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The relationship between casino proximity and problem gambling

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Abstract

Will increased casino proximity lead to, or correlate with, an increased prevalence of problem gambling? This study aims to address this research question by conducting a systematic review in the potential relationship between casino proximity and problem gambling. Keyword searches are conducted in PubMed and PsychINFO databases. Twelve studies, which were all from North America, were identified. Among the eight cross-sectional studies identified, correlations with statistical significance were demonstrated in five studies, indicating that casino proximity does have a role in problem gambling, but such correlations were not evident in the other three studies. Four longitudinal studies investigating the influence of new casino establishment on problem gambling were reported. The grand opening of a new casino resulted in increased casino gambling activities and problem gambling among local residents within 1 year, according to the studies conducted in Niagara Falls and Hull area, Canada. However, conflicting result was again observed in Windsor, Canada, as there was no significant increase in problem gambling within 1 year of new casino establishment. In addition, 2- and 4-year follow-up study in Hull area, Canada, showed that the rate of problem gambling did not increase, compared with those obtained before the casino establishment. The current data available from literature indicates that the relationship between casino proximity and problem gambling is still controversial, and remains to be established until more data are available, especially in Asian countries.

Keywords: Casino, Proximity, Problem gambling

Introduction

Definition of problem gambling

The concept of problem gambling should incorporate the ideas of both behavior and consequences (Delfabbro, 2009). In Australia, it has been agreed at a national level that problem gambling is characterized by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community (Neal et al., 2005; Delfabbro, 2009). The national definition of problem gambling in Australia is deliberately intended to be more general, aiming for incorporating many different reasons for people's inability to limit their time and expenditure. This can avoid not only controversial terms such as "compulsive gambling", "impaired control" but also specific reference to theoretical concepts that is possibly subject to contention (Delfabbro, 2009). In Europe, the definition of problem gambling is subtly

different from that in Australia, as the term of problem gambling is to describe gambling that compromises, disrupts or damages family, personal or recreational pursuits (Griffiths 2009). Yet, the assessment methods of problem gambling are quite similar all over the world, including Asia, Australia, Europe and North America, and they will be described in the following section.

Assessment methods of problem gambling

In clinical situations, problem gambling is the gambling behavior meeting the established diagnostic criteria for pathological gambling, such as Diagnostic and Statistics Manual Version IV-TR (DSM IV-TR), e.g., “pathological gambling”, and the gambling behavior with subclinical levels of pathological gambling, e.g., “problem gambling”, “at-risk gambling”, and “in-transition gambling” (Shaffer et al., 1999).

According to DSM IV-TR (American Psychiatric Association, 2000), the clinical definition of pathological gambling is persistent, maladaptive gambling expressed by 5 or more of the followings: The patient needs to put increasing amounts of money into play to get the desired excitement, has repeatedly tried (and failed) to control or stop gambling, feels restless or irritable when trying to control gambling, uses gambling to escape from problems, often tries to recoup losses, lies to cover up the extent of gambling, has stolen to finance gambling, has jeopardized a job or important relationship, has had to rely on others for money to relieve the consequences of gambling, or is preoccupied with gambling. For problem gambling, there is no formal clinical definition in DSM IV-TR, but field study usually defines it by 3 or 4 marks of the aforementioned statements, compared with 5 or more marks in pathological gambling (Welte, Barnes et al. 2004).

DSM IV-TR diagnostic criteria for pathological and problem gambling are essential for clinical practice, especially in psychiatry. In an epidemiological study or questionnaire survey, the presence of pathological and/or problem gambling is usually difficult to ascertain, if not impossible, as psychiatric diagnosis is usually not available. Simple screening or assessment tools are therefore available for classifying the respondents into “non-gambler”, “probable pathological gamblers” and “probable problem gamblers”, such as South Oaks Gambling Screen (SOGS) (Stinchfield, 2002), Problem Gambling Severity Index (PGSI) (Loo et al., 2011), and Canadian Problem Gambling Index (CPGI) (Ferris & Wynne 2001). SOGS is a 20-item questionnaire, with a 3–4 score classified as “probable problem gambler,” and 5 or more score classified as “probable pathological gambler” (Stinchfield, 2002). Short SOGS, a more concise version of SOGS, is a 5-item questionnaire with yes/no answers available for more rapid screening, and a score of 2 or above indicates pathological or problem gambling (Room et al., 1999). PGSI is a 9-item questionnaire, with a 1–2 score as “low level of problems with few or no identified negative consequences”, a 3–7 score as “moderate level of problems leading to some negative consequences” and a 8 score as “problem gambling with negative consequences and a possible loss of control” (Loo et al., 2011). However, in literature, it is observed that there are still some papers using the terms of “pathological gambling” and “probable pathological gambling”, and “problem gambling” and “probable problem gambling” interchangeably in an incorrect manner, especially for those studies not in the areas of clinical or medical sciences (Pearce et al. 2008).

Casino gambling

Although there is no formal consensus in the definition of “casino gambling”, according to Merriam-Webster dictionary, the definition of casino is “a building or room used for social amusements; specifically: one used for gambling”, and the definition of gambling is “1a: to play a game for money or property; b: to bet on an uncertain outcome; 2: to stake something on a contingency: take a chance”.

Casino gambling is popular. In a U.S. national survey of 2630 representative adults, casino gambling accounted for the largest extent of gambling involvement in the country (Welte et al., 2002). As a special form of gambling, casino gambling was found to be the form of gambling with strong association with problem gambling (Welte et al., 2009; Afifi et al., 2010). Among American youth, the form of gambling that made the largest contribution to gambling problems per 14 days of play was casino gambling. Incidence risk ratio for casino gambling, negative binomial regression of SOGS symptom count with past-year gambler was 2.52, which was of statistical significance at $p < 0.01$, demonstrating that casino gambling was associated with a large increase in gambling symptoms (Welte et al., 2009). In Canadian women, the top three types of gambling associated with highest odds of problem gambling were all related to casinos, i.e., video lottery terminals outside the casino and inside the casino, and other casino games (Afifi et al., 2010). Problem gambling related to casino gambling is, therefore, becoming a public health concern (Welte et al., 2009; Afifi et al., 2010).

Casino proximity

Gambling legalization of casino establishments started in Nevada, United States, in 1931, and the booming of casino industry was along with the prosperity experienced by Americans in post-war era (Dunstan, 1997). By 1993, complete spread of the trend within United States was established, as only two states, i.e., Utah and Hawaii, did not have legalized casino gambling (McGowan, 1999). The dissemination of this policy was not limited to United States, since the trend has also been spread to other regions of North America, Europe, and Asia since 1960s, i.e., Bulgaria in 1965, and South Korea in 1967 (Richard, 2010). Since 2007, Macao, a city with a population of 0.5 million in China, overtook Las Vegas with the highest turnover in casino industry (Macao: USD \$6.95 billion in 2007 versus Las Vegas: USD \$6.50 billion in 2007) (Walsh, 2007). International spread of casino gambling is evident, with casinos established worldwide, and the trend is aggravated by the fact that many governments consider the option of casino gambling legalization in their countries as a strategy to boost stagnant economy (Richard, 2010). Economic development needs, as measured by general unemployment rates, were found to be associated with the casino legalization decisions of national governments, and higher unemployment rates were more likely in the years that nations legalized casino gambling (Richard, 2010). While the positive outcomes are readily quantifiable by monetary amount, its negative impacts are more difficult to measure, except in the form of social capital, i.e., community's quality of life (Griswold and Nichols 2006). The calculation of social cost resulted from gambling studies remains controversial (Walker, 2003). Socio-cultural, environmental, and psychological impacts of both individuals and society as a whole should be balanced for the decision in gambling legalization. The negative influences of casino gambling, particularly for problem gambling, should not be underestimated.

Casino gambling is not possible if casino accessibility is simply non-existent. Multiple dimensions of casino accessibility have been reported in literature, including opportunities to gamble per venue, number of opportunities to gamble, number of venues, opening hours, conditions of entry, ease of use, initial outlay, social accessibility, and location of venues (Productivity Commission, 1999). Among the nine captioned dimensions, the number and spatial distribution of casinos, i.e., casino proximity, are particularly important (Productivity Commission, 1999), and casino proximity has been viewed as one of the important links between accessibility and gambling behavior (Hing & Nisbet, 2010). Casino proximity is defined as the physical distance or driving distance between respondent's residing home and nearest casino (Welte, Barnes et al. 2004; Pearce et al., 2008; Sevigny et al., 2008). Casino establishments will definitely increase the casino proximity among local residents, particularly if there are no such casinos in the area beforehand, and this, in turns, leads to a higher exposure of casino among local residents. But the definitions of "high" and "low" casino proximity vary substantially across different studies, probably due to different geographical sizes in the areas of interests. For instances, Pearce et al. (2008) described the distance between casino and respondent's home as closest when it is < 0.7 km, and as furthest when it is > 3.0 km, in New Zealand. Welte et al. (Welte, Barnes et al. 2004) utilized the cutoff point of 10 miles between nearest casino and respondent's home in United States. In contrast, Sevigny et al. (2008) categorized casino proximity into 0–100 km, 100.01–200 km, 200.01–300 km, and 300.01–981 km in the province of Quebec, Canada.

Rationale of this study

Critical analysis from a public health perspective in the influence of gambling on health has been examined (Korn and Shaffer 1999), with further extension on related mental disorders (Shaffer and Korn 2002). However, casino gambling is a special form of gambling, requiring the pre-requisite of casino establishment in the area. It is the responsibility of policy makers to grant the casino licensure within the region. If there are more casino establishments in the area, casino proximity for local residents would be increased accordingly. Inevitably, a public health problem will emerge during the policy decision making process: Will increased casino proximity sharply increase problem gambling in local communities? A more in-depth public health analysis specific to the relationship between casino proximity and problem gambling would be enlightening to many parties involved in the policy formulation process, including policy makers, legislators, public health practitioners, social services providers, medical service providers, non-governmental organizations, and frontline healthcare professionals.

Unfortunately, this important aspect of public health analysis in the potential relationship between casino proximity and problem gambling has not been comprehensively reviewed in literature yet. Geographically speaking, the investigation of public health impacts in casino proximity on problem gambling would be important not only in our residing community, Macao SAR, China, but also in many other areas with casino establishments. Therefore, in this study, we aim to address the research question in the potential relationship between casino proximity and problem gambling by means of a systematic review.

Methods

In order to identify studies focusing on the potential relationship between casino proximity and problem gambling, comprehensive literature search is conducted by using the PubMed and PsychINFO search engines, with the last search done on 6th January, 2012. The keywords used are mainly from three categories, which are:

- “casino” AND
- “problem gambling” or “pathological gambling” or “disordered gambling” or “problem gambler” or “pathological gambler” or “disordered gambler” AND
- “proximity” or “distance” or “physical accessibility” or “accessibility” or “access”

There are five inclusion criteria for the studies to be included in this systematic review. The studies must:

1. Have been peer-reviewed, refereed articles.
2. Have been about casino gambling since 1st January, 1990.
3. Be relevant to casino proximity and problem gambling.
4. Contain empirical outcome data about the relationship between casino proximity and problem gambling.
5. Have been published in English.

There are four exclusion criteria in this systematic review. Studies identified would be removed from further analysis if they are:

1. Without any original empirical data
2. Not relevant to problem gambling (such as drug abuse, alcohol and tobacco addiction, crime, suicide and bankruptcy associated with casino gambling)
3. Not relevant to casino proximity (such as social and cognitive accessibility of casino)
4. Case studies

The retrieved literature articles would be summarized as tables, and analyzed with reference to different types of studies, including cross-sectional studies and longitudinal studies.

Results

Among 101 studies identified by the specified keyword searches via PubMed and PsychINFO search engines, twelve of them meet the inclusion and exclusion criteria for this systematic review. The findings in the relationship between casino proximity and problem gambling would be categorized according to different types of studies, i.e., cross-sectional studies and longitudinal studies.

Cross-sectional studies

Summary of cross-sectional studies investigating the relationship between casino proximity and problem gambling is listed in Table 1.

Table 1 Summary of cross-sectional studies investigating the relationship between casino proximity and problem gambling

Countries	Methodology	Data collection	Findings related to problem gambling	Reference
Baraboo, Wisconsin, United States	<i>Study type:</i> Cross-sectional study <i>Number of participants:</i> 1394 patients <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS)	Patients attending the 3 primary care clinics were surveyed before meeting with the physician.	<i>Findings:</i> The prevalence of problem gambling (SOGS score ≥ 3) was identical, i.e., 6.2%, in all clinics, including Baraboo (experimental group) and two other control groups. The prevalence of pathological gambling (SOGS score ≥ 5) was higher in Baraboo, i.e., 4.0%, which was only 10 km from the nearest casino, compared with 1.4% and 2.7% in two control groups, but the differences were not significant after controlling for age and sex. <i>Comments:</i> No link was established between casino proximity and prevalence of problem and pathological gambling.	Pasternak and Fleming, 1999
All states in United States	<i>Study type:</i> Cross-sectional study <i>Number of participants:</i> 2631 adults, aged 18 or above. <i>Problem gambling assessment method:</i> DSM-IV.	Respondents' data were obtained from national telephone survey, and Census data was used for calculating the distance from respondent's home to nearest casino establishment	<i>Findings:</i> The presence of a casino within 10 miles of the respondent's home was positively related to problem gambling. Neighborhood disadvantage was positively related to frequency of gambling and problem gambling. <i>Comments:</i> A correlation relationship was established between casino proximity and prevalence of problem gambling.	Welte, Barnes et al., 2004
114 counties and the City of St. Louis in Missouri, United States	<i>Study type:</i> Cross-sectional study <i>Number of participants:</i> 6599 self excluders from Missouri casinos. <i>Problem gambling assessment method:</i> Self-exclusion rate and self-exclusion addition among the population.	Self excluders' information was obtained from Missouri Gaming Commission. Their demographic data was matched with the distance between participant's home and nearest casino, and the number of casinos clustered with the closest casino.	<i>Findings:</i> Kansas City and its surrounding region had most casino locations in Missouri counties. The Western region around Kansas City was an epicenter of problem gambling. The number of self-exclusion enrollment increased during the first few years of Missouri self-exclusion program, followed by leveling-off during the later years. Besides, after two casinos were opened in Northern and Central regions, the two places had highest rate of self-excluders addition over total number of self-excluders, and the increase was with statistical significance. <i>Comments:</i> The data suggested that number of self-exclusion enrollment and self-excluder addition rates, which were indirect indicators of problem gambling, was geographically clustered in the areas with more casinos.	LaBrie et al., 2007

Table 1 Summary of cross-sectional studies investigating the relationship between casino proximity and problem gambling (Continued)

Four medium-sized campuses, Ontario, Canada	<p><i>Study type:</i> Cross-sectional study <i>Number of participants:</i> 1579 university students <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS).</p>	<p>The data were collected via a variety of administration methods, including mailed survey, survey in classroom settings, data collection from psychology research pool, and approaching students in public settings at the university</p>	<p><i>Findings:</i> Compared with other universities far from a casino (control group), there were less no problem gambling group (34.0% vs. 66.0%), less mild gambling problem group (42.7% vs. 57.3%), similar moderate gambling group (48.1% vs. 51.9%), and more pathological gambling group (80.0% vs. 20.0%) among students in universities near to a casino (experimental group). Statistical significance, with p value of 0.00004, was achieved for a chi-square test with 2 (near to versus far from casino) x 4 (four levels of problem gambling) contingency table.</p> <p><i>Comments:</i> A positive link was established between casino proximity in respondents' residing university and problem gambling among university students.</p>	Adams et al., 2007
New Zealand	<p><i>Study type:</i> Cross-sectional study <i>Number of participants:</i> 12529 respondents, aged 15 years or above. <i>Problem gambling assessment method:</i> Two questions with dichotomous outcome variables developed to identify whether each respondent was a gambler or problem gambler (Lie/Bet questions).</p>	<p>The data was obtained from 2002/2003 New Zealand Health Survey. The finding was then correlated with geographical access to the closest gambling venue, i.e., travel distance to the nearest gambling venue along the road network</p>	<p><i>Findings:</i> Compared with those living in the quartile of neighborhoods with the furthest access to a gambling venue, i.e., casino, residents living in the quartile of neighborhoods with the closest access were more likely to be a gambler (Adjusted Odds Ratio: 1.60, 95% CI: 1.20 to 2.15), and problem gambler (Adjusted Odds Ratio: 2.70, 95% CI: 1.03 to 7.05)</p> <p><i>Comments:</i> Casino proximity, in terms of distance between living location and nearest casino, was found to be a statistical significant risk factor for being a problem gambler.</p>	Pearce et al., 2008
Quebec, Canada	<p><i>Study type:</i> 2 cross-sectional studies <i>Number of participants:</i> 8842 and 5148 participants. <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS) and Canadian Problem Gambling Index (CPGI).</p>	<p>Gambling habits were surveyed, and were correlated with the driving distance between the nearest casino and home.</p>	<p><i>Findings:</i> Positive links were established between casino proximity and gambling participation (at the provincial and Montreal levels) and expenditure (at the provincial level only). But there was no link between the current prevalence rate of problem gambling and casino proximity.</p> <p><i>Comments:</i> No link was established between casino proximity and prevalence of problem gambling.</p>	Sevigny et al., 2008

Table 1 Summary of cross-sectional studies investigating the relationship between casino proximity and problem gambling (Continued)

Victoria, Australia	<p><i>Study type:</i> Cross-sectional study</p> <p><i>Number of participants:</i> 533 gaming venue employees (18-70 years old).</p> <p><i>Problem gambling assessment method:</i> Problem Gambling Severity Index (PGSI).</p>	<p>A 13-item questionnaire, including 5 items in physical accessibility, was used to survey the participants.</p>	<p><i>Findings:</i> Casino table games did not have statistical significant relationship with physical accessibility in PGSI values, and gambling expenditure, but had a statistical significant relationship with physical accessibility in gambling frequency. Casino proximity is one of the criteria in physical accessibility of casino in this study.</p> <p><i>Comments:</i> No link was established between physical accessibility of casinos and prevalence of probable problem and pathological gambling.</p>	Hing & Haw, 2009
All Australian states	<p><i>Study type:</i> Cross-sectional study</p> <p><i>Number of participants:</i> 303 participants (18-61 years old).</p> <p><i>Problem gambling assessment method:</i> Problem Gambling Severity Index (PGSI).</p>	<p>Scales in Accessible Retreat were used in survey. Accessible Retreat was related to the degree to which venues were enjoyed because they were geographically and temporally available and provided a familiar and anonymous retreat with few interruptions or distractions.</p>	<p><i>Findings:</i> Accessible Retreat had 7 "convenience" items, covering different aspects of geographic, temporal and within-venue accessibility, and 5 "retreat" items, covering anonymity, lack of distractions, quietness, familiarity and perceived escape from life. Accessible Retreat was associated with stronger urges to gamble and gambling problems, indicating geographical and temporal availability had a role in PGSA.</p> <p><i>Comments:</i> A correlation was established between Accessible Retreat of casino and prevalence of problem gambling. However, the study did not provide further break down analysis in Accessible Retreat, in where casino proximity was measured in terms of "convenience".</p>	Moore et al., 2011

Correlation relationship between casino proximity and problem gambling was supported by five studies (Welte, Barnes et al. 2004; Adams et al., 2007; LaBrie et al., 2007; Pearce et al., 2008; Moore et al., 2011), suggesting that casino proximity had a role in problem gambling. Welte, Barnes et al. (2004) has established a relationship between the presence of casino within 10 miles of respondent's home and prevalence of probable problem/pathological gambling, which were found to be 7.2% and 3.1% among the respondents with and without casino within 10 miles of his/her home in United States (Welte, Barnes et al. 2004). Similar findings were also observed among university students in four medium-sized campuses in Ontario, Canada (Adams et al., 2007). Compared with universities far from a casino, there were less no problem gambling students, less mild problem gambling students, similar moderate problem gambling students and more severe problem gambling students in universities near to a casino, indicating that casino proximity does influence the prevalence of problem gambling (Adams et al., 2007).

Since high rate of problem gambling was observed among self-excluders, self-excluders' information was a good barometer for geographical distribution of problem gambling (LaBrie et al., 2007). LaBrie et al. (2007) has demonstrated that self-exclusion enrollment and self-excluder addition rates were geographically clustered in the areas with more casinos, i.e., Western region around Kansas City, United States, indicating that the region was an epicenter of problem gambling. Increased casino proximity was linked with more self-excluders, who had higher rate of problem gambling than general population (LaBrie et al., 2007).

Pearce et al. (2008) demonstrated that compared with those living in neighborhoods with the furthest access to casino, i.e., >3.0 km, those living with the closest access, i.e., < 0.7 km, were more likely to be a gambler (Adjusted Odds Ratio: 1.60; 95% CI: 1.20 – 2.15) and problem gambler (Adjusted Odds Ratio: 2.70; 95% CI: 1.03 – 7.05). Neighborhood with the closest access to casino, i.e., < 0.7 km, in New Zealand was therefore a risk factor for disordered gambling (Pearce et al., 2008).

Accessible Retreat, which included the ideas of both "convenience" and "retreat", was related to the degree to which venues were enjoyed because they were geographically and temporally available and provided a familiar and anonymous retreat with few interruptions or distractions (Moore et al., 2011). The "convenience" part in Accessible Retreat was relevant to casino proximity, while the "retreat" part was not. Moore et al. (2011) has shown that Accessible Retreat was correlated with higher gambling frequency, higher average amount spent/year on gambling, more financial stress, stronger urges to gamble and more disordered gambling. But further break down of "convenience" and "retreat" items was not reported, rendering the direct assessment in the influence of casino proximity on problem gambling difficult.

The positive associations between casino proximity and problem gambling were rejected in the other three studies among adult population (Pasternak and Fleming 1999; Sevigny et al., 2008; Hing & Haw, 2009), suggesting that conflicting evidences existed in literature among cross-sectional studies. (Pasternak and Fleming 1999) demonstrated that the prevalence of problem gambling among patients who attended primary care physicians were similar over 3 clinics, each of different casino proximity. Yet, there was a trend that the prevalence of probable pathological gambling was higher in the clinic with closer casino proximity, i.e., 4.0%, compared with two other

clinics with farther casino proximity, i.e., 1.4% and 2.7%, though statistical significant differences were not observed (Pasternak and Fleming 1999). Sevigny et al. (2008) reported no correlation between casino proximity and problem gambling, although positive correlations were found between casino proximity and gambling participation, and between casino proximity and gambling expenditure. Hing & Haw (2009) demonstrated no relationships among casino table games, problem gambling and gambling expenditure, although a positive correlation was found between casino proximity and casino gambling frequency.

In short, the summary of cross-sectional studies revealed inconsistent evidences in the potential relationship between casino proximity and problem gambling.

Longitudinal studies

Summary of longitudinal studies investigating the relationship between casino proximity and problem gambling is listed in Table 2.

The community effect of increased casino proximity via new casino establishment on increased prevalence of problem gambling within 1 year of casino grand openings was supported by two studies (Room et al., 1999; Jacques et al., 2000), and was rejected by one report (Govoni et al., 1998). Room et al. (1999) demonstrated increased average short SOGS values by more than 50% within 1 year of casino establishment in Niagara Falls, Canada. In Hull area, Canada, 1-year and lifetime prevalence of at-risk gamblers increased from 2.0 to 2.4, and 3.3 to 7.8, and those of probable pathological gamblers increased from 1.1 to 2.2, and 1.8 to 3.3 within 1 year of casino establishment in the area (Jacques et al., 2000). However, Govoni et al. (1998) stated that the prevalence of probable pathological gamblers and problem gamblers were similar between pre- and post-casino levels within 1 year of casino establishment.

Although the prevalence of problem gambling was raised in Hull area, Canada, within 1-year of new casino establishment as indicated in previous paragraph, 2- and 4-year follow-up data showed that the prevalence rate of problem gambling did not increase, i. e., leveling off, compared with those obtained before the casino establishment (Jacques et al., 2000; Jacques and Ladouceur 2006). It was suggested that pathological gambling could be better considered as an episodic rather than a chronic disorder (Jacques and Ladouceur 2006). After the novelty effect of new casino establishment erodes, some gamblers may lose interest and move to other activities, as early increases in problem gambling are typically followed by an adaptive process that leads to lower levels of involvement, or even abstinence (Jacques and Ladouceur 2006).

In short, similar to cross-sectional studies, the summary of longitudinal studies revealed inconsistent evidences in the potential relationship between casino proximity and problem gambling within 1 year of casino establishment. The relationship between casino proximity and problem gambling was particularly doubtful after 2-year of casino establishment because of the possible social adaption process of gamblers to the novelty of casino establishment in long-run.

Discussion

Public health implications for reducing problem gambling by controlling casino proximity

Casino gambling is one of the popular forms of gambling among problem gamblers (Black and Moyer 1998; Fong and Ozorio 2005; Wong and So 2003), particularly for

Table 2 Summary of longitudinal studies investigating the relationship between casino proximity and problem gambling

Countries	Methodology	Data collection	Findings related to problem gambling	Reference
Windsor, Ontario, Canada	<i>Study type:</i> Longitudinal study <i>Number of participants:</i> 2682 adult residents <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS).	A random survey of gambling behavior was conducted prior to the opening of Casino Windsor, and one year later.	<i>Findings:</i> The prevalence of probable pathological gamblers (SOGS score ≥ 5) and problem gamblers (SOGS score 3-4) were $0.8 \pm 0.3\%$ and $1.5 \pm 0.3\%$ at pre-casino level, and $1.1 \pm 0.3\%$ and $1.1 \pm 0.3\%$ at post-casino level. No significant differences were observed between pre- and post-casino levels within 1 st year. <i>Comments:</i> No link was established between casino proximity and prevalence of probable problem and pathological gambling.	Govoni et al., 1998
Niagara Falls, Ontario, Canada	<i>Study type:</i> Longitudinal study <i>Number of participants:</i> 1002 adults, aged 18 or above. <i>Problem gambling assessment method:</i> Short South Oaks Gambling Screen (SOGS).	Telephone survey was done to document the community effects before and after the opening of a casino within 1 year of establishment.	<i>Findings:</i> Short SOGS of both Niagara Falls in 1996, i.e., 0.131 ± 0.461 , and Ontario in 1997 (control), i.e., 0.140 ± 0.469 , were statistical significantly lower than that of Niagara in 1997, i.e., 0.198 ± 0.640 ($p < 0.05$). The casino opening brought more gambling by local residents, and an increase in reported gambling problem. <i>Comments:</i> Increased casino proximity, in terms of new casino establishment in the area, increased the reported gambling problem and average short SOGS values.	Room et al., 1999
Hull area, Canada	<i>Study type:</i> Longitudinal study <i>Number of participants:</i> 457 respondents from Hull area (experimental group) and 423 respondents from the Quebec City area (control group). <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS).	Household contacts and surveys were done before the opening of the Casino de Hull and 1 year later.	<i>Findings:</i> Compared with control group, experimental group exposed to the new casino showed a statistical significant increase in gambling on casino games, maximum amount of money lost within 1 day on gambling, and the number of participants who reported knowing a person who has developed a gambling problem. In Hull area, 1-year and lifetime prevalence of at-risk gamblers (SOGS score 3-4) increased from 2.0 to 2.4, and 3.3 to 7.8, and those of probable pathological gamblers (SOGS score ≥ 5) increased from 1.1 to 2.2, and 1.8 to 3.3. The increases were found to be statistical significant. <i>Comments:</i> Increased casino proximity, in terms of new casino establishment, increased the prevalence of at-risk and probable pathological gambling within 1 st year of casino establishment.	Jacques et al., 2000

Table 2 Summary of longitudinal studies investigating the relationship between casino proximity and problem gambling (Continued)

Hull area, Canada	<p><i>Study type:</i> Longitudinal study <i>Number of participants:</i> 457 respondents from Hull area (experimental group) and 423 respondents from the Quebec City area (control group). <i>Problem gambling assessment method:</i> South Oaks Gambling Screen (SOGS).</p>	<p>Household contacts and surveys were done before the opening of the Casino de Hull, 2 years and 4 years later.</p>	<p><i>Findings:</i> Although there were negative observations in increased casino gambling and the maximum amount of money lost within 1 day on gambling, the trend was not maintained at 2- and 4-year follow-ups. The prevalence rate of both at-risk gamblers (SOGS score 3-4) and probable pathological gamblers (SOGS score ≥ 5) did not increase at the 2- and 4- year follow-ups, compared with the data obtained before the casino establishment.</p> <p><i>Comments:</i> Increased casino proximity, in terms of new casino establishment, did not increase the prevalence of at-risk and probable pathological gambling within 2nd- and 4th year of casino establishment.</p>	<p>Jacques and Ladouceur 2006</p>
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men (Blanco et al., 2006). It has been shown to be associated with a high risk of problem gambling (Welte, Wieczorek et al. 2004). High frequency of problem gambling among casino patrons is reported in Canada, United Kingdom and United States (Fisher, 2000; Fong et al., 2011; Ratelle et al., 2004). Among 89 pathological casino gamblers in South Korea, it is found that the subjects were characterized by emotional instability (anxiety, depression, rash spontaneous impulsivity, gambling symptom severity), and impaired reward sensitivity/drive (impulsiveness connecting a purposeful drive to obtain rewarding stimuli) (Lee et al., 2008). Co-morbidities in pathological casino gambling are common: alcohol addiction, tobacco addiction (Blanco et al., 2006; Pasternak and Fleming 1999), mood disorder, anxiety disorder and eating disorder (Lee et al., 2008).

In this analysis, although the findings are inconsistent, the majority of reports identified in this report, i.e., 5 out of 8 cross-sectional studies (Welte, Barnes et al. 2004; LaBrie et al., 2007; Adams et al., 2007; Pearce et al., 2008; Moore et al., 2011), and 2 out of 3 1-year longitudinal studies (Room et al., 1999; Jacques et al., 2000), does suggest the potential link between increased casino proximity and increased problem gambling. Given that problem gambling is associated with a wide range of negative health, social and environmental consequences, one should never take the potential control measures lightly. Politically speaking, it may be a good idea if public health policy makers can reduce problem gambling by increasing casino proximity among adult population within a designated area, without casino's intrusion into residential areas in local communities. By decreasing casino proximity, it may reduce problem gambling among the local residents who live away from the area. For instances, 10 km and 3 km between residential home and nearest casinos are regarded as low casino proximity in United States and New Zealand respectively, and the captioned distances are effectively associated with lower prevalence of disordered gambling in the regions of interest (Welte, Barnes et al. 2004; Pearce et al., 2008).

In Macao SAR, China, there is now an opportunity to study the public health approach in reducing casino proximity among local residents. In the end of 2011, there are a total of 34 casinos in Macao SAR, China, with 23 casinos located in Macao peninsula (Figure 1) (Macao Gaming Inspection and Coordination Bureau 2012). From Figure 1, it is clear that 22 casinos are clustered within an area called "Porto Exterior", which is actually a reclaimed land since 1990s, and is designated for uses in both casino establishments and commercial areas. Residential areas in Macao peninsula are located at the northern and central regions (Figure 1), where no casinos are built therein. Clear separation of casinos and residential areas is evident (Figure 1). Compared with random spatial distribution of casinos, casinos clustering within a designated area in the region of interest would reduce casino proximity among local residents.

Although no articles describing the relationship between casino proximity and problem gambling in Macao are identified in this analysis, indirect evidences do exist in the two cross-sectional studies carried out by Institute for the Study of Commercial Gaming, University of Macau before and after the era of gambling liberalization. In 2003 and 2007, two telephone surveys were conducted for Macao citizens with ages 15–64 years old, with samples sizes of 1191 and 1963 (Fong & Ozorio, 2005; Fong, 2009). The prevalence rates of pathological gambling and problem gambling were found to be 1.78% and 2.50% in 2003 (Fong & Ozorio, 2005), and 2.60% and 3.41% in 2007 (Fong, 2009). Simultaneously,



the gaming liberalization in Macao starts between 2003 and 2007, and the number of casinos in 2003, 2007, and 2011 are 1, 17 and 34 respectively. Given that Macao is a small city, with an area of only 29.9 km², the government attempt in clustering casino establishments within a designated area may be easily nullified by rapid increase of casino number in the region, resulting in the net increase of casino proximity among local residents and the concomitant increases of prevalence rates of pathological and problem gambling.

Limitations of this study

The major limitation of this study is the fact that there are many determinants and confounding variables in problem gambling, other than casino proximity.

Firstly, as alluded to earlier sections, there are other casino accessibility dimensions besides casino proximity. Will the accessibility dimensions overlap with each other? The answer is likely yes, as this can be indicated by significant overlaps of accessibility dimensions during the development of a multi-dimensional gambling accessibility scale (Hing & Haw, 2009). Other casino accessibility dimensions may be the confounding variables to casino proximity in this study.

Secondly, as summarized in Table 1 – Table 2, there are only twelve studies included for analysis in this study. The paucity of data makes systematic review difficult, and conflicting evidences further exacerbate the difficulty in drawing meaningful conclusion therein.

Thirdly, it is expected that the definition of casino proximity varies from regions to regions, and from countries to countries. For example, casino proximity in Canada is surely not applicable to direct adoption in Macao SAR, China. Together with the scarce literature in the area, generalization of this study's findings would be difficult, particularly in Asian countries.

Fourthly, problem gambling can be a public health problem even if the region is without any casinos, i.e., without any casino proximity in the area. With the advent of gambling technology, internet gambling becomes increasingly popular worldwide, leading to problem gambling behavior (Peller et al., 2008). Internet gambling surely contributes to problem gambling, and is a significant confounding variable to casino proximity for problem gambling. However, this factor has not been considered in the current analysis, as focus is made only in the relationship between casino proximity and problem gambling.

Implications for future studies

During the review process, a number of knowledge gaps are identified, suitable for future researches in the area for better formulation of public health policy.

What are the current evidences in Asian countries on the relationship between casino proximity and problem gambling?

No data are available in Asian countries in the potential relationship between casino proximity and problem gambling. Although some findings in this study may be generalized, most results can probably not because of the substantial differences in political system, social structures, and cultural norms across the whole world, particularly in Asian countries.

Is there a universal scale for casino proximity, applicable to most places in the world, including Asian countries?

As indicated in earlier sections, there are substantial variations in the definitions of "high" and "low" casino proximity across different countries. Given that Macao is only a tiny city, with total area of 29.5 km², generalization of literature data to local environment can be difficult, and more local data should surely be needed before any meaningful extrapolation can be made. A more refined scale in casino proximity, which is applicable to most places in the world, including Asian countries, would be desirable. Here is a suggestion for the possible more refined scale in casino proximity:

$$rCP = \frac{D_C}{D_L} \quad (1)$$

where rCP is the ratio of refined casino proximity, D_C is physical distance between respondent's home and nearest casino, and D_L is the distance travelled in total by the respondent in the past 14 days. This function, rCP, considers factors in different sizes of the regions under study, and respondent's daily living habit in transportation. Of course, the scale needs to be further validated in future studies for its potential usefulness in estimating casino proximity.

Conclusions

This study summarizes the relationship between casino proximity and problem gambling. All findings retrieved come from North America. Data from cross-sectional studies are inconsistent, with 5 reports documenting positive correlations between casino proximity and problem gambling, while 3 reports rejecting the positive correlations among adult population. Data from longitudinal studies are also inconsistent, with 2 reports confirming the influence of increased casino proximity by new casino establishment on increased prevalence of problem gambling within 1-year of casino establishment in Niagara Falls and Hull area, Canada, while 1 report rejecting the influence in Windsor, Canada. 2- and 4-year follow-up study in Hull area, Canada, showed that the prevalence rate of problem gambling did not increase, compared with those obtained before the casino establishment. Although there are some evidences supporting the potential relationship between casino proximity and problem gambling, it remains to be confirmed, and established until more data are available in the area, particularly in Asian countries.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

HT carried out keywords searches and data analysis. HT drafted the manuscript, and DC has revised the manuscript. All authors read and approved the final manuscript.

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