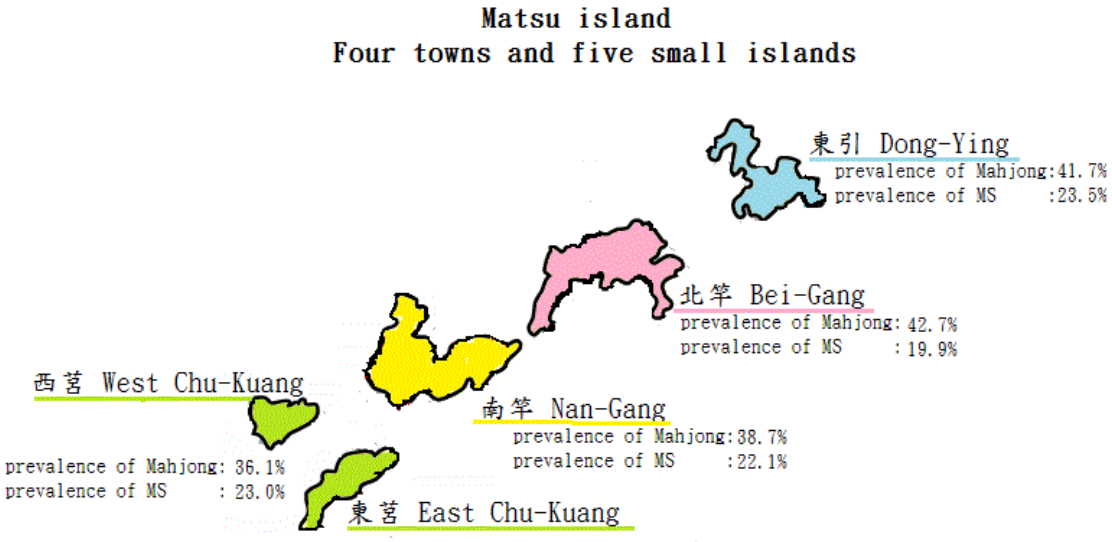
FIGURES

Figure 1: Prevalence rates of Mahjong playing and metabolic disorders in Matsu Island.



TABLES

Table 1: The prevalence rate of playing mahjong stratified by demographic characteristics.

	Prevalence of mahjong playing		
Variables	**no/total**	**Prevalence rate**	**p-value**
Total	813/2056	39.5%	-
Gender			
Male (%)	475/978	48.6%	<0.0001*
Female (%)	338/1078	31.5%	
Age (years)			
30-39	227/504	45.0%	<0.0001*
40-49	265/566	46.8%	
50-59	226/571	39.6%	
60-69	64/243	26.3%	
70+	31/172	18.0%	
Metabolic syndrome			
Yes	174/431	40.3%	0.5811
No	612/1573	38.9%	
Vegetable consumption			
≥1 unit/ per day	281/822	34.2%	0.0239*
< 1 unit/ per day	244/610	40.0%	
Exercise			
≦1hour/wk	126/292	43.2%	0.4727
> 1hour/wk	516/1263	40.4%	
Smoking			
Yes	275/439	62.6%	<0.0001*
No	481/1272	32.7%	
Alcohol			
Yes	398/775	51.4%	
No	321/1031	31.1%	<0.0001*
Islets			
Nan-Gang (urban)	466/1203	38.7%	0.3223
Bei-Gang (suburban)	147/344	42.7%	
Chu-Kuang (rural)	87/241	36.1%	
Dong-Ying (rural)	108/259	41.7%	

Table 2: The comparison between mahjong players and non-players.

Variables	Mahjong players (n=586)	Non-players (n=966)	P-value[1]
Age	51.6 ± 9.0	56.1 ± 11.3	<0.0001*
Male gender	356 (60.8%)	409 (42.3%)	<0.0001*
Smoking	204 (37.5%)	128 (14.4%)	<0.0001*
Alcohol	285 (55.8%)	298 (35.8%)	<0.0001*
Central obesity (abdominal girth, cm)	85.9 ± 9.6	85.0 ± 10.2	0.0704
Blood Pressure (mmHg)			
Systolic	127.9 ± 17.8	130.8 ± 18.1	0.0027 *
Diastolic	82.5 ± 11.9	82.6 ± 11.9	0.8987
Lower high-density lipoprotein cholesterol (mg/dL)	56.8 ± 14.4	60.6 ± 14.9	<0.0001 *
Triglyceride (mg/dL)	128.0 ± 111.7	112.2 ± 97.6	0.0047 *
Fasting glucose (mg/dL)	97.5 ± 24.2	95.8 ± 21.5	0.1414

Data are expressed by mean ± standard deviation.

[1] P-value by t-test for continues variables and chi-square test for categorical variables

* $P < 0.05$.

Table 3: The association between metabolic syndrome and demographic characteristics, stratified by gender.

Variables	Male				Female			
	MS (n=260)	Non-MS (n=569)	OR[1] (95% CI)	OR[2] (95% CI)	MS (n=166)	Non-MS (n=669)	OR[1] (95% CI)	OR[2] (95% CI)
Age								
40-49	81	216	1.01 (1.00-1.02)*		28	277	1.06 (1.04-1.08)*	1.07 (1.05-1.09)*
50-59	105	201			57	249		
60-69	48	87			47	87		
70+	26	65			34	56		
Mahjong playing								
Yes	109	241	1.06 (0.77-1.44)	0.93 (0.66-1.30)	42	178	0.96 (0.65-1.43)	1.50 (0.97-2.31)
No	120	280	1.00	1.00	107	436	1.00	1.00
Vegetable consumption								
≥ 1 unit/ per day	101	215	0.98 (0.70-1.36)		81	363	0.75 (0.51-1.10)	
< 1 unit/ per day	102	212	1.00		57	192	1.00	
Exercise								
> 1hour/wk	33	53	0.70 (0.44-1.12)		17	82	1.26 (0.71-2.22)	
≦1hour/wk	165	378	1.00		104	398	1.00	
Smoking								
Yes	113	230	1.18 (0.86-1.60)		4	11	1.43 (0.45-4.54)	
no	122	291	1.00		153	600	1.00	
Alcohol								
Yes	163	316	1.57 (1.09-2.24)*	1.55 (1.06-2.26)*	31	114	1.09 (0.70-1.70)	

no	55	167	1.00	1.00	115	460	1.00

Abbreviation: MS, metabolic syndrome; OR, odds ratio; CI, confidence interval
[1]: Crude odds ratio
[2]: Adjusted odds ratio

Table 4: The association between number of individual component of metabolic syndrome and the demographic characteristics.

No. of individual component of metabolic syndrome	0	1		2		≧3	
	No.	No.	OR (95% CI)	No.	OR (95% CI)	No.	OR (95% CI)
Age (linear)							
40-49	188	187	0.99(0.98-1.00)	118	1.02(1.01-1.04)*	109	1.03(1.02-1.04)*
50-59	116	183	-	151	-	162	-
60-69	20	70		75		95	
70+	13	44		64		60	
Gender							
Male	134	225	0.79(0.64-0.97)*	210	1.09(0.87-1.36)	260	1.85(1.48-2.32)*
Female	203	268	1.00	198	1.00	166	1.00
Mahjong playing							
Yes	120	167	0.94(0.74-1.20)	132	1.00(0.76-1.27)	151	1.19(0.92-1.53)
No	193	286	1.00	237	1.00	227	1.00
Vegetable consumption							
≥ 1 unit/ per day	150	246	1.20(0.94-1.53)	182	0.92(0.71-1.19)	182	0.84(0.65-1.08)
< 1 unit/ per day	105	157	1.00	142	1.00	159	1.00
Exercise							
> 1hour/wk	219	292	1.19(0.83-1.71)	265	0.95(0.66-1.37)	269	0.79(0.55-1.14)
≦1hour/wk	43	47	1.00	45	1.00	50	1.00
Smoking							
Yes	59	95	0.91(0.66-1.25)	87	1.00(0.72-1.37)	117	1.41(1.04-1.92)*
no	248	353	1.00	290	1.00	275	1.00
Alcohol							
Yes	101	176	0.96(0.73-1.26)	153	1.01(0.76-1.34)	194	1.65(1.24-2.19)*
no	187	245	1.00	195	1.00	170	1.00

[1]Adjusted for age

* $P < 0.05$

Table 5: The association between mahjong playing and the individual component of metabolic syndrome.

Playing status	Central obesity	Hypertension	Lower HDL-C	Hypertriglyceridemia	Higher fasting glucose
Ref. (vs. non-player)	1.00	1.00	1.00	1.00	1.00
OR[1]	0.84 (0.68-1.03)	0.89 (0.73-1.10)	1.22 (0.91-1.64)	1.46 (1.15-1.86)*	1.18 (0.94-1.51)
OR[2]	1.05 (0.85-1.31)	0.96 (0.77-1.19)	1.40 (1.03-1.91)*	1.33 (1.03-1.72)*	1.25 (0.97-1.62)
OR[3]	0.99 (0.78-1.25)	0.91 (0.71-1.15)	1.42 (1.02-1.98)*	1.30 (1.00-1.72)*	1.14 (0.86-1.50)

Abbreviation: OR, odds ratio; CI, confidence interval; HDL, high-density lipoprotein cholesterol

[1] Crude odds ratio

[2]Adjusted for age and gender

[3]Adjusted for age, gender, and alcohol

* $P < 0.05$

Table 6: The association between mahjong playing frequency and metabolic disorders.

Playing status	**No. of Metabolic syndrome**	**OR[1] (95%CI)**	**OR[1] for Abdominal obesity**	**OR[1] for hypertension**	**OR[1] for Low HDL-C**	**OR[1] for hypertriglyceridemia**	**OR[1] for Impaired fasting glucose**
For 175 subjects							
Mahjong playing							
No	17 (51.5%)	1.00	1.00	1.00	1.00	1.00	1.00
Yes	16 (48.9%)	0.86(0.31-1.97)	0.92(0.48-1.77)	1.05(0.53-2.09)	1.81(0.61-5.35)	1.22(0.52-2.83)	1.46(0.61-3.52)
Frequency of playing							
No	17 (58.6%)	1.00	1.00	1.00	1.00	1.00	1.00
1-12 times/year	5 (17.2%)	0.43(0.14-1.36)	0.93(0.43-2.05)	0.83(0.36-1.94)	1.36(0.36-5.29)	1.04(0.38-2.88)	0.37(0.09-1.48)
1-7 times/week	7 (24.1%)	1.05(0.36-3.09)	0.65(0.26-1.61)	1.16(0.45-2.96)	3.36(0.95-11.83)	1.20(0.40-3.61)	2.74(0.94-7.95)

[1]Adjusted for age and gender

*P-value less than 0.05

SUPPLEMENTAL TABLES

THE ASSOCIATION BETWEEN MAHJONG PLAYING AND METABOLIC RISK FACTORS: A COMMUNITY-BASED STUDY

This supplementary material has been provided by the authors to give readers additional information about their work.

Table S1: The association between central obesity and the demographic characteristics.

Variables	Central obesity		Odds ratio (95% CI)	P-value
	Negative	Positive		
Male gender	440 (52.4%)	399 (47.6%)	0.69 (0.57-0.84)	0.0002*
Age (years)	52.5± 10.0	56.3±10.9	1.04 (1.03-1.05)	<0.0001*
Exercise	486 (46.5%)	562 (53.5%)	1.15 (0.84-1.57)	0.3811
Smoking	194 (53.9%)	166 (46.1%)	0.73 (0.57-0.92)	0.0081*
Alcohol	312 (49.9%)	313 (50.1%)	0.86 (0.70-1.06)	0.1630
Mahjong playing	293 (51.1%)	280 (48.9%)	0.84 (0.68-1.03)	0.0960

* $P < 0.05$

Table S2: The association between fasting blood glucose and the demographic characteristics.

Variables	Fasting blood glucose		Odds ratio (95%CI)	P-value
	Normal	High		
Male gender	589 (68.7%)	275 (31.8%)	2.21 (1.76-2.77)	<0.0001*
Age (years)	53.5±10.4	58.0±11.4	1.04 (1.03-1.05)	<0.0001*
Exercise	801 (74.9%)	269 (25.1%)	1.19 (0.82-1.72)	0.3526
Smoking	263 (72.5%)	100 (27.6%)	1.30 (1.00-1.70)	0.0527
Alcohol	452 (71.2%)	183 (28.8%)	1.60 (1.25-2.04)	0.0001*
Mahjong playing	432 (73.9%)	153 (26.2%)	1.18 (0.94-1.51)	0.1575

* $P < 0.05$

Table S3: The association between blood pressure and the demographic characteristics.

Variables	Blood pressure		Odds ratio (95%CI)	P-value
	Normal	High		
Male gender	319 (37.9%)	523 (62.1%)	1.81 (1.49-2.20)	<0.0001*
Age (years)	52.2±9.7	56.6±11.1	1.04 (1.03-1.05)	<0.0001*
Exercise	493 (46.4%)	569 (53.6%)	0.91 (0.67-1.25)	0.5656
Smoking	146 (40.4%)	215 (59.6%)	1.29 (1.02-1.64)	0.0347
Alcohol	237 (37.6%)	394 (62.4%)	1.76 (1.42-2.17)	<.0001*
Mahjong playing	275 (47.5%)	304 (52.5%)	0.89 (0.73-1.10)	0.2757

* $P < 0.05$

Table S4: The association between high-density lipoprotein cholesterol and the demographic characteristics.

Variables	High-density lipoprotein cholesterol		Odds ratio	P-value
	Normal	Low	(95%CI)	
Male gender	750 (86.9%)	114 (13.2%)	0.85 (0.65-1.11)	0.2201
Age(years)	54.3±10.5	56.4±11.8	1.02 (1.01-1.03)	0.0058*
Exercise	925 (86.5%)	145 (13.5%)	1.04 (0.66-1.64)	0.8645
Smoking	304 (83.8%)	59 (16.3%)	1.18 (0.86-1.64)	0.3079
Alcohol	558 (87.9%)	77 (12.1%)	0.71 (0.52-0.96)	0.0246*
Mahjong playing	495 (84.6%)	90 (15.4%)	1.22 (0.91-1.64)	0.1773

* $P < 0.05$

Table S5: The association between triglyceride and the demographic characteristics.

Variables	Triglyceride		Odds ratio (95%CI)	P-value
	Normal	High		
Male gender	599 (69.3%)	265 (30.7%)	2.44 (1.93-3.08)	<0.0001*
Age (years)	54.5±10.6	55.1±10.9	1.01 (1.00-1.02)	0.3721
Exercise	835 (78.0%)	235 (22.0%)	0.77 (0.54-1.10)	0.1504
Smoking	227 (62.5%)	136 (37.5%)	2.59 (2.01-3.35)	<0.0001*
Alcohol	448 (70.5%)	187 (29.5%)	1.88 (1.47-2.41)	<0.0001*
Mahjong playing	430 (73.5%)	155 (26.5%)	1.46 (1.15-1.86)	0.0021*

* $P < 0.05$

Table S6: The association between metabolic syndrome and the demographic characteristics.

Variables	Metabolic syndrome		Odds ratio (95%CI)	P-value
	No	Yes		
Male gender	569 (68.6%)	260 (31.4%)	1.84 (1.47-2.31)	<0.0001*
Age (years)	53.6±10.5	56.9±10.8	1.03 (1.02-1.04)	<0.0001*
Exercise	776 (74.3%)	269 (25.7%)	0.94 (0.66-1.33)	0.7131
Smoking	241 (67.3%)	117 (32.7%)	1.57 (1.21-2.04)	0.0006*
Alcohol	430 (68.9%)	194 (31.1%)	1.66 (1.31-2.12)	<0.0001*
Mahjong playing	419 (73.5%)	151 (26.5%)	1.14 (0.90-1.44)	0.2924

* $P < 0.05$

ROLE OF THE STUDY / RESEARCH PROCESS

As an International Master student at Tampere School of Public Health, I was lucky to have such kind of chance to study here and taking some courses really useful and interesting for my research.

My primary interest during the bachelor carrier is the epidemiology since my entered the course. It is one kind method to figure out the relationship between risk factors and health. In Asia, mahjong is a famous and popular game around our Chinese World, even some my relatives and friends are crazy for that interesting gambling game. I feel curious to the relationship between the game and our body health. If I could provide some evidence for the health effects for the mahjong players, it might be a good reason to make them be alert to the game.

Thanks for professor Tony Hsiu-Hsi Chen's kind help and guidance, I could collect data from communities by questionnaire. He helped me handle the regulation of local health bureau so I could go to this off-shored island and collected the questionnaire for study.

After data collection, I brought the questionnaires back and then key-in the data and clean the data in the computer. Professor Tony Hsiu-Hsi Chen discussed the method for statistic analysis with me, and helped me choose the correct methods to interpret the result. We've spend some time to purify the effects from mahjong playing because it is a behavior which always accompany with other negative behavior. After many test, we finally found the logistic regression was a good methods to have reasonable result. There were such few previous studies focus on mahjong playing, it is the other difficult situation we met while doing literature review. After reviewing some papers related to gambling, we found some researcher would mix many different kinds gambling activity into one article, and mahjong playing might be one.

For the article drafting, it took another long time to fix the paragraph order, introduction and discussion part. Professor Tony Hsiu-Hsi Chen had recruited some senior colleagues to help me to review and revise in detail. Since I finished the first draft for the final manuscript, we had several meetings to revise the article.

Under the guidance of professor Tony Hsiu-Hsi Chen from the first start to the end, I finished the process including data collection, data key-in, data analysis, design of programs using SAS software language, article drafting, and the final submission of the manuscript to the journal.

ACKNOWLEDGEMENT

To finish this article, I would like to deliver my thanks for my supervisor: Professor Tony Hsiu-Hsi Chen and Professor Clas Haken-Nygard, they guide me how to be a great researcher and always provide some technical support. I really feel appreciate for their help.

During the article writing process, Professor Tony Hsiu-Hsi Chen offered lots of help for the draft revised, including English language modified and result interpretation. I would like to express my thanks for him.

Another thanks for our programme coordinator, Catarina Stahle-Nieminen, she help me a lot during the year not only while I stay in Finland, but also after I come back to Taiwan. Thanks for her efforts for the general administration and help.

Besides, I have to thanks for my family members; they always express their support for my decision during the study years, they make me to have positive attitude toward the thesis during study period, and continuing the process until now. It is impossible to finish the article without their supporting and accompany.