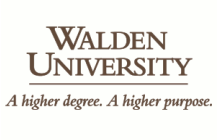

2017

The Association Between Child Abuse and Attempted Suicide in Hong Kong

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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2017

Abstract

The Association Between Child Abuse and Attempted Suicide in Hong Kong

by

Wong Hing Sang Wilfred

MMedSc, the University of Hong Kong, 2003

BSc, the University of the West of England, 1996

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health in Epidemiology

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Abstract

Children are the cornerstone of the community as well as the future of society. Child abuse and suicide among the young population is a serious and prevalent problem. Through a number of survey studies undertaken in other countries including Canada, United States, and Australia, researchers demonstrated that child abuse was related to suicidal behavior. However, this association had not been examined in Hong Kong. However, the number of hospital admissions for child abuse in Hong Kong had increased from 15.6 to 61.9 per 100,000 between 1995 and 2015 and 3.7% of child abuse cases had previously recorded suicide attempts. This study aimed to identify the association between child abuse and suicide attempts compared with influenza infection using electronic hospital admission records. From January 1, 1995 to July 31, 2016, patients with admission age $\leq$ 18 years with the diagnosis of child abuse or influenza infection were included in this study (n = 54,256). The study also retrieved data on suicide attempt hospital admissions after the first hospital admission from the database. The study results demonstrate that the adjusted hazard ratio indicated that at any given point of time, child abuse subjects had 4.79 times higher risk (95% CI 3.88 to 5.92) of attempting suicide compared with influenza infected subjects. The hazard ratio for sexual abuse and physical abuse compared with the influenza infected group was 6.48 (95% CI 4.56 to 9.19) and 4.83 (95% CI 3.67 to 6.34). Study results indicated that there was a significant association between child abuse and suicide attempts in Hong Kong. If confirmed, the study results may inform policy and interventions to reduce child abuse and consequently child suicide attempts.

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Chapter 1: Introduction

Introduction

In order for the people of Hong Kong to lead healthy lives, the children should be safe, happy and free from harm. According to Chinese culture, there is a misconception that children need to be punished to ensure obedience and respect to their parents (Wang, Xing, & Zhao, 2014). These cultural concepts have created physical abuse problems for the children as they have experienced different types of punishment (Kim et al., 2000).

Asian culture does not acknowledge child abuse and suicidal behavior of youth. Child abuse and suicide among the young population is a prevalent problem. The suicide attempt rate in China was 2.5% for men and 3.2% for women in the last decade (Hu et al., 2015). In addition, it was estimated that 43.1% of minor children in China experienced physical abuse (Ji & Finkelhor, 2015). The World Health Organization (WHO; 2016a) defined child abuse as one of the risk factors for suicide attempts. However, scholars cannot identify when the children will attempt suicide after being exposed to abuse. Professionals have not identified the underlying issues that affect the development of child suicidal behavior.

Researchers have demonstrated that child abuse, especially sexual abuse, was related to suicidal behavior in Canada, the United States, and Australia (Afifi et al., 2016; Cero & Sifers, 2013; Davies & Jones, 2013; Devries et al., 2014; Martin, Dykxhoorn, Afifi, & Colman, 2016). However, child abuse and suicidal behavior has not been evaluated in the Hong Kong community in the past decade despite the increasing incidence of child abuse in Hong Kong over that period. The rising number of the child

abuse cases reported by the Social Welfare Department (SWD) reflects the trend of increased child abuse in Hong Kong (SWD, 2015). Additionally, previous researchers have reported that the annual child maltreatment hospitalization rate in 2001 was 31.0 per 10,000 children, and it increased to 73.4 per 10,000 in 2010 (Ip et al., 2016). In addition, the movement to develop new policies for preventing child abuse has been slow. The Family Conflict and Sexual Violence Policy Unit and the Child Protection Policy Unit were formally established in October, 1997 (Hong Kong Police Force, 2016), yet the number of child abuse cases has been increasing annually. There were 589 registered child abuse cases in 2005, which increased to 874 in 2015 (SWD, 2015). The figure indicates that child abuse in Hong Kong became worse and the damages to children increased.

Background

Child Maltreatment

Child maltreatment includes all types of abuse and neglect (Hawton & Roberts, 1981). Some scientists define physical and sexual abuse as child abuse and psychological abuse or neglect as child maltreatment (National Society for the Prevention of Cruelty to Children [NSPCC], 2017). However, child maltreatment and child abuse are commonly the same terms for which an adult's actions prove to be physically or mentally harmful to a child's health (Chan et al., 2013). In this dissertation, child abuse and child maltreatment mean the same. There are mainly four types of child maltreatment: physical abuse, sexual abuse, emotional abuse, and neglect (Leventhal, 2005). The type of child abuse reflects the type of harm the child has incurred. Usually, only physical abuse and

sexual abuse harms are visible during consultation; emotional abuse and neglect are often difficult to ascertain by the clinician due to a lack of obvious signs (McElvaney, Greene, & Hogan, 2014).

Children are a vulnerable group in society. In Hong Kong, persons aged less than 18 are defined as children, and youth from 15 to 18 are treated as adolescents (Census and Statistics Department [C&SD], 2015b). An individual aged between 18 to 25-years-old is called a young adult (Massachusetts Institute of Technology, 2017). However, children and adolescents cannot exercise their rights within the community. They depend on their family or government to protect their rights and keep them safe.

Children suffering from abuse or neglect are more vulnerable than other children. Policy implementation, community support, and health care professionals need to work together to reduce the incidence of abuse (Pirdehghan, Vakili, Rajabzadeh, Puyandehpour, & Aghakoochak, 2016) and diminish at-risk behavior as abused children grow up (Norman et al., 2012). Abused children can restore their physical and mental health and return to normal lives with proper support. (Webster & Temple-Smith, 2010). Children who were exposed to abuse will develop mental health problems or engage in risky behavior (Finkelhor, Turner, Shattuck, & Hamby, 2013; Mahram, Hosseinkhani, Nedjat, & Aflatouni, 2013). Mahram et al. (2013) found that child maltreatment leads to negative health repercussions. Such children could develop suicidal and homicidal tendencies and experience substance abuse, school failure, employment difficulties, teenage pregnancy, adult attachment difficulties, family violence, and intergenerational violence (Chan et al., 2013). Suicide is one of the leading causes of mortality in China; suicide cases accounted

for 3.1% of potential years of life lost and were the 10th leading cause of death (Sun & Zhang, 2015). Health care professionals should address the consequences of child abuse and develop prevention methods to reduce the tragic consequences of child abuse.

Suicide and Suicidal Behavior

Suicide means the self-termination of life by a person using different methods, such as self-harm. According to Centers for Disease Control and Prevention (CDC; 2015), suicide is the 10th leading cause of death in the United States. The WHO (2016a) claimed that the high risk groups for suicide were individuals with mental disorders or people experiencing conflict, disaster, violence, abuse, or a sense of isolation. Researchers have demonstrated the association between child abuse and suicide (Afifi et al., 2016; Chan et al., 2013; Devries et al., 2014; Norman et al., 2012); however, few scholars have addressed the relationship between child maltreatment and suicidal behavior. Therefore, the correlation between suicidal behavior and child abuse is not well understood.

The Trends of Child Abuse and the Impact on Public Health

In Hong Kong, the C&SD's (2015b) record showed that the incidence of child abuse was increasing in the past two decades, especially child neglect and sexual abuse. Child abuse adversely affects development in children, who may subsequently develop behavioral problems and mental health issues (Danese et al., 2009; Finkelhor et al., 2013; Mahram et al., 2013; Widom, DuMont, & Czaja, 2007). The WHO (2016a) also regarded child abuse as one of the risk factors causing suicidal behavior among children. However, the effect of child abuse on suicidal behavior among Hong Kong children is still unclear.

Few researchers have examined the association between child abuse and suicide attempts in Hong Kong culture. Wong and Sun (2008) examined the deaths of adolescents due to external causes and demonstrated that the leading external causes of death for adolescents were traffic accidents and suicide. However, the Child Fatality Review Panel (2015) indicated that suicide was the biggest cause of unnatural death, and the number was higher than death by accidents. In 2015, there were 85 child death cases due to suicide, and 83 cases were due to accidents (SWD, 2016a). Therefore, suicides may be one of the major causes of death among Hong Kong adolescents. Identifying and intervening on the risk factors related to child death after exposure to abuse may reduce the mortality rate.

Theoretical Framework

This study was based on several theories. However, the main theoretical frameworks were based on (a) the child development theory; (b) the attachment theory; and (c) the interpersonal-psychological theory. The child development theory by Erikson (1950) contains the attachment theory, social learning theory, and sociocultural theory. The child development theory is used to explain how child abuse impacts children's development, their social relationships, and the development of mental health issues (Huang, Sherraden, Kim, & Clancy, 2014). The social learning theory and sociocultural theory developed by Bandura in 1977 are used to explain how children learn new or risky behavior from others and how cognitive, behavioral, and environmental factors influence child behavior. The interpersonal theory is used to illustrate the frustrate sense of belonging and perceived feeling of burden that causes suicidal ideation and attempt (Van Orden et al., 2010). The above theories were used to describe how child abuse affects

child development and leads to mental health problems, risky behavior, disturbed and dysfunctional families, and unhealthy personal communication skills.

According to the interpersonal-psychological theory, by reducing an individual's self-esteem, childhood physical abuse increases the risk of suicidal behavior (Cero & Sifers, 2013). Child abuse was associated with health problems that include mental disorders (Sachs-Ericsson, Blazer, Plant, & Arnow, 2005). Mental health disorder is the mediator for attempted suicide, suicide planning, and suicide ideation (Nahaliel et al., 2014). Children suffering from sexual abuse and emotional problems may be more likely to attempt suicide (Smith et al., 2015). Child abuse is a risk factor for mental health problems and suicidal behavior. Therefore, the relationship between child abuse and suicide attempts needs to be investigated.

Problem Statement

In Hong Kong, suicide was the leading cause of non-disease death for adolescents during the period of 1996-2000 (Wong & Sun, 2008). Therefore suicide is an imprtant cause of child mortality worth investigating. In 2007, there were 14 suicidal and 20 accidental deaths; in 2015, there were 85 suicides and 83 accidental deaths in Hong Kong (SWD, 2016a). The higher number of suicide deaths was linked to the increasing number of psychiatric disturbances, family dysfunction**,** low self-esteem, and exposure to peer suicide (Ho & Hung, 1998). Ho and Hung (1998) believed that child abuse is related to youth suicide in Hong Kong. Abused children have higher rates of attempted suicides (Chan et al., 2013; Cluver, Orkin, Boyes, & Sherr, 2015; Devries et al., 2014; Fanning,

Meyerhoff, Lee, & Coccaro, 2014; Perales, Gallaway, Forys-Donahue, Spiess, & Millikan, 2012).

Influenza infections also cause hospital admissions and child deaths in Hong Kong (Leung et al., 2017; Wu et al., 2017). The child hospital admissions for influenza infection has also increased. Nelson et al.'s (2014) study indicated that hospitalization for children less than 5 years old with influenza, increased from 924 to 1,591 per 100,000 from 2005 to 2010. Influenza was also suggested to have an association with suicide attempts and mood disorder in 2011 (Okusaga et al., 2011). Recently, treatment of influenza with Tamiflu is also suspected to be a risk factor for suicide and behavioral disturbance (Chung & Joung, 2010). However, there are few researchers in Hong Kong using hospital admission records to address the association between suicide attempts after being exposed to child abuse and influenza infection. There were also few studies on the timing for suicide attempts after exposure to child abuse and influenza infection (Dunn, McLaughlin, Slopen, Rosand, & Smoller, 2013).

The underlying factors leading to suicide in Hong Kong remain largely unknown. There was a need to understand what possible factors caused children to have suicidal tendencies after being exposed to abuse or influenza infection and also detect the timing of when they attempted suicide. However, different types of child abuse have different effects on children, and therefore requiring different preventive interventions. Hoven, Wasserman, Wasserman, and Mandell (2009) showed that recognition of symptoms and identification of high risk population to perform targeted prevention efforts was an effective deterrent for suicide.

Fanning et al. (2014) mentioned that only sexual abuse and emotional abuse were independently associated with suicide attempts and physical abuse was related to the intermittent explosive disorder. Stansfeld (2016) also noted that three or more childhood adversities that included physical and sexual abuse had 4.3 times higher association with suicidal ideation. Besides childhood adversities, many studies also demonstrated that other risk factors such as the child's age, gender, social background, and race may also be associated with suicidal behavior (Buron et al., 2016; Onishi, 2015; Shadick, Backus Dagirmanjian, & Barbot, 2015). However, few studies have used hospital admission records to address the risk factors associated with suicide attempts. Therefore, the purpose of my study was to fill the gaps in understanding whether child abuse or influenza infection and/or other factors are independently associated with suicidal behavior. The research results could provide critical information to the health care sector by showing whether a child suffering from abuse may develop suicidal behavior; while helping in the development of appropriate intervention programs.

This study also brings to the attention of the public and policymakers that child abuse may associate with suicidal behavior in children in Hong Kong. The relationship of suicidal behavior with child abuse can provide essential information that allows policy makers to design a suitable method to mitigate the damage after the injury. The research result could provide data that may be used to prevent children and adolescents from developing psychological problems and suicidal behavior in Hong Kong.

Measurement Tools for the Association of Child Abuse and Suicide Attempts

Child abuse and suicidal attempt are hidden public health issues in the community. Both are hard to identify by health care professionals, especially for children and adolescents (McElvaney et al., 2014). It is impossible and unethical to design a true experimental study to discover the causal relationship between child abuse and suicidal attempt. Researchers in most studies to date have used cross-sectional questionnaire surveys (Kann et al., 2016; Pirdehghan et al., 2016), face to face interviews (Cluver et al., 2015; Martin et al., 2016; McElvaney, Greene, & Hogan, 2012), or phone interviews (Finkelhor et al., 2013; Taylor et al., 2011) to collect data for the association analysis.

Electronic Patient Records (EPR) are a reliable data source that allow researchers to utilize the database to conduct surveillance and research (Coleman et al., 2015). Clinicians determine and enter diagnosis codes to the EPR system when the patient is admitted to the hospital. Therefore, the EPR system could reveal an individual's detailed health history and the long-term health consequences. Because of this, I could retrieve the suicide attempts records to conduct a cohort analysis for child abuse and influenza infection cases.

The Time Sequence of the Hospital Admission between Exposure and Event

The EPR contains all hospitalization information for each patient admitted to the hospital. The cohort design was such that patients who did not have hospital admission history for suicide attempts before the first hospital admission for child abuse or influenza infection were not included. The hospital admissions for suicide attempt must have happened after the abuse or influenza admissions (Figure 1). Therefore, the onset

date and follow-up period were different for each patient. Throughout the study period, the EPR records indicated who had suicide attempt admissions after the exposure to child abuse (Figure 1). However, some subjects were lost to follow-up due to death within the study period, and the analysis treated the patient as a censored case.

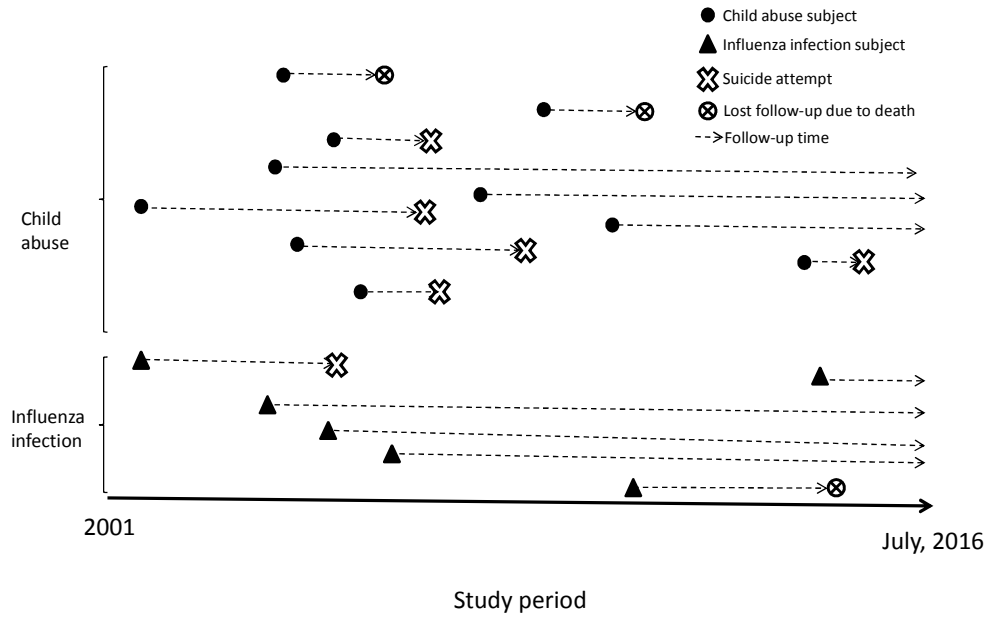

Figure 1. The time sequence of the hospital admission between exposure and event.

A Suitable Study Control

The study aimed to investigate the relationship between child abuse and suicide attempts. Therefore, an appropriate study design is to select the patients in the same period that did not have a history of child abuse, as a comparison group. However, many previous studies claimed that mental disease and chronic illness were associated with suicidal behavior (Andrade, Sesso, & Diniz, 2015; Chung, Han, Park, & Kim, 2014; Liu, Yeh, Weng, Bai, & Chang, 2016; Martin et al., 2016). If the study included all subjects who were not exposed to child abuse, the data size may have contained over 81% of the

children admitted to public hospitals in Hong Kong (C&SD, 2015a). The data file of approximately 590,000 patients was too large, and the data size was much bigger than the power needed to address the research question. Therefore, my study used a generally common disease for which children are also hospitalized as a comparable group.

Influenza

Influenza infection is a common disease in Hong Kong and especially among children. Chiu et al. (2012) reported that from 2005 to 2011, 4.3% of child hospitalizations were related to influenza. Nelson et al. (2014) estimated the direct and indirect cost of each child hospitalization was $1,217 and $1,328. Therefore, I selected influenza infection hospital admissions without exposure to child abuse and mental health history; as the comparison group.

Choice of Influenza Infection Cases as the Comparison Group

The reasons I chose child influenza infection as the comparison group was (a) the influenza virus causes a significant disease burden in Hong Kong (Chiu et al., 2012); (b) every child has the same chance of getting infected by influenza; (c) vaccination can reduce the influenza hospitalization rate (Cowling et al., 2017); (d) the incidence rate of influenza hospital admissions during 2005 to 2011 for children below 18 years of age was around 2.8% in Hong Kong (Nelson et al., 2014), a sample size suitable for comparison; and (e) influenza is a commonly known and understood disease. Therefore, I used children with influenza infection as the comparison group. However, some children do not receive yearly vaccinations due to various reasons, such as because the child had a

health issue or the socialeconomic difficulty, and the study could not address this limitation (Liao, Lam, Cowling, & Fielding, 2016).

Purpose of the Study

In this study, I investigated the association between child abuse and suicide attempts. In the past, few studies had used hospital admission data to investigate the association of child abuse and suicide attempts among children. In this study, I used the quantitative method with different statistical approaches to address the association between child abuse and suicide attempts. I also wanted to identify the risk factors that can predict adolescent attempts at suicide. The research results provided evidence whether abused children compared with an influenza infected group, were at higher risk for attempted suicide or suicidal behavior. The study results also indicated that hospital admission records were a critical source for detecting high risk groups for suicide attempts.

My study used Chi-square test to identify the difference in suicide attempts between an abused child group and influenza infected child group. The Chi-square result revealed the odds of a suicide attempt. However, my study contained different follow-up times for each child who was hospitalized for child abuse or influenza infection. Cox regression estimated the hazard ratio of suicide attempts between two groups. The results showed the risk of suicidal behavior after exposure to child abuse. My hope is that this information can help the policy makers and researchers to design effective suicide prevention methods. Ultimately, Hong Kong may reduce the suicide attempts rate and reduce suicidal behavior among children and young adults.

Research Questions and Hypotheses

RQ1: Is there any difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size?

$H_0$1: There is no significant difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection, after controlling for covariates including age of onset, gender, race, household income, and household size.

H_a1: There is a significant difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection, after controlling for covariates including age of onset, gender, race, household income, and household size.

RQ2: Is there any difference in time to suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size?

$H_0$2: There is no significant difference in time to suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

H_a2: There is a significant difference in time to suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

Nature of the Study

The target subjects for this research were Hong Kong children less than or equal to18-years-old. They had a history of hospitalization for either child abuse or influenza during 1995 to 2016 in 38 public hospitals. In the study, I used influenza hospital admission to serve as the control group to compare the suicidal rate in abused children. The research method is a non-experimental design, and the study aim was to explore the correlation between child abuse and attempted suicidal behavior.

The research design was a cohort design using the secondary data with a non-probability convenience non-randomized sampling method. I retrieved the data from the hospital electronic database. ICD-9 diagnosis code of 995.5 (child maltreatment syndrome), 995.8 (other specified adverse effects) and E967 (perpetrator of child and adult abuse) were included as diagnosis for child abuse. The first event of hospital admission for influenza infection with ICD-9 code 487 during 1995 to July 2016 was also extracted from the system. I used these cases to obtain any history of suicidal attempts until July 2016. The outcome measurement was attempted suicide, categorized as case, or control. I used (a) Chi-square test to test the percentage difference in levels of of the categorical variables between case and control group in the univariate analysis; (b) unpaired t-test calculated the mean difference in onset age, household income and household size between child abuse and influenza infected group. The following variables: sex, race, onset age, household income and household size, were adjusted for, in the Cox proportional regression models to estimate hazard ratios for the risk of attempted suicide between the two groups of children (Statsdirect, 2016); and (c) I also

conducted further analysis separating child abuse types into two groups: physical and sexual abuse for the first abuse admission separetly comparing with influenza group. The reason for separate analysis was because Cero and Sifers, (2013) claimed physical abuse was a major risk factor for suicide attempts, physical abuse reduced self-esteem, and increased the risk for suicide attempts among children.

Definitions of Key Terms

Child abuse: It is a broad term that includes child maltreatment, child abuse and child neglect wherein a parent, caretaker or adult indulges in inappropriate actions with a child less than or equal to 18-years-old. The actions include beating, sexual assault, verbal abuse, and failure to provide necessities required by a child (neglect).

Physical abuse: Physical abuse is an intentional act causing pain, injury or trauma to a person. Child physical abuse is an inappropriate physical action forced upon a child, which includes assault, battery or hitting the child with an object resulting in severe pain, and injury (Schilling & Christian, 2014).

Sexual abuse: Sexual abuse is any form of sexual conduct with the non-consenting person. Sexual abuse of a child is a crime – a heinous sexual act on a child aged less than or equal to 18-years-old.

Suicide attempts: Suicide attempts includes the behavior of self-harm where an individual tries to injure their body or terminate their life.

Other specified adverse effects: Doctor discovers injuries, symptoms and conditions but cannot find out the main reason. If the patient is less than 18 years we also consider is a children abuse.

Perpetrator of child and adult abuse: The coding contains the perpetrator information of child abuse.

Public hospital: The Hong Kong Government established public hospitals. There are 41 public hospitals in different locations in Hong Kong providing comprehensive, affordable and highly professional medical health care services to its citizens.

The electronic patient database: The electronic patient database is the system storing a patient's medical detail within the public hospital. Each patient gets a unique reference number which allows a researcher to retrieve the information of a patient without knowing their identity.

Social Change Impact of This Study

Children are the most vulnerable group in the society. Health care professionals need to try the best to provide quality care to the vulnerable population (Wood et al., 2012), and we should reduce the negative consequences that affect children's health after any tragic event. The data from the CDC (2015) indicate that suicide was the tenth leading cause of death in the United States. Many scientists and researchers have conducted studies to demonstrate that childhood sexual abuse is associated with suicide attempts. However, the association of other types of child abuse with suicide attempts has been mixed. In addition, there has been few studies on childhood sexual abuse and suicide in the population of Hong Kong. The study that I conducted contributed to bridging this research gap.

This research aimed to identify the factors associated with suicide attempts. The research findings provided more information about the significant risk factors for suicidal behavior among young adults and children. The main social change impact of the results is to inform strategies to reduce the incidence rate of suicide attempts and also the suicidal behavior of youth in Hong Kong. The information from the study can be used to encourage the public to pay more attention to the risks of suicidal behavior and reduce the number of suicides among abused children. I hope to get the study results published and furthermore use the evidence developed from my study to collaborate with potential stakeholders. My research results could help develop more prevention programs for child abuse victims and reduce the mortality rate from suicide while the positive outcome could provide more information to the clinicians, legal and educational professionals in particular and society in general to design intervention methods. The government could provide more services for families of abused children that include therapy and medication to help prevent and treat mental health problems (Ganz & Sher, 2009).

Assumptions

According to the census report, in Hong Kong, more than 85% of the children admitted to public hospitals when they have health problems (C&SD, 2015b). Therefore, in my research study, I assumed that the samples of the participants were representative of the children population in Hong Kong. The tools to secure child abuse and suicide attempts refer to the ICD-9 coding within the hospital database. The study design assumed that all child abuse cases and suicide attempts cases reported by the hospital system were real cases. The health-care professionals use the best of their personal and

clinical judgment to identify the health issues. I also assumed that the electronic patient database was well established with all public hospital data included in the system after 1995 and that no data have been lost till present. My study did not store the personal identifier in my database, and the analysis data was anonymous.

Scope and Delimitations

In this study, the main focus was to specifically look at children who reported a history of child abuse, attempted suicide among children admitted to public hospitals in Hong Kong. The study did not take into account admissions in eleven private hospitals for child abuse victims and suicidal attempt victims if the victims did not declare that they had been exposed to that injury. In Hong Kong, all suspected child abuse causes are mandatorily transferred to Hospital Authority's hospital and reported to the policy and SWD. There was also another issue in using the public hospital electronic patient database which was established during the year 1995 and only contains 21 years of data. The data from the HA hospital was not generalized enough as rich families may be using more private health service than the poor people. Therefore, the chance of detecting the problem for children living in the poor population have a higher chance of being compared to the rich families. The above factor would cause external validity issues for the study.

The other delimitation is the age of the subjects when exposed to abuse. In Hong Kong, a child is defined as one whose age is less than 18-years-old. When the victim of abuse reaches 18-years-old, then the case is re-classified as an adult abuse case. The

underestimation of the prevalence of child abuse could produce internal validity in the research.

Limitations

The limitation of the study is that the identification and classification of child abuse and suicide attempts were based on the clinician's judgment and experience. Non-physical child abuse and minor self-harm are very difficult to detect. Sometimes, the health-care professional may need a long consultation with the victim to make the diagnosis. According to some researchers, children may not disclose details during consultation (McElvaney et al., 2014). Therefore, these information biases are part of the limitations of the study.

Berkson's bias is one of the limitations of the study. The study design used patient's hospital admission of exposed to child abuse compared with influenza disease hospital admission. Berkson's bias is a selection bias that usually introduces in hospital admission record for cases and control study. There may be systematically different from one another that people with more than one disease or severe problem are more likely to be admitted compared with people with one disease or minor problem. The likelihood of being admitted to the hospital will be higher, and the odds ratio will be distorted (Sadetzki, Bensal, Novikov, & Modan, 2003).

The electronic database does not record the severity of child abuse. So I could not examine the effect on the severity of child abuse on suicide attempts. The social background of the patient was also not recorded in the system, which is a major risk factor for suicidal behavior (Onishi, 2015).

Significance of Study

The objective of this dissertation was to investigate the association of suicidal behavior with children exposed to abuse. Self-harm and suicides are some of the major causes of disease burden and death globally. Devries et al. (2014) conducted a meta-analysis and showed that childhood sexual abuse is associated with suicide attempts. Their results showed a higher pooled ORs of the co-twin analysis from the twin studies was 2.65 with the 95% confidence interval from 0.82-4.49. However, the temporality of the association is not well established, and the association was highly heterogeneous (Devries et al., 2014). In another study, researchers also showed that adverse childhood experiences were associated with all suicidal behavior that included suicide ideation, suicide planning and attempted suicide (Cluver et al., 2015). However, besides sexual abuse, other types of child abuse associated with suicidal behavior are unclear. Hong Kong only has very few studies that have investigated the association of suicide attempts with childhood sexual abuse (Chan & Burd, 2012; Shek & Yu, 2012; Yip et al., 2011). Most of these studies have used interviews, questionnaires, and surveys to investigate the association between child abuse and suicidal behavior, but they have seldom used hospital admission records to detect the association and the time when the victim might commit suicide. In this study, I filled the above-mentioned research gap and used hospital admission records to conduct the outcome.

The research aimed to address an important health problem, at the same time closed the research gap that child abuse can predict suicidal attempt in Hong Kong. The evidence justified this study that child abuse might be a factor affecting children's

behavior, and provide useful information to improve the health care model within the community.

Chapter 2: Literature Review

Suicidal behavior may occur early after a trauma (Buron et al., 2016). However, the effect of the trauma varies for different individuals, especially with children. The onset timing of suicidal ideation and the reason that children plan and attempt suicide are still unclear (Brausch & Holaday, 2015). In the last century, many studies tried to identify the risk factors for suicidal behavior among children after physical or sexual abuse, but the connections between child abuse and suicide attempts are still unclear. The risk factors for suicide attempts among abused children remain one of the biggest concerns of the public health researchers. Researchers have tried to gather evidence to explain the manner of suicidal behavior after child abuse in order to develop a suitable preventive program and treatment for victims. Through enduring efforts by many researchers such as Cao et al. (2015), Devries et al. (2014), Hu et al. (2015), and Shenk, Griffin, and O'Donnell (2015), the link between child abuse and suicidal attempts became apparent. The theory of attachment, family, and parenting were well accepted for explaining the pathway and reasons behind why a child would attempt suicide after exposure to abuse (Cero & Sifers, 2013; Keenan, Evans, & Crowley, 2016; Van Orden et al., 2010). However, there were still research gaps because it time-consuming and very costly to setup an experimental study design to examine the association between child abuse and suicide attempts.

I performed this literature review to identify the existing health problems related to child abuse and suicide attempts. I also wanted to investigate the concepts and relationships between child abuse and suicide attempts. I sought appropriate research

designs and theories to explain the linkage between child abuse and suicide attempts, recognize the research gaps on the association between child abuse and suicide attempts, and to collect any available data answering the research questions.

The Literature Review Procedure

I used PubMed and Google Scholar to perform the literature review search. I used the following keywords and word combination for the search process: *child abuse, child sexual abuse, child abuse and mental health, child abuse and prevalence, child abuse and risk factors, adverse childhood experiences, suicide attempts, suicidal ideation, self-harm, children,* and *adolescents.* The search was limited to the previous 5 years from 2011 to 2016. The study also included some related, significant, and historical articles. The literature review process was focused on the causal relationship between child abuse and suicide attempts and the risk factors for suicide attempts. The target subjects of this study were Hong Kong children, and the aim of the study was to identify the association of child abuse and suicide attempts. I used the Endnote software to capture, store, organize, and manage the references (Zhang, 2012). There were approximately 250 articles reviewed, and 177 articles were filtered out and stored in the Endnote as the main sources for the literature review.

The Trend of Child Abuse and Suicide Attempts

There is increasing evidence ng that children exposed to violence in their family or community or to maltreatment will develop behavioral, physical, and mental health problems as consequences (Danese et al., 2009; Widom et al., 2007). According to the morbidity and mortality report from the CDC (2015), suicide rates are higher in men than

in women. The suicide rate fluctuated significantly after 2007 for women in the United States. In 1994, the suicide rate for men was 15.7 per 100,000 and for women 2.7 per 100,000. In 2012, the rates were 11.9 for men and 3.2 among women (Sullivan, Annest, Simon, Luo, & Dahlberg, 2015). Suicide is a leading cause of death among adolescents in the United States, and understanding the risk factors and high risk groups for suicide is a priority to reduce the suicide rate.

The Prevalence of Child Abuse in Asian Countries

A meta-analysis study showed that the rate of physical abuse of children in China was significantly higher than that of most other countries (Ji & Finkelhor, 2015). The authors used the Child Conflict Tactics Scale and Childhood Trauma Questionnaire to rate the severity level from minor bruises to severe fractures or death. The estimated prevalence of minor physical abuse was 43.1%, while severe physical abuse was 7.8%. The result was remarkably higher than the global result estimated by Stoltenborgh (2013). Stoltenborgh, Bakermans-Kranenburg, van Ijzendoorn, and Alink (2013) used the data from Africa, Asia, Australia, Europe, North America, and South America and estimated that the prevalence of physical abuse in children was around 22.6%. The meta-analysis illustrated that physical child abuse is a widespread, global phenomenon that affects children around the world. No country can escape this problem, and more cross-cultural research is needed, especially in developing countries (Stoltenborgh et al., 2013).

Hong Kong is a part of China, but its culture and political status are very different from mainland China. Ji and Finkelhor (2015) used a meta-analysis study to address the difference between child abuse in different locations. The study showed that physical

abuse for children in mainland China was significantly higher compared to the rest of the nonmainland country. The result was comparable with another previous study in which the researchers used data from Hong Kong (Tang, 1996) and the mainland (Kim et al., 2000) with a similar methodology. The percentage of Hong Kong students who reported suffering minor assaults was 13.2%, significantly lower than 42.2% reported by mainland Chinese students. Physical assault was 8.5% in Hong Kong children population during 1996 and 22.5% in the mainland children population during 2000. The authors explained that the discrepancy might be due to mainland society being more accepting of corporal punishment than Hong Kong (Ji & Finkelhor, 2015). Also, advocacy and intervention for child abuse are much more active in Hong Kong than on the mainland.

Child Abuse in the United States and the United Kingdom

Countries such as the United States of America and the United Kingdom have well-developed surveillance systems and policies to monitor child abuse in order to protect children and reduce the rate of abuse (Klevens, Barnett, Florence, & Moore, 2015; U.S. Department of Health & Human Services, 2013). As a result, the rates of child abuse are lower there than in other countries. According to the child maltreatment report prepared by the Children's Bureau of the U.S. Department of Health and Human Services in 2014, 702,000 children had suffered abuse, accounting for 9.4 victims per 1,000 of the U.S. child population. The death rate was estimated at 2.2% of child abuse population. The perpetrators were mainly victim's parents (U.S. Department of Health & Services, 2014).

In the United Kingdom, the rate of severe maltreatment for children under the age of 11 was 5.9%, 18.6% for age range 11 to 17, and 25.3% for age range 18 to 24 years (Radford et al., 2011). The report from the United Kingdom also noted that the trend for child maltreatment showed a decline in rates of sexual and physical abuse since 1990 (Radford et al., 2011). The decreasing pattern was also observed in the United Stated (Finkelhor & Jones, 2006). The United States and the United Kingdom have developed some preventive programs, and this might have reduced the rates of child abuse in the past 25 years. If these countries provide the blueprint and share the success stories with developing countries, those countries could follow a similar trajectory and reduce their rates of child abuse.

The Child Abuse Situation in Hong Kong

Child maltreatment has become a critical issue in Hong Kong where there is no official surveillance system for child abuse (Ip, Wong, & Li, 2012). In 2015 the SWD reported 874 cases of child abuse (SWD, 2016b). While this figure is significantly lower than the figures reported in the United States and the United Kingdom, it may be due to the limited sources for unearthing child abuse cases. The real situation in Hong Kong may be underestimated.

A previous study using hospital data to determine child maltreatment and hospitalization showed that the hospitalization rate for Hong Kong child maltreatment was 80% higher than that in the United Kingdom (Ip et al., 2010). The data showed that children suffering from abuse causing hospitalization in Hong Kong were more serious cases than those in the United Kingdom. The hospitalized cases usually represented the

more severe cases because the victims needed longer treatment in the hospital after injuries. The hospital pediatric units in Hong Kong during 2007 reported that the prevalence of maltreatment for children was 0.16% of the total hospital admission. In the cases of child abuse, 57% of the hospitalizations were physical abuse, 29.6% were sexual abuse, and 12.1% were neglect (Ip et al., 2012). This result was different from the self-reported results from Jia et al. (2014) study that indicated that the predominant types of child abuse were psychological abuse (57.6%), neglect (27.4%), physical abuse (6.1%), and sexual abuse (0.3%). Chen (2015) estimated that around 70,000 children under the age of 18 had been exposed to abuse in Hong Kong and concluded that the data presented by SWD was under-reporting the real situation of child maltreatment there. The difference between the survey results of Chen's study in 2005 and the SWD data revealed that there were many child abuse cases hidden within the community. Therefore, many child abuse cases in Hong Kong had been overlooked or missed by the health care system and the damage done by child maltreatment underestimated as well.

The Prevalence of Suicide Prevalence in the United States, South Africa, and Hong Kong

The problem of suicide has affected many countries around the world. The age-adjusted rate of suicide in the United States in 2012 was 3.0 per 100,000 among 10-24 years (Aerenhouts et al., 2015). The figures from the Youth Risk Behavior Surveillance in 2009, 2011, 2013 and 2015 demonstrated that the suicide attempts rate for adolescents was increasing in the United States. The percentages change from 6.3%, 7.8%, 8.0% and 8.6% (Eaton et al., 2012; Eaton et al., 2010; Kann et al., 2014; Kann et al., 2016). The

data from the Youth Risk Behavior Surveillance demonstrated that the attempted suicide rate of 3.0% did not reflect the real problem among adolescent. The reason may due to recall bias or the subject does not want to answer the sensitive question during the survey process.

Another prospective study conducted in South Africa illustrated that the rate of attempted suicide was 2.2% for boys and 4.1% for girls reporting suicide attempts in the past month; 3.0% of boys and 6.3% of girls reported suicide planning in the past month (Cluver et al., 2015).

There has been no regular youth risk survey in Hong Kong. Therefore, the prevalence of suicidal behavior in Hong Kong is unknown. A meta-analysis estimated that the Chinese adolescent suicidal ideation and suicide attempts prevalences were 3.9% and 0.8% (Cao et al., 2015). Hong Kong adolescents also exhibit the problem of suicidal behavior. The suicide deaths involving persons below the age of 18 reported by the C&SD were small during 2007 to 2010, but the number has increased from 10 cases per year to 17 cases per year, which is equal to 2.77 per 100,000 increased to 4.7 per 100,000 (Legislative Council, 2012). It was a misconception that the problem of suicide in Hong Kong's youth was not as severe as compared with other developed countries. The data reported by the C&SD were of all suicide deaths. However, C&SD classified some adolescent deaths as unnatural death.

Shek and Yu (2012) revealed the severity of adolescent suicidal behavior in Hong Kong, they claimed that 32.7% of the students reported at least one experience of deliberate self-harm, 13.7% had suicidal thoughts, and 4.9% had suicidal plans (Shek &

Yu, 2012). The figure was higher than the result in the C&SD report. Therefore, the severity of adolescent suicidal behavior had been underestimated; it is necessary to address the risk factors and the prevention methods for suicidal behavior among the children of Hong Kong.

The Consequence of Child Abuse

WHO (2016a) considered child exposed to abuse was a major risk factor for suicide. The assumptions were due to child abuse affects child development (Finkelhor, Turner, Shattuck, & Hamby, 2013), serious injury consequence (Bartschat, Richter, Stiller, & Banschak, 2016), damaging interpersonal relationship (Van Orden et al., 2010), breaking the family, disturbing attachment (Lowell, Renk, & Adgate, 2014), and causing emotional dysregulation (Shenk et al., 2015). The consequences of childhood maltreatment may be the critical risk factors that incite the victim towards suicide.

The Implications of Child Maltreatment

The abuse on a child may last for a limited period, but its impact can last for a lifetime. The consequences include increased the risk of injury, sexual disease, non-communicable disease, musculoskeletal problems and disability (Hillis, Mercy, & Saul, 2016). Besides the physical damage, the nonphysical consequences of child abuse may affect children's development. Childhood sexual and physical abuse leads to serious health problems for both men and women. Green, Flowe-Valencia, Rosenblum, and Tai (2001) demonstrated that sexual and physical abuse are both associated with generalized pain, diabetes (Kendall-Tackett & Marshall, 1999), and other health issues such as gynecological problems, headaches, and arthritis (Sachs-Ericsson et al., 2005). A study

conducted by Sachs-Ericsson and colleagues (2005) reviewed the health consequences of child abuse while supporting the hypothesis that psychiatric disorders partially mediated the effects of physical and sexual abuse on adult health. The research provides evidence that child abuse will continuously influence the health status of the subject, causing mental disorders. Therefore, some possible mechanisms may affect the pathway between child abuse and adult health problems. Sachs-Ericsson et al.'s paper also indicated that child abuse could alleviate life-long health issues.

Intellectual and Academic Problems

The intellectual and academic problems of an abused child may be far worse compared to non-abused children. Children with a history of abuse may be at an increased risk of intellectual disability which may affect their academic performance (Euser, Alink, Tharner, van, & Bakermans-Kranenburg, 2016). The academic achievement deficits linked with mental health well-being that includes anxiety, low mood, aggression, social skills deficit, and poor inter-personal relationships that disrupt developmental process and attachment, reduce emotion regulation, and self-esteem (Romano, Babchishin, Marquis, & Frechette, 2015).

Substance Abuse

Studies have demonstrated that subjects experiencing child abuse would have an increased risk of using legal drugs, smoking, and alcohol consumption (Davies & Jones, 2013; Pirdehghan et al., 2016). The victims of child abuse are more likely to develop alcohol dependency, and the impact of alcohol abuse may be linked to legal issues, health problems, work related, and family problems (Lown, Nayak, Korcha, & Greenfield,

2011). The Lown (2011) study results also showed that sexually abused women have a higher chance of developing problems related to alcohol dependence compared to those who have been physically abused. The use of illegal drugs and alcohol during an immature age is considered risky, and delinquent behavior. However, the reason an abused subject performs such delinquent behavior may be to mediate and alleviate the inner pain received from a childhood experience of maltreatment. The use of illegal drugs and alcohol will affect a person's mental health, increase depression and lower self-esteem. Therefore, besides the external risky behavior, victims will also have intrinsic problems. Children with a history of abuse may develop symptoms that include hopelessness, depression, lower self-esteem, and self-worth issues (Suzuki & Tomoda, 2015). Maltreatment may also affect a child's cognitive processing by disturbing the child-parent interaction. Children need encouragement from parents in order to understand how other people think and feel. Without the support of the parents, this cognitive and academic function is affected; so certain researchers (Mills et al., 2011) suggested that child abuse and neglect were an adverse risk factor for children's cognitive development.

Suicidal Behavior and Child Abuse

Suicidal behavior may be one of the most severe consequences of exposure to child abuse. Some theories explain the behavior pathway why children develop suicidal tendencies after being exposed to maltreatment (Van Orden et al., 2010; Wilson & Scarpa, 2015). Increasing evidence demonstrates that children exposed to violence and maltreatment in the family or community may develop behavior problems as well as

physical and mental health issues throughout their lives (Danese et al., 2009). Evidence also demonstrates that mental health disorder was the mediator between baseline adverse childhood experiences and suicidal attempt, suicide planning, and suicide ideation (Cluver et al., 2015). Also, children exposed to emotional and sexual abuse were at an increased risk of a lifetime of suicide attempts (Smith et al., 2015). Abuse, violence and parental death were the most adverse experiences for children. Children suffering from abuse, especially maltreatment by their parents, could damage their mental health, and fracture the ability to form relationships with others (Thomas, Phillips, & Gunther, 2013).

The Risk Factors for Suicidal Behavior

Besides child abuse, previous studies in other countries have shown that a lot of risk factors that may be related to suicidal behavior. Some of the main risk factors include mental disorders, social isolation, physical illness, emotional and cognitive factor, interpersonal relationship of an abused child, and family functions.

Child Abuse

Some studies have demonstrated that child abuse will increase the possibility of suicide ideation, suicide planning and suicidal attempts (Afifi et al., 2016; Devries et al., 2014; Martin et al., 2016). In the WHO (2016a) fact sheets, abuse was one of the risk factors that increase suicidal behavior. A recent study demonstrated that suicide attempts were associated with sexual and physical assault (Bryan, McNaugton-Cassill, Osman, & Hernandez, 2013). Physical abuse was significantly associated with an increased risk of suicide ideation, while sexual abuse was significantly related to suicidal attempt. Bryan et

al. (2013) in a study showed that different types of abuse contributed to various kinds of suicidal behavior.

Mental Disorders

Mental illness is another risk factor for suicidal behavior. There are many types of mental disorders, and most of them are the consequence of child abuse. A study conducted in Shanghai reviewed the record of suicidal drowning from 2010 to 2016. The research team found that 33.8% of victims suffered from depression while 20.2% were schizophrenics. However, only 44.2% had visited psychiatric clinics, and less than 10% of victims had taken regular medication (Fang et al., 2015). This study illustrated that people with mental health problems might not have sufficient medical support for recovery. Emotional problems had been demonstrated that would increase the risk of a lifetime of suicidal attempts (Smith et al., 2015). Though the association of child abuse and mental disorders has been established especially in studies conducted in countries other than Hong Kong, the potential effects of the different types of child abuse are not clear.

Social Isolation

Isolation is an intense feeling of loneliness. The social isolation factor is inarguably the strongest and most reliable predictor of suicidal ideation and attempts (Van Orden et al., 2010). A case series study for child suicide in England demonstrated that social isolation or withdrawal was one of the biggest problems reported by children with mental health issues. 25% of the subjects claimed to be affected by this (Rodway et al., 2016). Numerous studies have demonstrated that suicidal behavior was linked with

loneliness, social withdrawal, living alone and having little or no social support. According to the child development theory, attachment theory and the interpersonal theory, the communication skills of the victims become weak after the incident. Therefore, it is easier for them to develop feelings of loneliness. According to a study, children suffering maltreatment by their parents will have their ability to form relationships with others inhibited. The underlying impact for the victims will be difficult to build and maintain relationships in adulthood (Thomas, Phillips, & Gunther, 2013).

Physical Illness

In reference to an observational study performed by Rodway and research team in England, results indicated that about 36% of the subjects with suicidal history reported physical health conditions (Rodway et al., 2016). Another study conduct in Denmark used hospitalization data to address the relationship between physical illness and suicide (Qin, Webb, Kapur, & Sorensen, 2013). The result also showed that hospitalization (for physical illness) was a significant risk factor for suicide after adjusting for psychiatric and socio-economic factors. Cancer may be one of the risk factors responsible for suicidal attempt in both children and adults population. A study conducted in China, compared the physical illness between suicide cases using control of pair-matched case study design. The finding discovered that cancer and stroke were strongly associated with suicide (Jia, Wang, Xu, Dai, & Qin, 2014). Another descriptive study illustrated that subjects with epilepsy, asthma, migraine, psoriasis, diabetes mellitus, eczema and inflammatory polyarthropathies were at an increased risk of self-harm (Singhal, Ross,

Seminog, Hawton, & Goldacre, 2014). Therefore, physical illness plays an important role in suicidal behavior.

Emotional and Cognitive Factors

The emotional and cognitive factors were also critical risk factors associated with suicidal behavior. A subject with the emotional and cognitive issues may create an environment of hopelessness, helplessness, and despair around himself. The interpersonal theory explains that a subject who has experienced child abuse will attempt suicide because his emotional and cognitive abilities have been affected (Brausch & Holaday, 2015).

The Interpersonal Relationship of an Abused Child

The interpersonal relationships of an abused child were weaker than a non-abused child. The victims of child maltreatment were found to have difficulties forming healthy interpersonal relationships with others (Romano, Babchishin, Marquis, & Frechette, 2015). Poor attachment could explain the phenomenon of these children being unable to develop appropriate social skills and bonds with others. An abused child could be rejected by his peers and family; causing aggression, sensitivity, ambivalence in the victim along with the inability to develop social skills as this behavior was the mediator for depression and abuse (Wilson & Scarpa, 2015). A study demonstrated that a weak relationship between mental disorder and child abuse with the correlation coefficient of 0.2. (Pirdehghan et al., 2016). Furthermore, child abuse and neglect showed a marked increase in the risk of depression, bipolar disorder, substance and alcohol abuse

(Nemeroff, 2016). All these consequences of child abuse are the risk factors for suicidal attempts.

Other Risk Factors

Other risk factors that associate with both suicidal behavior and child abuse are poor self-esteem, aggressiveness, and family dysfunction. The suicidal ideation can be increased by low self-esteem (Ko Ling, Yan, Brownridge, Tiwari, & Fong, 2011) while child maltreatment may cause depression through attachment styles and low self-esteem (Suzuki & Tomoda, 2015). A study found that the severity of emotional and physical abuse was significantly associated with an increasing frequency of aggressive behavior (Auslander, Sterzing, Threlfall, Gerke, & Edmond, 2016) and aggressive behavior was a risk factor for suicidal behavior. A healthily functioning family and open parent-adolescent communication were the protective factors preventing suicide ideation (Kwok & Shek, 2011). However, child abuse, especially within the family (parent/relative) may damage these protective shields causing children to develop suicidal ideation. Dunn et al. (2013) suggested that the age of first exposure to maltreatment was a critical factor associated with subsequent depression and suicidal ideation (Dunn et al., 2013). The study results demonstrated that earlier the exposure to child maltreatment (0-5 years), stronger the association with depression. Children who suffered sexual abuse at an early age had 146% more chance of suicidal ideation (Dunn et al., 2013). Child abuse during early childhood would have a greater negative impact on the child regarding attachment, emotion regulation and stress response than if the event happened at a later stage. Therefore, a child exposed to abuse during the first five years of his life was more

troubled and damaged compared to children exposed to maltreatment afterward. Thus, the youngest age group would be the most vulnerable group of children (Dunn et al., 2013).

Review of Screening Tool

Screening Tool for Child Maltreatment

Child abuse and neglect are commonly detected and discovered in the emergency department in the hospital. However, child maltreatment cases are difficult to identify in the real situation. The victims may delay disclosure of the incident or not tell the entire truth during the consultation (McElvaney et al., 2014). Abused children find it difficult to seek help from others, and this is a major factor influencing the child not tell the whole truth during medical counseling. Some scientists suggested that the victims may be afraid of no one believing them, of uncomfortable questions being asked about their well-being or of feelings of shame during the counseling (McElvaney et al., 2014). Therefore, the incident report of child abuse cases was much lower than the survey results, and the abuse cases were usually more severe than observed in the emergency department (Ip et al., 2010).

A standard questionnaire was often used to assess the incidence of child maltreatment in the survey study design. For example, a national study designed their questions by extracting items from Adverse Childhood Experiences (ACE) questionnaire and Childhood Trauma Questionnaire to address the child physical abuse prevalence (Sugaya et al., 2012). The Adverse Childhood Experiences International Questionnaire (ACE-IQ) is publicly available on the internet allowing the researcher to download the

original questions from the WHO website. The ACE-IQ is a tool designed for survey and used to detect the adverse childhood experiences and subsequent health outcomes and health risk behaviors among children (WHO, 2016b). The ACE-IQ questionnair was designed for measuring adverse childhood experiences for all countries; therefore, the questions within ACE were commonly used in many survey studies. The trauma questionnaire was used to address physical maltreatment and physical abuse in children, and they were the most common forms of early trauma (Singh, Manjula, & Philip, 2012). Self-report forms for injury were commonly used for detecting physical abuse among adolescent subject in many survey studies.

Tools for Assessing Suicidal Behavior

Many studies estimating adolescent suicidal behavior used surveys, focus groups, questionnaires or personal interviews. A study conducted by Chan et al. (2013) addressed the association between sexual abuse and suicidal behavior in Malaysian youth. The research team used a self-administered questionnaire to assess the risk of sexual abuse for suicidal behavior. This study demonstrated that sexual abuse was a more significant risk factor for suicidal ideation, plans and deliberate self-harm (Chan et al., 2013). Some self-reported questions were commonly used for accessing the suicidal behavior among children and adolescents in the survey study. The questionnaire asked a simple question whether they had ever seriously thought about attempting suicide during the past 12 months? This question had been used for the Youth Risk Behavior Surveillance (Kann et al., 2014) and many other survey studies aimed to assess children's attempted suicidal behavior. The questions were very simple and straightforward for the children. Therefore,

the tools used to assess suicidal behavior among the young age group are reliable and valid (May & Klonsky, 2011). MINI International Psychiatric Interview is another tool used for the face-to-face interview with the children and adolescents (Sheehan et al., 2010). The tools could measure self-harming desire, suicidal thoughts, ideation, planning, and attempts. The reliability and validity of the tool were well accepted for determining suicidal behavior (Cluver et al., 2015). However, using questionnaires and interviews for measuring suicidal behavior and child maltreatment had some limitations. The first limitation was the recall bias. The participants had forgotten the incident during the interview or while filling up the questionnaire. The other limitation was the selection bias in that the case might be recruited from a special clinic, school or consultation center thus generating external validity issue. The missing data from the subject could create information bias and affect the quality of the research. Besides these limitations, collecting data on sensitive issues such as suicidal behavior was a big challenge. The researchers needed extensive training for the interview as well as post interview counseling to ensure that they could collect the actual data during the interview (Taylor et al., 2011). The non-coverage error, low prevalence condition, measurement error and the non-responsive cases could also affect the validity and reliability of the study.

The Prevention Method for Suicidal Attempt

There are many programs for prevention of youth suicide that are listed by the CDC. For example, school gatekeeper training, community gatekeeper training, general suicide education, peer support programs and crisis center hotlines, etc.(Harrod, Goss, Stallones, & DiGuiseppi, 2014; Katz et al., 2013). Some of the prevention programs work

with schools to ensure that students can receive education for suicide prevention. The school gatekeeper programs were related to identifying at-risk peers and encouraging them to seek help. However, there was a review paper showing that only the Signs of Suicide and the Good Behavior Game had an impact on suicide attempts while other programs could reduce suicidal ideation, improve general life skills, and change gatekeeper behavior (Katz et al., 2013). The prevention programs could collaborate with community stakeholder or combine several programs to optimize the preventive power.

Concerning the attachment theory and the family function theory, a family program may be suitable for preventing suicide attempts among child abuse victims. The Family Bereavement Program (FBP) shows significant intervention effects on suicide ideation and suicidal attempts by children after parental death (Sandler, Tein, Wolchik, & Ayers, 2016). Tonmyr (2015) also advocated an intervention program that could improve child health after exposure to maltreatment. He called it Nurse-Family Partnership (NFP), the evidence of the RCT studies shows that the program can reduce the number of child injuries, improve cognitive and language development along with child mental health, raise school readiness, reduce adolescent antisocial behavior and increase maternal economic self-sufficiency (Tonmyr, 2015). Many studies have demonstrated that intervention had specific effects on different suicidal behavior. However, if we want to maximize the effect of an intervention program for preventing suicide, we should identify the group with higher risk and the risk factors. Thus, we should use more resources on the rightly targeted subjects at the right time to diminish or remove the subjects' suicidal behavior. For example, the school gatekeeper programs need a lot of money to train the

school gatekeepers to identify the high risk peers for suicide. Therefore, the effectiveness of the program in reducing the suicidal attempt may be small (Katz et al., 2013). Katz (2013) also concluded that school-based suicide prevention programs might have no effect.

Implications for Research and Practice

Suicide prevention can be classified as primary, secondary and tertiary prevention. Primary suicide prevention aims to reduce the incidence rate of suicide in the general population. Therefore, suicide prevention program at school or community can be classified as primary suicide prevention (Harrod, Goss, Stallones, & DiGuiseppi, 2014). Secondary suicide prevention aims to decrease suicide attempts within the high risk group while tertiary suicide prevention targeted the repeatedly suicidal group (Ganz, Braquehais, & Sher, 2010). Some scientists advocate that secondary suicide prevention is the most important and efficient program for reducing the suicidal rate (Farre et al., 2016; Ganz, Braquehais, & Sher, 2010). The most effective secondary suicide prevention strategies are pharmacological interventions, psychological interventions, follow-up care, reduced access to lethal means and responsible media reporting of suicide (Mann et al., 2005). The research results provided evidence that children exposed to abuse had a higher chance of attempting suicide. Therefore, using this research finding it could be advocated that children suffering from abuse have a higher risk of attempting suicide. Therefore, more resources and larger workforce should be allocated for child abuse victims and secondary prevention or tertiary prevention program should be implemented to eliminate the suicidal behavior. In the past, it was difficult to locate children who have suicidal

thinking or identify when a subject would attempt suicide. The research gaps may be the reason that some of the prevention programs were ineffective (Aerenhouts et al., 2015). Results from my cohort study can provide risk estimates and demonstrate which type of child abuse have the highest risk of suicidal behavior and when the most critical period of suicide attempts is. When we have a clear picture of the suicidal pattern of an abused patient, then we can decide when and what intervention program can be applied to reduce the suicidal behavior for the victims.

The Theoretical Framework

Child Development Theories

The child development theories focus on explaining the emotional, physical, social and cognitive development of children during growth. These theories contain various ideas which allow different theorists to explain how children's development is influenced. Several major theoretical approaches describe child development in various domains. Three major theorists (Erikson, Bowlby, and Ainsworth) propose theories related to children's emotional and psychological development. Erikson (1950) built upon Sigmund Freud's theory and proposed a stage theory of development to explain human psycho-social development. Erikson believed that there are 8 separate stages for the psychological development of a person. Human development needs to go through a series of lessons and challenges that helps children grow up (Geert, 1986). According to this theory, if during the adolescent period, a child is unable to overcome conflict, the consequence will influence his overall functioning due to the damaged sense of personal identity. According to a biological study early-life adversity will reduce subject longevity

by shortening the telomere length (Wenner & Randall, 2016); the result of Wenner and Randall (2016) showed that early-life adversity had a great impact on health. A national survey reported that child physical abuse was significantly associated with mental health problems and increased the risk of psychiatric disorders. Adversity may permanently affect the victim, causing him to exhibit risky behavior such as suicide. Wenner and Randall (2016) demonstrated that men who were sexually abused during childhood will had a higher risk of depressive symptoms, suicidal ideation, and attempts. Machisa, Christofides, and Jewkes (2016) also demonstrated significant results that men would developed post-traumatic stress disorder if they experienced to abuse in childhood.

Attachment Theory and Mental Problem

The child development theories focus on how parents, caregivers, peers and other social factors impact the development of the child. Parental attitudes, behavior, expectations, and involvement affect child development (Huang et al., 2014). The social theories of child development include attachment theory, social learning theory, and sociocultural theory. The attachment theory proposed by Bowlby and Ainsworth (1970) contained significant research on child abuse. Bowlby was the first to examine the attachment relationship between children and parents. He believed that this relationship had a critical impact on the development of the child while continuously influencing his social relationship throughout adult life. Attachment is an emotional bond that links the children with their caregivers; the relationship is necessary for a child as he grows. Bowlby explains that children connect with their mother and learn how to behave from them. Thus the learning process can increase the child's survival rate. Bowlby also

identified four unique characteristics of attachment that includes proximity maintenance, safe haven, secure base and separation distress. The theory also suggested that if the relationship between child and mother were damaged, it would disturb the child's emotional development in the long term (Bowlby & Institute of Psycho-analysis (Great Britain), 1982). Some theorists further explained Bowlby's attachment theory by suggesting that the four major patterns of attachment theory were secure attachment, ambivalent insecure attachment, avoidant insecure attachment and disorganized attachment (Cassidy & Berlin, 1994; Cortina, 2013). Secure attachment explains that when children are frightened or worried, they seek their parents or caregivers to feel secure. However, in many child abuse cases, the perpetrators are the victim's parents or caregivers (Kloppen, Haugland, Svedin, Maehle, & Breivik, 2016; Thomas, Phillips, & Gunther, 2013). So, the child cannot seek safety and security from them in such a situation. The ambivalent attachment explains that when children receive inconsistent and unpredictable care from their parents, they will develop ambivalent/anxious attachment patterns. Even worse, there is a syndrome called the Parental Alienation Syndrome (PAS). The PAS explained that when couples experienced a messy divorce or an ugly separation when divorced/ separated couples. They may use their child as a weapon in their conflict; it leaves the child feeling ambivalent in the process (Farkas, 2011). The parental alienation syndrome is a form of psychological child abuse and causes the child to develop psychological problems. A study demonstrated that children exposed to parental alienating behavior were significantly associated with psycho-social symptoms (Bernet, Baker, & Verrocchio, 2015). Children with avoidant attachment style could be due to

neglect; with the children avoiding the parents. In this case, children will treat their parent the same as a stranger. Subjects with avoidant attachment experience may show some character defects that include failure to support others during stressful times and inability to share feelings, thoughts, and emotions (Koelen, Eurelings-Bontekoe, & Kempke, 2016). When children are frightened, they will seek their parent/caregiver to make them feel safe. However, if the source of fright is their parent/caregiver, the child will encounter an unsolvable dilemma, and we call this situation a disorganized attachment. Disorganised attachment is the most extreme form of insecure attachment (Byun, Brumariu, & Lyons-Ruth, 2016). Children with a disorganized attachment will display dazed behavior (Beebe et al., 2010). Attachment Theory makes a case for a critical theory that children will develop mental health problems after exposure to child abuse. In many cases, the perpetrators are usually closely related to the victim. If the perpetrator is the child's parent, then this will damage the family function and the parenting. Attachment Theory provides a useful conceptual framework that child abuse associated with insecure parent-child attachment may influence the recovery of the child (Alexander, 1992). Besides the physical damage suffered in abuse, Attachment Theory explains the long-term consequences in the child, who copes by developing depression, anxiety, and stress from maltreatment (Pirdehghan et al., 2016).

Social Learning Theory and Sociocultural Theory

Bandura proposed the Social Learning Theory in 1977. He suggested that children learn new behavior from observing others. The theory explains that children change their behavior during growth by interacting between cognitive, behavioral and environmental

influences. Children and adolescents may learn risky behavior from others. Studies demonstrated that social contagion could be a risk factor for non-suicidal self-injury (Jarvi, Jackson, Swenson, & Crawford, 2013) and also suicidal attempt (Mueller & Abrutyn, 2015; Randall, Nickel, & Colman, 2015). Another psychologist Vygotsky (1987) proposed a theory explaining the social learning phenomena of the subject named sociocultural theory. Vygotsky believed that children learned from their parents, caregivers, peers and the culture. The social and environmental factors influenced children's development. Vygotsky was more focused on the children's internal feelings, emotions, ideas and language (Keenan et al., 2016). The family systems theory explained that the family was the major composer of an interconnected, interdependent individual (Kwok & Shek, 2011). The family members significantly influenced an individual's behavior. The parent-child communication was a critical factor affecting a child's thinking and behavior. The research of Kwok (2011) conducted a detailed relationship analysis between the functioning of the family and suicide ideation using a cross-sectional survey. The research team discovered that mother-adolescent communication was more important than father-adolescent communication in association with suicidal thinking; healthy family relations was negatively related to adolescent suicidal ideation. The significant elements for the healthy functioning family include mutuality, conflict and harmony, parental concern, and parental control (Kwok & Shek, 2011).

The Interpersonal Theory of Suicidal Behavior

According to the interpersonal theory, the suicidal behavior goes through habituation and opponent processes. The theories explained that the subject responds to

repeated exposure to physically painful and fear-inducing experiences. The most critical concepts of the interpersonal theory that explained the desire for suicide were the feelings of thwarted belonging and perceived burden (Van Orden et al., 2010). Child abuse is an obviously difficult incident in the daily health care system, especially when the community is not aware of the consequences of child abuse. On the other hand, a child may not want to reveal the complete tragedy during the consultation. Unsurprisingly, there were a lot of undetectable yet repeated child abuse cases within the community. The victims were repeatedly exposed to the damage before identification and treatment by the health care system.

A hospital-based study on child abuse demonstrated that the incidence death rate for a subject with repeated consults was 4%, and this figure was 1% higher than the subjects with single consultation (Martindale et al., 2014). The research team concluded that subjects with repeated consults might be at a higher risk of subsequent abuse, and this is the result of the failure in identifying and providing a suitable safety plan for the children. The interpersonal-psychological theory explains that child abuse incidents will reduce an individual's self-esteem. Subjects with childhood physical abuse may be directly or indirectly at an increased risk of suicidal behavior (Cero & Sifers, 2013). Evidence suggested that child abuse was associated with serious health problems including mental disorders (Sachs-Ericsson et al., 2005). Mental health disorder was a mediator for attempted suicide, suicide planning, and suicide ideation. Children having emotional problems combined with sexual abuse could increase their risk of a lifetime of attempted suicide (Smith et al., 2015). On the other hand, mental health issue was not an

indicator that the child felt a sense of thwarted belonging or perceived burden. However, the experience of child abuse could lead to the development of social isolation and feelings of loneliness. Cumulative Adverse Childhood Experiences (ACEs) could trigger suicidal behavior and suicide attempts (Cluver et al., 2015). Cluver et al. (2015) provided main evidence to support the association of child abuse with suicidal behavior.

The theoretical perspectives for suicidal behavior include biological, psycho-dynamic, cognitive-behavioral, and developmental (Van Orden et al., 2010). Theories explaining childhood suicidal behavior include intense affective states (Hendin, 1991), desire to escape psychological pain (Baumeister, 1990; Shneidman, 1998), disturbed attachment (Bowlby, 1973), emotion dysregulation (Linehan, 1993) and family systems (Richman, 1986; Sabbath, 1969). Each of the above theory can explain part of the landscape of child suicidal behavior after abuse in any form. Childhood maltreatment and mental disorders are the risk factors that are relevant to the development of social isolation and feeling of loneliness. Thus, childhood maltreatment and mental disorders predispose individuals to perceive that they are unwanted or expendable; these experiences may also elevate the risk for the perception of burden. All the above theories agree that child abuse is a risk factor that causes mental health problems and suicidal behavior. Therefore, assessment is required to bridge the research gap, the risk factor and other mediators affecting this linkage.

Gaps in Literature

The relationship between child abuse and the adverse psychological consequences is well established, and this concept is well accepted by scientists (Norman et al., 2012).

Many research results also advocate the association of child maltreatment and adolescent suicidal behavior (Afifi et al., 2016; Devries et al., 2014; Martin et al., 2016). However, almost all researchers use cross-sectional data with a retrospective report to examine the association between child abuse and suicidal behavior. There were limitations for detecting the severity of child abuse associated with suicidal attempt and the timing for attempted suicide after the adverse incident could not be determined. The recall bias, incomplete replies, low response rate and the external validity, affected the research quality. Therefore, a better method was needed to detect the incidence of child abuse and suicidal attempts. My study using hospital admission data filled the research gap because it provided a detailed medical history for a subject with instances of child abuse or influenza infection and the timing of attempted suicide after the injury. The record of particular incidents reduced the recall bias and reporting error, gives detailed demographic information and the time of each event, allowing the researcher to conduct an associative analysis between child abuse and suicidal attempts.

My dissertation study used hospital admission record to capture the first child abuse or influenza infection cases during 2001 to July 2016. Then I went back the system and checked if the subjects had the suicide admission after the child abuse or influenza infection event. Each subject within the database contained detailed information of the above hospital records retrieved for analysis. The study design reduced the recall bias and the reporting error. The long-term follow-up of subjects during 2001 to July 2016 within the same system provided valuable information to bridge the research gap.

Conclusion

Based on the literature review, there is a research gap for the association between child abuse and suicidal behavior, especially in Hong Kong. Also, most existing studies used survey methodology, questionnaire, focus groups interviews for assessing the link between child abuse and suicidal behavior. There have been very few studies using hospital data to examine the consequences of child abuse. In Hong Kong, there has been especially little research examining the association of child abuse with suicidal behavior. The hospital database is a large dataset that could answer some epidemiology questions. My research design showed the possibility of using hospital data to address serious health problems which were difficult to detect using traditional measurement tools.

Children are the most vulnerable group in society. We should try our best to provide quality care to this vulnerable population (Wood et al., 2012) and we should reduce the negative consequences that affect children's health after any tragic event. In U.S., suicide was the tenth leading cause of death in 2014 (CDC, 2015). In many parts of the world, many studies have shown that childhood sexual abuse was associated with suicide attempts. However, the association of other types of child abuse with suicidal attempts and the timing for suicide attempts after exposure to abuse was inconsistent. Also, there is little evidence that childhood sexual abuse or child abuse is associated with suicidal behavior in the young population of Hong Kong. This study contributed to bridging the aforementioned research gaps. Once we have the evidence of the association, prevention, and health care follow-up can be provided for the subject exposed to child abuse

Chapter 3: Research Method

As mentioned in Chapters 1 and 2, the association between child abuse and attempted suicide is an understudied public health issue. Devries et al. (2014) claimed that it is difficult to develop a useful method for examining the association. The reasons were due to many potential confounders and because the baseline of suicidal behavior was not well-controlled. In addition, there is always a challenge in collecting population data on sensitive issues such as sexual or physical abuse (Taylor et al., 2011). Therefore, the most critical component of my research was to use a valid study design to examine the association between the experience of child abuse and attempted suicide among Hong Kong youths. In my study, I analyzed electronic hospital admission records from 41 public hospitals.

In this chapter, I explain the research methodology and the study design I used. I also discuss threats to internal and external validity in this chapter. A brief discussion of the targeted population and data retrieval, statistical analysis, data cleaning, and power estimation procedures and techniques are also presented. The chapter concludes with a summary of key points and a transition to the next chapter.

Research Questions and Hypotheses

RQ1: Is there any difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

$H_0$1: There is no significant difference in time to suicide attempt in subjects with a history of child abuse compared to those with a history of influenza infection after

controlling for covariates including age of onset, gender, race, household income, and household size.

H_a1: There is a significant difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

RQ2: Is there any difference in time to suicide attempt in subjects with a history of physical or sexual abuse compared to those with a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size?

$H_0 2$: There is no significant difference in time to suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

$H_a 2$: There is a significant difference in time to suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

The International Classification of Diseases, 9th Revision

The International Classification of Diseases, 9th Revision (ICD-9) coding is the standard diagnostic tool used by clinicians in labeling patient diseases. Each disease type has a specific diagnosis. For example, 995.5 (child maltreatment syndrome), 995.8 (other specified adverse effects), E967 (perpetrator of child and adult abuse), and 487 (influenza). Patients with diagnosis code of 995.8 and E967 which is not sexual abuse because all sexual abuse needed to be reported to police in Hong Kong. E967 only record

the perpetrator information, additional coding will be added to the record if the case was physical abuse or sexual abuse. Use of the ICD-9 coding scheme also allows health professionals to do epidemiologic studies and health management work (Chen et al., 2015). In the past, researchers could only retrieve the diagnosis code from the patient folder in a hard copy format. The development of EPR provided a dramatic change to epidemiologic studies because of the electronic system's record of all disease coding. In the past decade, many countries developed their EPR to store patient records. It provides a quick way for health professionals to identify and filter out a specific diagnosis using ICD-9 (Schnitzer, Slusher, Kruse, & Tarleton, 2011). The EPR system can also quickly generate the patient list of a particular disease. Therefore, people can use EPR for surveillance, research, and information (Coleman et al., 2015). The EPR usually contain the medical and treatment histories of patients.

In my research study, use of ICD-9 information was necessary in order to identify which subjects had experienced child abuse, influenza, or suicide attempts in their histories. The measurement tool was based on the ICD-9 code made by the clinician during consultation. The information in the EPR database included diagnoses, patient age, gender, number of episodes of hospital admission, living area, date of admission and admission outcome (Table 1). Coleman et al. (2015) used ICD-9 diagnostic tools to retrieve chronic disease cases with results showing sensitivity and specificity in over 90% of the cases. However, ICD-9 also has some weak points; the accuracy for rare diseases is low, and the classification is not very detailed, which can lead to underestimation (Phiri et al., 2015; Uchiyama et al., 2015).

Variables

My study included one dependent variable, two independent variables of interest, and seven independent variables as potential confounding variables. The levels of measurement for study variables are presented in Table 1.

Table 1

Study Variables, Categories, and the Measurement Scale

Variables	Categories	Scale of measurement
Child abuse status (independent variable of interest)	0 = not abused (influenza-unexposed); 1 = Abuse (exposed)	Binary
Gender (independent)	1 = Female; 2 = Male	Binary
Race (independent)	1 = Chinese; 2 = Non-Chinese	Binary
Admission Age (independent)	Continuous	Interval
Abuse type (independent variable of interest)	1 = Others; 2 = Physical; 3 = Sexual; 4 = Physical & Sexual	Nominal
Average household size (independent)	Number	Interval
Average household income (independent)	Number	Interval
Perpetrator (independent)	1 = Others; 2 = Father; 3 = Mother; 4 = Father and mother	Nominal
Last follow-up (independent)	Number	Interval
Suicide attempts (dependent)	0 = No; 1 = Yes	Binary

Methodology

Population of the Study

The population of this study was mainly children. In Hong Kong, subjects who are 18-years-old or younger are classified as children and admitted to the pediatric ward

by law. The target participants for my study were any patients admitted to a public hospital during the years 1995-2016 with a child abuse or influenza diagnosis. The data extraction was conducted in two phases. In the first step, I used the ICD-9 coding to determine the children admitted with child abuse and influenza to build the main dataset. The ICD-9 codes for child abuse are 995.5 (child maltreatment syndrome), 995.8 (other specified adverse effects) (such as injury, untreated illnesses, poor hygiene, etc.) and E967 (perpetrator of child and adult abuse). The code for influenza is 487.

After identifying patients who met my study criteria, I extracted their data from the database. Information including an individual's gender, ethnicity, admission age, district of residence, abuse type, and the perpetrator, along with the database reference identity number, was also extracted. Only the first episode of child abuse and influenza infection was kept in the primary record. After building the main record, I used the individual record reference number to find any reported suicide attempts in the hospital records after the onset of child abuse exposure or influenza admission. As part of my study design, I also excluded subjects who had a suicide attempt history before the onset of child abuse or a hospital admission due to influenza infection. I merged the hospital admission records for the dates of suicide attempts along with the suicide events with the main database using the unique patient reference number for analysis.

Socioeconomic Gradients in Hong Kong

Hong Kong contains 18 residential districts, and each district has its character, living population density, and socioeconomic status (C&SD, 2015a). In my study, I used Hong Kong data from the C&SD (2015a) and extracted the economic information for the

residential districts (Table 2). Data extracted from the hospital data contained subject residential districts. The socioeconomic information collected from the C&SD was merged for each to reflect an individual's socioeconomic background using the residential districts. Here it showed that each living area contained their household size and household income (Table 2). The district's economic information somehow reflected the resident's economic status, for example the living density, household income and working population. However, 595 subjects around one percentage were admitted to the hospital and had not provided their living address. Therefore, the system labeled the living area as *other*, and the information for this area was missing. In my study, I substituted the overall mean value for the missing data when the household size and household income were missing. I also conducting a sensitivity analysis excluding the missing value to see if this will affect the association between child abuse and suicide attempt. Finally, I found that the small missing data did not affect the significant of the association.

Table 2

Household Income and Household Size in Hong Kong

Residential area	Average household size (person)	Average household income (HK$)
Central and Western	2.7	35,000
Eastern	2.9	29,000
Islands excl. North Lantau	2.8	26,000
Kowloon City	2.8	24,200
Kwai Tsing	2.9	20,600
Kwun Tong	2.8	20,000
Mongkok and Yau Tsim	2.6	25,000
North	3	24,500
Others	2.8	26,671
Sai Kung excl. Tseung Kwan O	3.1	33,000
Sham Shui Po	2.7	19,000
Shatin	3	27,500
Southern	3.1	29,200
Tai Po	3.1	28,000
Tsuen Wan	2.9	28,000
Tuen Mun	2.8	23,000
Wan Chai	2.6	40,000
Wong Tai Sin	2.9	21,300
Yuen Long	3	22,800

Sample Size and Power Analysis

Power or sample size analysis is based on the effective size, type I error, and level of statistical significance. G*power statistical program (Faul, Erdfelder, Buchner, & Lang, 2009) was used to analyze the sample size. The dependent variable was whether or not the subject had attempted suicide; therefore, the response was binary. In Cluver et al.'s (2015) study, subjects suffering from adverse childhood experiences were found to have 2.46 higher odds of attempting suicide. Perhaps, I used a conservative odds ratio (1.5) as the estimated effect size for my study to calculate the sample size. For a desired power of 80%, a significance level of 5%, two tails, a total of 1,074 subjects, equally divided between the case and comparison groups, were required.

Research Design and Rationale

The study I conducted was a quantitative study with a non-experimental design. As part of my quantitative approach, I used deductive logic and statistical analysis, and interpretation to test the hypotheses. My study retrieved secondary data from the hospital electronic database; therefore, no subject recruitment was required for the study procedure. All data variables were collected from the database. I used ICD-9 coding to classify children exposed to child abuse and subsequent attempts suicide.

Data Sources

Using public hospital electronic patient records for secondary data analysis has several advantages and disadvantages. The most beneficial point was that the data were already collected and available in the database so much related information could be retrieved and prepared for use. The data were in database format, can export to excel, or

easily transfer to other analytical software for analysis. However, I needed local IRB approval in order to use data.

The volume of data from the public hospitals was also one of the strengths of my study. My study used all available data to conduct the analysis. A large amount of data would increase the sample size which improved the accuracy of my results and also enhanced the power of my analysis. There was a professional team that organized and validated the data within the database to ensure the data accuracy.

The History of EPR and Development Journey of Clinical Data Analysis and Reporting System

The Hospital Authority in Hong Kong is a legal organization, which was formed in 1990. This organization manages all public health care services in Hong Kong, including 41 hospitals and service institutions, 47 specialist out-patient clinics, and 73 general out-patient clinics, which it runs in Hong Kong. Children suffering from child abuse, influenza infection, and suicide attempts who need hospitalization can only be admitted to these 41hospitals. The specialist and general out-patient clinics can refer admitted patients to hospitals if needed. According to the information provided by the Hospital Authority, there were 1.63 million inpatients and day patient discharged, 2.22 million accident and emergency attendances and 9.6 million attendance for the specialist outpatient clinics during the academic year of 2014/2015 (HA, 2016). The Census records show that the Hospital Authority covered more than 73% of the population of Hong Kong in hospital admission while the percentage of hospital admissions for children was even higher than 85% (C&SD, 2015b). Hong Kong started the development

of health informatics policy in 2007 as the Hong Kong Government had addressed the importance of using Electronic Patient Record the EPR (Poon, 2012). The government had setup a steering committee to monitor the usage of the EPR system in the HA system. The Hospital Authority then formed an EPR office to co-ordinate the whole process of using the EPR system. The duty of the EPR officers was to address the legal, policy, privacy, and security issues. The EPR officers also provided software and technical support to different sections in the development of the clinical IT system for the EPR. Different computers in the system handle different health data like the clinical management system (CMS) is responsible for handling patients' diagnosis and procedure code information. The inpatient admission system (IPAS) takes care of the patient demographics record. The EPR also contains the emergency attendance system, drug usage database, outpatient appointment, and attendances information system, laboratory test result system and the radiology examination system. However, each system was separate from the other and provided a different function for a specific unit within the Hospital Authority organization. The Clinical Data Analysis and Reporting System (CDARS) was implemented in Hospital Authority in 1995 with the aim to combine all electronics systems within the Hospital Authority to give quality support for clinical audit, data analysis, report generation and research related to human health.

The data in the CDARS has high security clearance, and the user needs to apply for the username and password from the Hospital Authority before being granted access to the system. All patients' information within the CDARS is anonymous with the identity replaced by a unique identification call reference key. When the subject is

admitted to hospital again, the system will search their reference key, and this number will not change and used by others. The researcher can use the reference key to follow a subject who has used the Hospital Authority hospital service for a period. Therefore, the reference key is critical information for a cohort study. An internal audit showed that there was a high ICD-9 coding accuracy in Hospital Authority clinical system for different types of diseases (Cheung, Fung, Chow, & Tung, 2001).

A study in Hong Kong had used the hospital data to compare suicidal cases with United Kingdom (Yip et al., 2011). This study demonstrated that deliberate self-harm cases reported to the emergency department database could be extracted for analysis. The study design also provided evidence that suicidal cases could be retrieved from the Hong Kong hospital electronic record. Yip et al. (2011) study also used the data of abuse cases and suicidal history acquired from the Hospital Authority database. The results of the study disclosed the socio-demographic profiles for Hong Kong's deliberate self-harm cases and showed that females had a higher suicidal rate than males in a ratio of 1: 2.4 with the majority less than 35-years-old. Yip's result also showed that the suicidal group was mainly a young age group and there was a research gap for this phenomenon. However, there were limitations for Yip et al. (2011) study; in the form of the sampling method. The researchers only selected subjects from a regional hospital. Thus, the research study contained external validity issues. This study design used data collected from all public hospitals in Hong Kong that covered records of more than 81% of the hospital admissions of the Hong Kong children's hospital (C&SD, 2015), thus improving the external validity of my study.

Data Cleaning and Variables Recoding

When the patient had a history of suicide admission, the last follow-up date was the date of admission for suicide. When the subjects did not have any suicide record, but were in the death registry, then the last follow-up date was the date of death. For all other records, the last follow-up was set as 31 July 2016 (end of follow-up). When patients had both influenza admission history and child abuse history, the case was defined as a case of child abuse. Hong Kong has 18 districts, each with its characteristics, population density, and socioeconomic status. In my study, I used socioeconomic information merged to each residential residential district (Table 2). When a subject showed multiple exposures to child abuse during the study period, then only the first hospital admission date was used as the onset time, and each subject only donated one count in the database with a unique reference key. The data were classified into case and control group using the variable of one represent subject exposed to influenza, and two subjects exposed to abuse and each patient contain the unique patient reference number. All variables including child abuse type, gender, race and suicidal attempt were recoded for analysis (Table 1).

Advantages and Disadvantages of the Data Sources

My study methodology also had limitations and challenges. The data are located in the hospital system is for internal use and not available publicly. I needed to learn how to use the system to retrieve the data and understand the meaning of each variable field. Since I was using secondary data and the study design is non-experimental. Therefore, randomization for subject recruitment was not allowed in my study design. The sampling

method was a non-probability convenience non-randomized sampling method. Although the public hospitals cover over 81% of the adolescent population in Hong Kong, the sampling method of my study was not be able to cover the whole child population of Hong Kong. In addition, some relevant information was not available in the data. Variables like family income, parents' mental status, residential environment and child's caregivers are important factors that may affect a child's suicidal behavior but were not be available in the dataset. The accuracy of the study results may therefore be limited by the incomplete information.

Statistical Analyses

Chi-square test, unpaired t-test, and Cox regression were used to address the research questions for this study. These analyses are appropriate when comparing the dependent variables between groups. The Cox regression analysis possess the ability to handle multiple independent variables, as in my study. I had considered others multiple regression methods for my study but the dependent variable being binary (with or without suicidal behavior), other statistical methods were deemed inappropriate compared to my selected method.

Data Analysis Plan

My study used SPSS version 21 software to perform data cleaning and analyze the data. Two imputation methods were used for handling the missing response depending on the level of measurement. I used hot-deck imputation to replace the binary and nominal missing response (Andridge & Little, 2010), a mean value for the whole group used for continuous missing response replacement. The reason for using these two

methods as I don't want add bias to the data and these two imputation methods were commonly used for imputation. Finally, only 1% residential area information was missing and only mean value imputation had been used

Research question 1 was tested using the Chi-square test to assess any significant association between suicide attempts between child abuse and influenza patients. The p-value and odds ratio on suicide attempts between two groups were used to indicate the difference. The Chi-square test was also used to test the differences in gender, race and suicide attempts between child abuse and influenza group. The analysis result was used to detect the percentage difference of gender, race and suicide attempts between child abuse group and influenza infected group. The unpaired t-test was used to calculate the means of the age of onset, household income and household size between case and control and detect the difference of the above variable between two groups. All significant variables were put to the Cox regression.

The Cox regression was used to calculate the adjusted hazard ratio for suicide attempts between child abuse patients compared with influenza patients. The result was used to answer research question one. Cox regression was also used to calculate the adjusted hazard ratio comparing between physical or sexual abuse with influenza infected group after adjusted for age, gender, race, household size, and household income. The result was used to answer the research question two. In addition, the Kaplan-Meier analysis with a reverse survival curve (1 – survival) was used to analyze the occurrence of suicide attempts with the difference in "time-to-events" between the two groups. The

survival analysis and Kaplan-Meier were used to allow the reader to visualize the development of suicide attempts according to the time after the injury.

Threats to Validity

The development of electronic medical record provides a quick way that allows a researcher to examine chronic illness, multi-morbidity, health care services and health burden of the community (Hauswaldt, Hummers-Pradier, & Junius-Walker, 2012). There are many advantages and limitations of using secondary data. In my study, the main advantages were the large sample size; the child abuse cases were already identified by doctors and follow-up of the subjects was done within the hospital system. However, secondary data has its limitations - the data were not collected to address any specific research questions, the reason why some important variables are unavailable (such as mental health condition, family structure, father and mother education) in the dataset. The limitations of the dataset can affect the internal and external validity and are discussed in the following sections. Berkson's bias is one of the threats for the study. My study used patient's hospital admission of exposed to child abuse compared with influenza disease hospital admission. There may be systematically different from one another that people with more than one disease or severe problem are more likely to be admitted compared with people with one disease or minor problem. The likelihood of being admitted to the hospital will be higher, and the odds ratio will be distorted (Sadetzki, Bensal, Novikov, & Modan, 2003).

Internal Validity

The internal validity is important for researchers to determine the cause-and-effect relationships. In my study, I wished to conclude that child abuse experience caused the suicide attempts. However, I needed to have a high degree of internal validity to claim that there was a strong evidence of causality. In my study, there were some threats to the internal validity. The first one was the confounding variables, because the dataset was not designed for this hypothesis, much needed information, including some potential confounders, was not available in the dataset. The household income and household size which were based on the population census data. If we could have each patient's household income and size that may affect the hazard ratio of the child abuse case related to suicide attempt.

The next problem was that of the selection of exposed and unexposed subjects. The sampling design was not a random assignment, and this was a threat to internal validity. The follow-up procedure between exposed and unexposed groups was also another threat because poor people tend to be admitted more than the children living in a rich family. And also children born in Hong Kong had a longer follow-up period in the health care system compared with the new immigrants. In Hong Kong, when a child suffers from child abuse, the social worker, and the hospital examine the case and follow-up with several hours of counseling. The follow-up pattern is different for children admitted with influenza illness. I only capture the first onset of the hospital admission. Therefore the onset age of influenza group was younger than child abuse group, so the follow-up period for influenza group may longer than child abuse group. The discrepancy

in follow-up between the exposed and unexposed groups was also a significant threat to the internal validity. It was because the longer follow-up time could capture more adverse consequence. Although the subjects with hospital admissions for both influenza and child abuse were identified, however, there were some abuse cases which were not identified at the beginning and thus The follow-up time may be shorter comparing if the cases could be discovered eariler.

External Validity

Through my study results, I wished to reflect the problem in the children's population of Hong Kong. Therefore, I hope my results could be generalized to the Hong Kong children's population. As I mentioned in the previous section, the Health Authority admissions covered over 81% of child hospital admissions in this city. However, there were still some external validity issues. The selection of exposed and comparison groups was dependent on the first admission of child abuse or influenza admission, therefore the demographic characteristics might have been biased. Which was difficult diagnosed child abuse for younger age and female comparing with influenza infection. Therefore, only after several attempted suicides and admitted to a public hospital, that may aware the doctor knows that the cause was child abuse comparing with influenza infection. Subjects with the milder form of attempted suicide might not have been admitted to the hospital, thereby affecting the external validity and internal validity.

Ethical Procedures

Ethical considerations are critical in all studies that involve a patient's clinical information as in my study. Before data retrieval, permissions and IRB approval were

obtained from the local IRB board (#UW 16-194), and I also needed to get the IRB from Walden University.

In the dataset, it is acknowledged that I could not identify the subjects (i.e., the data were de-identified). Instead, the system used a reference key to label each subject. The reference key was like a study subject number that only the hospital administrator can use to retrieve information about the patient. Although the dataset did not contain personal information, I still kept all documents and data in a password protected server.

Summary

The purpose of this quantitative study was to examine the association of child abuse and suicide attempts, after adjusting for some confounding factors. In the study, I used hospital admission data as the secondary data to examine child abuse cases and demonstrate the possibility of using data to investigate the consequences of child abuse. The method I used was critical for studying rare diseases using the hospital record. In the past, child abuse study was usually conducted with survey study design. The researchers found it very difficult to identify the subjects of child abuse and address the consequences as a result of the event.

Suicidal attempts among children have become an important public health issue. Using the electronic patient record to identify the high risk group for suicidal attempt may be a new way for medical professionals to prevent this tragedy. Although the study method has its limitations, however, the electronic data exists free of charge and may yield valuable results for the public. Therefore, my study provided useful information to the health care service as well as to policy makers.

Chapter 4: Results

Introduction

In this chapter, I present the results of the study showing the difference in incidence of attempted suicide between children with history of child abuse and the nonabused influenza infected group in Hong Kong. Children are usually the most vulnerable group in the community, and sometimes children's rights, hopes, health, and freedom are deprived by adults. When they suffer any form of abuse, they cannot seek help or solve the issue by themselves. The first research question examined the relationship between suicide attempts and child abuse by comparing the risk of suicide attempts between an exposed and nonexposed group. The second research question examined the difference in suicide attempts between physical abuse or sexual abuse compared to children hospitalized for influenza. Therefore, only these two types of child abuse cases were included in this analysis. The Chi-square test and unpaired *t* test were used in the univariate analysis to examine the difference between the child abuse group and influenza infected group for various variables including suicide attempts and others risk factors. I used Cox regression for multivariable-adjusted analysis to find out the independent effect of child abuse on suicide attempts. The analysis results also help elucidate the association between suicide attempts and child abuse group and influenza infected group. I also used Cox regression for the multivariate analysis to find out the independent effect of different types of child abuse on suicide attempts. I also used Chi-square test and one-way analysis of variance (ANOVA) in the univariate analysis to

investigate the difference in variables among different types of child abuse in order to understand the demographic among different types of child abuses.

Demographic Characteristics of the Study Sample

From January 1, 1995, to July 31, 2016, 54,256 patients were included in this study. Of these, 42,207 (77.8%) had hospital admission for influenza while 12,049 had hospital admission with child abuse diagnosis. There were 428 subjects diagnosed with both child abuse and influenza. In the analysis, the above mentioned subjects were removed from the influenza group and classified as the child abuse group. The male to female ratio was 1: 0.87. The study subjects were mainly of Chinese ethnicity (89.4%). The hospital admission records showed suicide attempts in 661 subjects (Table 3).

Table 3

Demographic Characteristics of the Study Sample

Characteristics	N	%
Groups		
Influenza	42,207	77.8
Child abuse	12,049	22.2
Gender		
Male	28,980	53.4
Female	25,276	46.6
Race		
Chinese	48,525	89.4
Non-Chinese	5,731	10.6
Suicide attempts		
No	53,595	98.8
Yes	661	1.2
Abuse type*		
Unknown	6,826	57.0
Physical	3,888	32.3
Sexual	1270	10.5
Physical and Sexual	65	0.5
Perpetrator*		
Others Relatives / Others Person	8,526	70.8
Father	2,018	15.7
Mother	1,403	11.6
Father and Mother	102	0.9

Note. $N = 54{,}256$. * Only for the child abuse data ($n = 12{,}049$)

Time to Suicide Attempts and Data Screening Before the Analysis

Time to suicide attempts was the duration between hospital admission for child abuse or influenza disease to the hospital admission for suicide attempts. My study was a retrospective cohort study. The outcome event of suicide attempts occurred after the date of the child abuse and influenza infection to maintain a temporal sequence from exposure to outcome. Therefore, after calculating the time to suicide attempts, 83 cases containing controversial sequence of the events were removed from the analysis. Finally, the dataset contained a total number of 54,173 subjects, of which 12,014 had been diagnosed with child abuse and 42,159 as influenza infection.

Temporal Pattern of First Hospital Admission for Child Abuse and Influenza Infections

Data showed a yearly increase in first hospital admission separately for child abuse and influenza infections in Hong Kong (Figures 2 and 3). The hospital admissions showed child abuse at 15.6 per 100,000 in 1995. After reaching a peak at 72.6 per 100,000 in 2009 admissions gradually decreased to 61.9 in 2015 (Figure 2). The hospital admission for influenza infections also showed a temporal increase. In 1995, influenza infection was extremely low at 1.5 per 100,000. The admission rate increased remarkably to 270.9 per 100,000 in 2015 with a distinct peak in 2009 (Figure 3). Since Hong Kong was suffering from the H1N1 pandemic during the year of 2009, the severity of the pandemic caused a huge increase of hospitalizations among children (Yang et al., 2012), therefore explaining the peak admission rate for influenza in 2009.

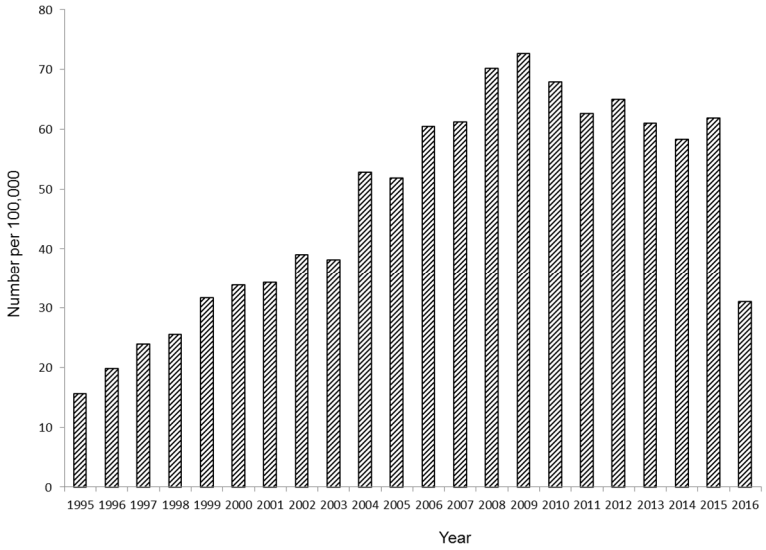

Figure 2. First hospital admission for child abuse from 1995 to July, 2016

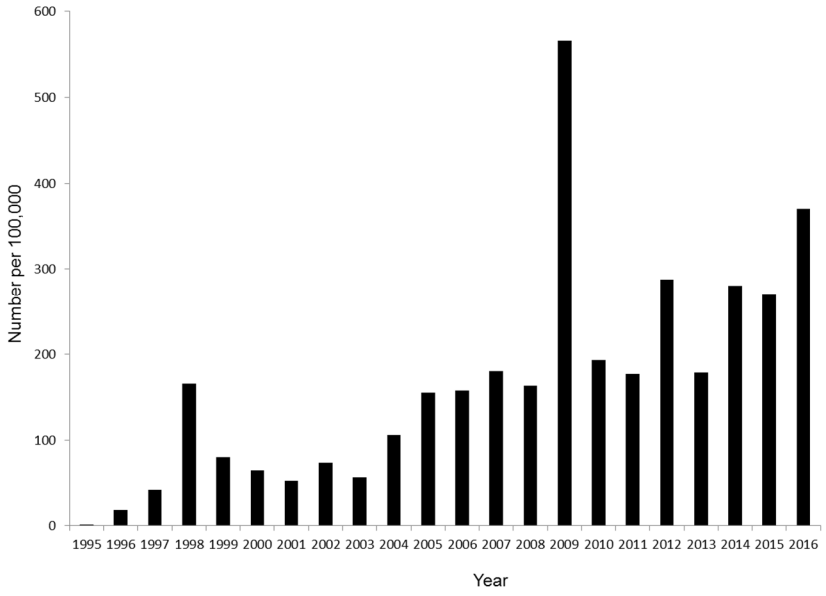

Figure 3. First hospital admission for influenza infection from 1995 to July, 2016.

Research Question 1: Is there any difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size?

$H_0$1: There is no significant difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

H_a1: There is a significant difference in time to suicide attempt in subjects with a history of child abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

Univariate Analysis Between Child Abuse and Influenza Infected Group

Suicide attempts. Before performing multivariate analysis to identify risk factors for suicide attempts, each risk factor was included separately in a univariate analysis, and the factors identified as significant were retained for multivariate analysis. Chi-square test showed a significant unadjusted association between suicide attempts and child abuse compared to the control group ($p < 0.001$). More than 3% of the children attempted suicide after being exposed to abuse while only 0.3% of influenza subjects attempted suicide. The odds ratio was 12.2 with 95% confidence interval 10-14.8 (Table 4).

Gender. Besides suicide attempts, the Chi-square analyses result also showed that gender and race were significant factors between the two groups (Table 4). The result indicated that the number of girls was higher in the child abuse group compared to the influenza-infected group. In the child abuse group, 52.5% were girls versus 44.9% in the influenza infected group. The odds ratio was 1.36, which meant that girls had 36% higher

chance of ending up as child abuse victims in comparison with the influenza infected group ($p < 0.001$).

Race. Chi-square analysis result showed that Chinese children had a greater chance of being in the abuse group than the non-Chinese children, using the influenza hospital admission as the comparison group, with an odds ratio of 1.59 ($p < 0.001$). Chinese children made up 91.9% of the child abuse group versus 88.7% in the influenza disease group (Table 4). Indeed, Chinese children had 59% higher chance of being child abuse victims than the non-Chinese compared with the similar ratio in the influenza infected group.

Admission age, household income, and size. I used an unpaired *t* test to compare the mean differences in the age of admission, household income, and household size between the exposed and nonexposed group. The findings showed that all variables were significantly different between the two groups (Table 4). Therefore, the above mentioned factors might also confound the association between suicide attempts and child abuse. The admission age of the influenza disease group was younger than that of the child abuse group with a mean difference of 4.2 years ($p < 0.001$). Children living in low-income families had a higher chance of being in the abuse group. As shown in Table 4, the mean household income for the child abuse group was HK$24,427.8, which was significantly lower than the household income of children in the influenza group ($p < 0.001$). The result also indicated that abused children often lived in a smaller household compared with the influenza disease group, with a mean difference of 0.012 person ($p < 0.001$). Despite the strong association between child abuse and suicide attempts in the

univariate analysis, I still could not conclude that exposure to child abuse was an independent risk factor for attempted suicide at this point as there were other factors that confounded the above relationships. For example, there were more females and Chinese children in the child abuse group, and if both these were the risk factors causing suicide attempts, then the relationship between child abuse and suicide attempts may be confounded by these factors.

Table 4

Univariate Analysis for Gender, Race, Suicide attempts, Age of Admission, Household Income, and Household Size Between Child Abuse and Influenza Infected Group

	Child abuse Number (%) / Mean (SD)	Influenza infected Number (%) / Mean (SD)	X^2-value / T-value	p-value	Odds ratio / Difference (95% C.I.)
Gender			216.3	<0.001	1.36
Female	6,304 (52.5%)	18,923 (44.9%)			(1.30, 1.41)
Male	5,710 (47.5%)	23,236 (55.1%)			
Race			96.3	<0.001	1.59
Chinese	11,036 (91.9%)	37,411 (88.7%)			(1.48, 1.72)
Non-Chinese	879 (8.1%)	4,748 (11.3%)			
Suicide attempts			1017	<0.001	12.2
Yes	445 (3.7%)	133 (0.3%)			(10.0, 14.8)
No	11,569 (96.3%)	42,026 (99.7%)			
Age of admission (year)			101.3	<0.001	4.2
Mean (SD)	8.3 (4.5)	4.1 (3.9)			(4.1, 4.3)
Household income (HK$)			22.5	<0.001	1046.8
Mean (SD)	24,427.8 (4190.8)	25,474.6 (23.3)			(955.6, 1138.0)
Household size (No. of persons)			8.8	<0.001	0.012
Mean (SD)	2.89 (0.132)	2.90 (0.138)			(0.009, 0.015)

Univariate Risk Factor Analysis for Suicide Attempts

After investigating the individual variables within the exposed and unexposed group, the variables were also used to detect the association between the suicide attempts and non-suicide attempts group since there was a strong relationship between suicide attempts and child abuse group and we needed to understand the others risk factor that associated with suicide attempts. The relation between other risk factor with suicide attempts may strengthen or remove the linkage between suicide attempts and child abuse.

Gender. Gender was a significant factor that associated with suicide attempts. The Chi-square result indicated that females had a higher percentage of suicide attempts (Table 5). The result demonstrated the percentage of female children was 68.5% within the suicide attempts group, and the figure was higher than male children 31.5%. The odds ratio for a female attempt suicide compared with a male was 2.5 with a significant p-value of <0.001. That meant that females had more than two times higher chance of attempting suicide compared with male ($p<0.001$) (Table 5).

Race. The Chi-square analysis results also showed that Chinese children had a greater chance of attempting suicide compared with the non-Chinese with an odds ratio of 3.0 ($p<0.001$). Chinese children in suicide attempts group were 96.2% versus 89.4% in the non-suicide attempts group (Table 5). Indeed, Chinese children had three times higher chance of suicide attempts compared with the non-Chinese. The results showed that we were 95% confident that Chinese children had at least two times higher chance than non-Chinese children for suicide attempts ($p<0.001$) (Table 5).

Admission age, household income, and size. Unpaired *t* test was used to compare the mean differences in the age of admission, household income and household size between suicide attempts and non-suicide attempts subjects. Both the age of admission and household income had demonstrated a significantly difference between the two groups (Table 5). The suicide attempts subject had a higher age of admission and a lower household income. The social economic status of the suicide attempts subject was lower than the non-suicide subjects and the mean difference was HK$ 748 lower than the subject of non-suicide subject ($p<0.001$). On the other hand, suicide attempts subject possessed higher age of admission in contrast with the non-suicide subjects. The mean age difference between the two groups was 5.1 years ($p<0.001$). The above mentioned risk factors associated with the suicide attempts group had similar characteristics compared with the child abuse group. One factor that was not significantly different between suicide attempts and non-suicide attempts subject was the household size. The mean difference between two groups was 0.01 person with a p-value of 0.296.

Table 5

Univariate Analysis for Gender, Race, Age of Admission, Household Income, and Household Size Between Suicide Attempts and Nonsuicide Attempts Group

	Suicide attempts	Non-suicide attempts	X^2-value / T-value	p-value	Odd ratio / Different (95% C.I.)
	Number (%) / Mean (SD)	Number (%) / Mean (SD)			
Gender			113	<0.001	2.5
Female	396 (68.5%)	24,831 (46.3%)			(2.1, 3.0)
Male	182 (31.5%)	28,764 (53.7%)			
Race			28.3	<0.001	3.0
Chinese	556 (96.2%)	47,891 (89.4%)			(2.0, 4.6)
Non-Chinese	22 (3.8%)	5704 (10.3%)			
Age of admission (year)			28.0	<0.001	5.1
Mean (SD)	10.1 (4.8)	5.0 (4.3)			(4.8, 5.5)
Household income (HK$)			4.0	<0.001	748.9
Mean (SD)	24,501.5 (4149.8)	2,5250.4 (4522.4)			(378.6, 1119.3)
Household size (No. of persons)			1.0	0.296	0.006
Mean (SD)	2.89 (0.133)	2.90 (0.136)			(0.017, 0.005)

Survival Pattern Between Child Abuse and Influenza Infected Groups

Kaplan-Meier Survival Analysis and 1-Minus Survival Curve

Kaplan-Meier survival analysis is one of the best methods used to measure the fraction of subjects surviving for a certain amount of time after the treatment. We can also compare survival patterns of two different groups. In my study, I aimed to measure the time when the subjects attempted suicide instead of suicide death. The 1-minus survival curve was using 100% minus the survival percentage in the y-axis to indicate the apparent suicide pattern between two groups since the hospital admission, either due to child abuse or influenza infections. The result of the Kaplan-Meier analysis showed that more subjects would attempt suicide in the child abuse group (Table 6). Nearly 5% subjects would attempt suicide in the ten years since the admission, and more than 7% subjects would attempt suicide in twenty years. The test statistic for the Log-Rank analysis was 824.5 with a p-value of less than 0.001, indicating that the percentage of suicide attempts among children in child abuse group was significantly higher than the subjects in influenza infection group ($p<0.001$). The Kaplan-Meier result also showed a difference in suicide attempts between abuse group (0.24%) and influenza infected group (0.19%) (Table 6). However, the difference between two groups was greater at ten years after the admissions. The percentage difference gradually increased from 3.75 % at ten years to 6.02 % at twenty years after the admissions (Table 6). From the 1-survival curve, it shows that the time to admission due to suicide attempts between two groups was different (Figure 4). 1- survival is using 100% - events (suicide attempts) percentage.

Table 6

Kaplan-Meier Survival Percentage Analysis for Abuse and Influenza Group

Follow-up year	Abuse group		Influenza inflected group		Log-rank p-value
	Survival (%)	Reverse Survival (%)	Survival (%)	Reverse Survival (%)	
5	99.76	0.24	99.81	0.19	<0.001
10	95.87	4.13	99.65	0.35	
15	94.33	5.67	99.26	0.74	
20	92.95	7.05	98.97	1.03	

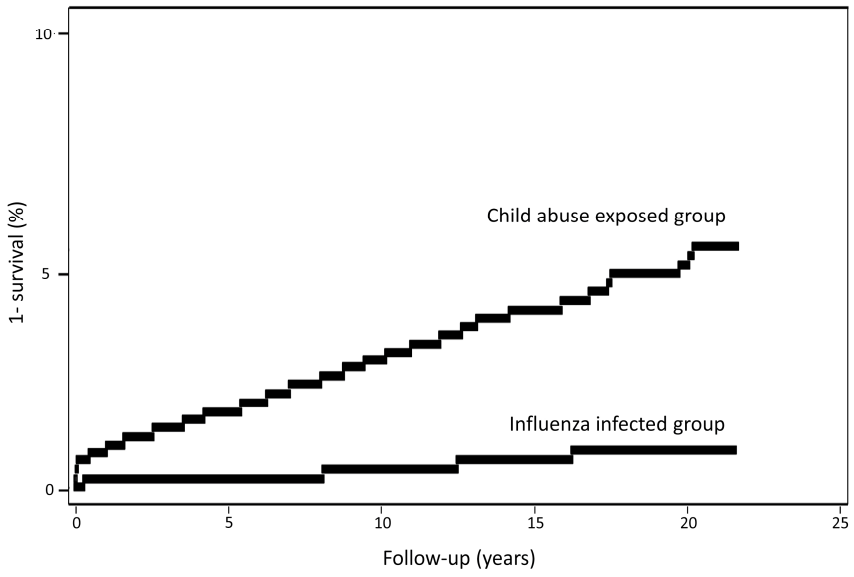

Figure 4. *1- survival curve for the time of developing suicide attempts between groups exposed to child abuse and groups infected with influenza*.

Cox Regression Result Between Child Abuse and Influenza Infected Group

The Cox regression result indicated that after controlling for gender, race, admission age, average household size and average household income, compared to the influenza group, exposure to child abuse was a significant factor affecting the risk of attempted suicide. The adjusted HR indicated that at any given point of time, child abuse subjects had 4.79 times higher risk (95% CI 3.88 to 5.92) of attempting suicide, compared with influenza infected subjects ($p<0.001$) (Table 7). Based on the Cox regression result, I rejected the null hypothesis in favor of the alternative hypothesis. The analysis results demonstrated that there was a significant difference in risk to suicide attempts between subjects with a history of child abuse and the comparison group, after controlling for several potential confounders, including the onset admission age for child abuse or influenza infection, gender, race, average household size and average household size.

Other risk factors that affect the time to suicide attempts. Cox regression results also revealed that in addition to child abuse the other significant independent risk factors affecting the risk of suicide attempts, were gender, race, and admission age. A male had a lower risk of suicide attempts compared to a female with a hazard ratio of 0.53 ($p<0.001$). A Non-Chinese also has a lower risk of suicide attempts, compared to a Chinese subject with a hazard ratio of 0.55. Children with onset at an older age at first admission had a higher risk of suicide attempts, with an increase of one year increased the risk of suicide attempts by 16% ($p=0.006$). Neither average household size nor income were significant risk factors for time to suicide attempts.

Table 7

Cox Regression Analysis for Developing Suicide Attempts Between Abuse and Influenza Infected Group After Controlling for Others Risk Factors

Factors	*B*	SE B	p-value	Adjusted hazard ratio (AHR)	95% CI for AHR
Group (abuse vs. influenza)	1.57	0.11	<0.001	4.79	(3.88, 5.92)
Gender: Male vs female	-0.64	0.09	<0.001	0.53	(0.44, 0.63)
Race: Non-Chinese vs. Chinese	-0.60	0.22	0.006	0.55	(0.36, 0.84)
Age of admission, per year increase	0.15	0.01	<0.001	1.16	(1.14, 1.18)
Average household size, per number of person increase	-0.01	0.34	0.97	0.99	(0.51, 1.92)
Average household income, per one dollar increase	0.00	0.00	0.31	0.9993	(0.999, 1.0003)

Research Question 2: Is there any difference in risk of suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size?

$H_0$2: There is no significant difference in to the risk of suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after controlling for covariates including age of onset, gender, race, household income, and household size.

H_a2: There is a significant difference in to the risk of suicide attempt in subjects with a history of physical or sexual abuse and a history of influenza infection after

controlling for covariates including age of onset, gender, race, household income, and household size.

Different types of child abuse and suicide attempts: RQ2. The analysis only included subjects with physical abuse or sexual abuse history comparing separately with influenza inflected group. This analysis aimed to examine the association of suicide attempts after exposure with different types of child abuse. The child abuse cases were classified as physical abuse, sexual abuse, or both Only sexual abuse or physical abuse were included in the data analysis procedure. However, before answering research question two, I also wanted to describe the data for this aim.

Univariate Analysis and Basic Demographic trends Among Different Abuse Types

The suicide attempts was seen in 5.3% cases of sexual abuse and doubled to 12.5% in both sexual and physical abuse type ($p < 0.001$). From the Chi-square test result, it could be deduced that there was a significant gender difference in different types of abuse. The result showed sexual abuse and both physical and sexual abuse type was associated with female gender in comparison with male gender ($p < 0.001$). Race/ethnicity was also associated with abuse type in the univariate analysis: as shown in Table 8, fewer non-Chinese were diagnosed with both physical and sexual abuse type ($p = 0.01$).

Table 8

Univariate Analysis Among Different Abuse Types

Factors	Others N=6841	Physical N=3877	Sexual N=1259	Physical and sexual N=64	p-value
Gender					<0.001
Female	3,306 (48.5%)	1,825 (47.1%)	1,120 (89.0%)	53 (82.8%)	
Male	3508 (51.5%)	2052 (35.9%)	139 (11.0%)	11 (17.2%)	
Race					0.01
Chinese	6,224 (91.3%)	3,606 (93.0%)	1,150 (91.3%)	56 (87.5%)	
Non-Chinese	590 (8.7%)	271 (7.0%)	109 (8.7%)	8 (12.5%)	
Suicide					
Yes	219 (3.2%)	151 (3.9%)	67 (5.3%)	8 (12.5%)	<0.001
No	6595 (96.8%)	3726 (96.1%)	1192 (94.7%)	56 (87.5%)	
Perpetrator					<0.001
Others	5,371 (78.8%)	1,939 (50.0%)	1,150 (91.3%)	37 (57.8%)	
Father	864 (12.7%)	1032 (26.6%)	102 (8.1%)	16 (25.0%)	
Mother	532 (7.8%)	857 (22.1%)	4 (0.3%)	8 (12.5%)	
Father and mother	47 (0.7%)	49 (1.3%)	3 (0.2%)	3 (0.2%)	

The perpetrator also differed significantly among different types of abuse ($p < 0.001$) (Table 8). Influenza infected patients didn't have perpetrator and had not put into the Cox-regression model. The ANOVA analysis results indicated that all three variables were significantly different among different types of abuse. The age at first admission for physical and sexual abuse type was highest among all abuse types ($p < 0.001$). Average household income and size also differed significantly among abuse types (Table 9).

Table 9

Analysis of Variance (ANOVA) Result Analysis Among Different Abuse Types

Factors	Others	Physical	Sexual	Physical and sexual	p-value
Age of admission (year)					<0.001
Mean	7.8	9.0	9.3	11.2	
Standard deviation	4.4	4.3	4.6	4.4	
Average household size (No. of persons)					0.003
Mean	2.9	2.9	2.9	2.9	
Standard deviation	0.13	0.13	0.14	0.12	
Average household income (HK$)					<0.001
Mean	24,783	23,942	24,004	24,303	
Standard deviation	4,404	3,750	4,152	3,161	

Survival Pattern Among Different Abuse Types

The result of Kaplan-Meier analysis and the reverse survival percentage indicated that the development of suicide attempts was significantly different among abuse types ($p < 0.001$) (Table 10). A higher percentage of reverse survival percentage was observed for

physical and sexual abuse. The five years reverse survival percentage for this type of abuse was 12.5% which was higher than other abuse types. Overall, sexual abuse had a higher reverse survival percentage than physical and others abuse (Table 10).

Table 10

Kaplan-Meier Survival Percentage Analysis of Developing Suicide Attempts Among Different Abuse Types

Follow-up year	Others		Physical		Sexual	
	Survival (%)	Reverse survival (%)	Survival (%)	Reverse survival (%)	Survival (%)	Reverse survival (%)
5	98.0	2.0	97.8	2.2	95.3	4.7
10	96.4	3.6	95.8	4.2	93.4	6.3
15	95.1	4.9	93.8	6.2	92.6	7.4
20	93.7	6.3	92.7	7.3	-	-

Follow-up year	Physical and sexual		Log-rank *p* value
	Survival (%)	Reverse survival (%)	
5	87.5	12.5	<0.001
10	87.5	12.5	
15	-	-	
20	-	-	

Cox Regression Result of Physical Abuse, Sexual Abuse Comparing with Influenza Infected subjects

The Cox regression results for physical abuse compared with influenza infected subjects indicated a similar result of the whole abuse group with influenza infected group (Table 11). The adjusted HR of physical abuse in comparison with influenza infected group were 4.83 (95% CI 3.67 to 6.34). The result indicated that the risk of a suicide attempt for children who experienced physical abuse was 4.83 times higher compared with influenza infected group after controlling for the factors of gender, race, admission age, average household size and, average household income (Table 11). The result also showed that gender, race, and age of admission were independent risk factors that associate with suicide attempt; average household size and household income did not effect on suicide attempt (Table 11).

The Cox regression results in sexual abuse compared with influenza infected group indicated a stronger adjusted HR than for physical abuse. The adjusted hazards for suicide attempts in sexual abuse type was 6.48 times higher (95% CI 4.56 to 9.19) compared with influenza inflected group (Table 12). The 6.48 hazard ratio is higher than the physical abuse's 4.83 and also all types of abuse 4.79 in comparing with influenza infected group. The Cox regression results also indicated that after adjusting for the covariates factors; both gender and age of admission were significantly associated with suicide attempts. Gender had a marginal significant p-value of 0.047 and age of admission was a strong significant factor with a p-value of <0.001. The hazard ratio of suicide attempt indicates that children with sexual abuse history had a higher risk of

attempt suicide comparing with physical abuse children and influenza infected children. This result enabled us to answer the second research question by rejecting the null hypothesis and in favor of the alternate hypothesis. We concluded that there was a statistically significant difference in risk of suicide attempts of physical abuse, or sexual abuse comparing with influenza infected children, after controlling for the risk factors of age at onset, gender, race, household income, and household size. Furthermore, the type of abuse was an independent risk factor that affected the development of suicide attempts. Both gender, race, and admission age also significantly affected the development of suicide attempts in physical abuse comparison (Table 11). In sexual abuse comparison with influenza group, only age of admission shown the significant result (Table 12).

Table 11

Cox Regression Analysis for Developing Suicide Attempts Between Physical Abuse and Influenza Infected Group After Controlling for Other Risk Factors

Factors	*B*	SE B	p-value	Adjusted hazard ratio (AHR)	95% CI for AHR
Group (abuse vs. influenza)	1.57	0.14	<0.001	4.83	(3.67, 6.34)
Gender: Male vs female	-0.46	0.12	<0.001	0.57	(0.45, 0.73)
Race: Non-Chinese vs. Chinese	-0.84	0.34	0.014	0.43	(0.22, 0.84)
Age of admission, per year increase	0.14	0.01	<0.001	1.15	(1.12, 1.18)
Average household size, per number of person increase	-0.01	0.48	1.46	0.23	(0.70, 4.54)
Average household income, per one dollar increase	0.00	0.00	0.054	0.9993	(0.9992, 1.0004)

Table 12

Cox Regression Analysis for Developing Suicide Attempts Between Sexual Abuse and Influenza Infected Group After Controlling for Other Risk Factors

Factors	*B*	SE B	p-value	Adjusted hazard ratio (AHR)	95% CI for AHR
Group (abuse vs. influenza)	1.87	0.18	<0.001	6.48	(4.56, 9.19)
Gender: Male vs female	-0.33	0.16	0.047	0.72	(0.53, 0.99)
Race: Non-Chinese vs. Chinese	-0.67	0.34	0.053	0.51	(0.26, 1.01)
Age of admission, per year increase	0.17	0.02	<0.001	1.12	(1.15, 1.22)
Average household size, per number of person increase	0.06	0.55	1.06	1.06	(0.36, 3.08)
Average household income, per one dollar increase	0.00	0.00	0.69	0.9993	(0.9992, 1.0004)

Conclusion

The analysis and results of this chapter provided valuable information in answering both questions one and two. When compared to influenza infection, exposure to child abuse was an independent factor associated with suicide attempts. When a child was exposed to child abuse, the risk of suicide attempts was higher than a child infected by influenza. The risk was 4.79 times at any time point after being exposed to the injury. My results also showed that among abuse subjects sexual abuse had a higher hazard of suicide attempts comparing with physical abuse and influenza infected group. The adjusted HR of sexual abuse comparing with influenza infected group was 6.48 (95% CI 4.56 to 9.19) which is much higher than the physical abuse group's hazard ratio of 4.83 (95% CI 3.67 to 6.34), and also higher than the whole physical abuse group's hazard ratio

4.79 (95% CI 3.88 to 5.92). They may be the most vulnerable group among the child abuse subjects.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The results indicated that child abuse in Hong Kong is a significant risk factor associated with suicide attempts. The results were comparable to those reported in studies from other countries. Additional critical information provided by this study is the time of attempting suicide after the patient admitted to the hospital with the diagnosis of child abuse. Detecting a child abuse case in society is not easy, and seizing the opportunity to reduce the suicidal behavior associated with it is even more challenging. Usually, only the serious child abuse cases are admitted to the hospital. The results of this study indicated that child abuse was significantly related to suicide attempts. The medical professionals should be aware of this association and identify the child abuse cases and provide them with a suitable and a timely referral to reduce the suicidal behavior. In this chapter, I provide a brief interpretation of the results in relation to the purpose of the study. Also, I discuss the significant findings and compare my results with those from previous studies, some of them conducted in other countries. I also provide some study deliverables and implications based on the study results.

Purpose

The purpose of this retrospective cohort study was to examine the relationship between exposure to child abuse and suicide attempts among children in Hong Kong. Through the study I also identified the risk of suicide attempts among different types of abuse. Previous research studies that demonstrated an association between child abuse and suicide attempts were mainly cross-sectional surveys (Hu et al., 2015; Kann et al.,

2016; Norman et al., 2012; Singh et al., 2012; Smith et al., 2015). Very few studies addressed the timing of attempted suicide after exposure to child abuse (Dunn et al., 2013) and seldom had any research paper demonstrated that patients' hospital records could be used to address the above research questions. Besides the above stated aims, my ultimate aim with this study is to raise public awareness of child abuse issues. Child abuse can have serious consequences. Child abuse might cause affected children to contemplate suicide or attempt suicide. Hong Kong is a developed country and has a well developed health care and social welfare system in place. However, suicidal behavior is still one of the most critical public health issues that undermines the health and well-being of the children in Hong Kong. The study results revealed that an association between child abuse and suicide attempts existed among the child population of Hong Kong. Therefore, suicide prevention groups could target the cases in the hospitals that have been diagnosed as child abuse. My study results showed that children with a history of child abuse were associated with a higher risk of suicide attempts. if replicated, these results may inform strategies for preventing child abuse and consequently suicide attempts.

Interpretation of the Findings

The Association of Child Abuse and Influenza Infection With Suicide Attempts

I observed that there was an increase in the number of hospital admissions for child abuse and suicide attempts from 1995 to 2009. The hospital admissions for child abuse and suicide attempts peaked in 2009 and then gradually decreased (Figures 1 and 2). The result of this research answered the first research question and demonstrated that there was a significant association between exposure to child abuse and suicide attempts

when compared to the nonabused influenza group. The adjusted HR of 4.79 ($p < 0.001$) in Cox regression analysis indicated that children exposed to child abuse had a 4.79 times higher chance of attempting suicide at any given time compared to a children infected by influenza, adjusting for an individual's gender, race, first admission age, household income, and household size.

The Association of Sexual or Physical Abuse With Suicide Attempts

The results that answered the second research question showed a significant difference in risk for suicide attempts among subjects who suffered physical abuse and sexual abuse compared with influenza infected children. I used the the Cox regression model to separately analyze the risk for physical and sexual abuse with influenza infected group. The results for physical abuse indicated that the adjusted HR were 4.83 (95% CI 3.67 to 6.34) times higher for attempting suicide for physical abuse comparing with influenza infected group. The hazard ratio was similar comparing with the whole abuse group's 4.79. The sexual abuse group demonstrated the highest adjusted HR of 6.48. The results filled the gap in the literature regarding child abuse subjects and showed that more attention should be paid to those who had been sexually abused. The results were adjusted for gender, race, admission age, average household size, and household income, which meant that the effect of the association between both sexual or physical abuse and suicide attempts was independent of the above factors.

Time of Attempting Suicide After Exposure to Abuse

Another important message of this study regarded the timing of suicide attempts after exposure to child abuse. The Kaplan-Meier survival percentage with a reverse

survival percentage (100% - survival percentage) showed that 0.24% of child abuse patients attempted suicide within the first 5 years after the injury. However, there was an increase from 0.24% to 4.13% for the next 5-year period and it reached 7.1% in 20 years' follow-up. This was significantly different from the influenza-infected group. The suicide attempts percentage for this nonabused group was only 1.03% in 20 years of follow-up (Figure 3).

When applying the same analysis to the child abuse cases and comparing the difference in timing for suicide attempts among subjects with different types of abuse, the Kaplan-Meier survival percentage with 1-survival percentage which used 100% minus the survival percentage showed that the percentage of suicide attempts among different types of abuse were different at 5 years follow-up. The highest percentage was seen in children with both physical and sexual abuse type with a suicide attempts rate at 12.5%, followed by sexual abuse type at 6.3%, physical abuse type at 4.2% and other abuse types at 3.6% (Table 10). The Kaplan-Meier results showed that children with both sexual and physical abuse would have a higher chance of attempting suicide in the first five years after the injury. In other words, more than one out of 10 children with a history of both physical and sexual abuse would attempt suicide in 5 years. To the best of my knowledge, this is the first study examining the difference in timing for suicide attempts among different types of abuse. The results strengthened the evidence that not only is abuse a key risk factor for attempting suicide, the type of abuse is also a critical factor. The findings of this study were also compatible with the child development, attachment, and the interpersonal theories. Without caregiver support, the physical and mental health of

children is adversely affected. In addition, repeated exposure to abuse may generates pain and fear that may cause a desire to end life (Van Orden et al., 2010). With children exposed to child abuse, the parent-child linkage may be broken, resulting in pain and injury to the child. Sometimes the damages to the child cannot be remedied. When comparing the pain and fear among different types of child abuse, it was also predicted that both physical and sexual abuse would damage the children most compared with other types of abuse (Singh et al., 2012). Therefore, the results indicated that the most vulnerable group was the children who suffered from both sexual and physical abuse.

Other Risk Factors Associated With Suicide Attempts

Besides gender and age of the subject being independent risk factors associated with suicide attempts, the research data also showed that race/ethnicity was also an important factor related to suicide attempts. The data in this study contained both Chinese and non-Chinese subjects that allowed such comparison to be made. The research finding showed that Chinese children would have a higher risk of attempting suicide after being exposed to child abuse than non-Chinese children. Race was also related to the time of developing suicide attempts among different types of child abuse.

Comparison with Other Countries

The results provide an important message to the public of Hong Kong that children exposed to child abuse are at a higher risk of attempting suicide. The results were comparable with those from other countries. The prevalence rate of suicide attempts among child abuse in the current study was 370 per 10,000 from January 1, 1995 to July 31, 2016, which was much higher than the prevalence rate 0.27 per 10,000 seen at 2014

in the normal population, as estimated by the Hong Kong Council of Social Service in 2014 (Hong Kong Council of Social Service, 2014). The vast disparity in the results may due to my using hospital data in the study, whereas the study from the Hong Kong Council of Social Service was a cross-sectional population survey. A prospective study by Cluver et al. (2015) of child suicidal behavior in sub-Saharan Africa showed that the cumulative odds ratio of exposure to more than five adverse childhood experiences with suicide attempts compared with no adverse childhood experiences was 2.46 with 95% C.I. of 1.00 to 6.05. The relationship of adverse childhood experiences with suicide attempts in the Cluver et al. (2015) study was marginally significant. Another cross-sectional study in Malaysia by Chan et al. (2013) showed that the odds ratio of sexual abuse with deliberate self-harm was 2.26 with 95% C.I. of 1.05 – 4.04 compared with the general population. A meta-analysis conducted by Norman et al. (2012) that include the United States, United Kingdom, Canada, Australia, Japan, Netherlands, New Zealand, South Africa, Israel, South Korea, South Africa, Thailand, Taiwan, China, Denmark, India, Philippines, France, Italy, Europe and Hong Kong showed that the pooled odds ratio for physical abuse with risk of suicide attempts was 3.40 with 95% C.I. from 2.17 to 5.32; for emotional abuse it was was 3.37 with 95% C. 2.44 to 4.67. The meta-analysis included various study designs including retrospective, prospective, cross-sectional, and case-control, but child sexual abuse was not included as a potential risk factor. Most studies adjusted for the age, sex, and social education status. In comparison, my study results showed a stronger association between child abuse and risk of suicide attempts. My study showed a higher hazard ratio of a child exposed to child abuse with risk of

attempting suicide of 4.79 with 95% C.I. from 3.88 to 5.92 at any time point when compared to a child infected with influenza. Most of the study used the non-abused subject as the comparison group that was different to my study. Therefore, my study result may not as higher than others if my study comapring group also used non-abused patient. The result of the second question demonstrated that if a child was exposed to sexual abuse, the child would have a higher chance of attempting suicide. In previous research studies, many had indicated sexual or physical abuse is an individual risk factor for suicide attempts. This study provided additional information to the public and researchers regarding suicide attempts after child abuse.

A study conducted by Kuramoto, Runeson, Stuart, Lichtenstein, and Wilcox (2013) showed that the time at risk for hospitalization in relation to suicide attempt among offspring who lost their parent to suicide is within 1 to 2 years after parental death (Kuramoto et al., 2013). Although this study cannot be directly compared to Kuramoto et al.'s study, the results showed that 4% of the abused children would have hospitalization for attempting suicide in the first 5 years after being exposed to the child abuse. The reason is that my study only records the first episode of child abuse to a suicide attempt and did not check any other factor happening that the patients encounter during the follow-up period.

Besides child abuse being an independent risk factor associated with suicide attempts, the study results also indicated that girls and younger age at onset had a higher risk for attempting suicide. Both these findings matched other research findings (Auslander et al., 2016; Chan et al., 2013; Finkelhor et al., 2013). This study also

demonstrated that more Chinese children would attempt suicide when compared with non-Chinese children. A similar finding from the United States Youth Risk Behavior Surveillance demonstrated that the prevalence of most health behaviors varied by sex and race (Kann et al., 2016).

Limitations

As mentioned in the previous chapter, the study has several limitations. Firstly, the main limitation is the diagnosis of child abuse and suicide attempts was based on clinical diagnosis. These two health issues are not easy to detect in the emergency units, especially in the system of Hong Kong. It was because the workload for the clinicians in the emergency units was extremely busy in Hong Kong compared with another well-developed country. Nonetheless, as mentioned by McElvaney et al. (2014), children will not disclose the details during consultation. Therefore, the doctor may only detect the obvious cases or serious harm. Therefore, the child abuse case or suicide attempts may be under-reported in the system. Under-reporting likely attenuates the association between child abuse and suicide attempts. On the other hand, the study cannot verify the child abuse, and suicide attempts cases are the real child abuse or suicide attempts when there was no significant scar. The doctor only can relate to the evidence to make the diagnosis. When the child was too young or afraid to tell the truth, doctors cannot make a proper diagnosis of these cases. The information observed from the doctor may cause information bias.

Secondly, the study also had a selection bias in that many minor self-harm cases might not be present to the public hospital. Instead, they may use the private services.

These cases cannot be retrieve from the public hospital database and thus, not included in my study. Therefore, my study may miss these numbers and the study result may not be generalizable enough to represent the whole population in Hong Kong. The charges of the public hospital was fixed at HK$120 equivalent to USD 15 per day, which was much lower than the private sector. According to the census report, more than 80% children used public hospital service, there were still around 20% of the children with a better socioeconomic (SES) background using private services. Therefore, the SES status of the subjects in my study may be lower than the general population.

Thirdly, in using the electronic database, 83 cases were removed from the analysis as the outcome had occurred before the event. The period of study was not enough to trace back all records and ensure the temporal sequence of the event and outcome. I could get more extended period I can detect if these 83 suicide cases were due to abuse or not.

Fourthly, an additional limitation of this study was Berkson's bias. The study used patient hospital admission records to examine the association. The study is difficult to eliminate the Berkson's bias, which is a selection bias that more serious cases would attend the hospital more frequently. Then these subjects would have a higher chance of being selected by the study compared with the others. Child abuse subjects may have a more clinical severe problem and attended hospital more frequently. Therefore, there was a higher chance for these patients to be included in the study than the influenza infected group. Therefore, the association between child abuse and suicide attempt can be stronger than it actually is due to this reason.

Fifthly, after retrieving the data from the electronic database, I found that many of the child abuse cases were unclear in the types of abuse. The doctors did not specify the child abuse type when there was not any significant surface scars or syndrome in the patient records. As a result, there may be misclassification of the diagnoses between some sexual abuse and physical abuse. One may be classified into the other group for analysis. This may generate wrong estimation for the association of different types of child abuse with suicide attempts.

Sixthly, my dissertation research used the residential area average household income and household size to represent an individual's economic status, the figure did not truly reflect the subjects' social economic background, as well as their parental education levels. That is, aggregate SES data may not accurately reflect individual SES.

Seventhly, depression was the psychiatric diagnosis that commonly associated with suicide. However, my study did not include this information for analysis because it was not available in the hospital admission records.

Lastly, another limitation is that the dataset did not contain any information of the completed suicide; therefore, the result did not cover the whole spectrum of suicidal behavior and its association with child abuse.

Recommendations for Future Research

This study provided an important message that children exposed to child abuse in Hong Kong are at risk for suicide attempts. The research results also demonstrated that children exposed to both physical and sexual abuse were at higher risk for attempting suicide. However, the study could not accurately integrate data on the socioeconomic

status of the subject on suicidal behavior and whether the parent would affect this association or not. This study also could not demonstrate the difference between mental health status and physical condition of the subject who had or had not attempted suicide. Since children exposed to both physical and sexual abuse would have a higher chance of attempting suicide, the parental child bonding and severity of harm from child abuse may be critical factors that affect the suicidal behavior. Given the many limitations in my study, more research is warranted to understand the relationship between child abuse and suicide attempt. More research will inform the development of effective intervention programs to prevent child abuse, and hopefully reduce the incidence of child abuse and also the suicide attempt rate.

Public Health Promotion Strategies

The public health marketing strategy was important for many studies. My study results show an important message that child abuse may be a high risk group for suicide attempts. If results are replicated in other studies, then early intervention programs may be implemented. I plan to publish the study results in an international journal. Then the message can outreach to the professionals, and I also need to attend relevant conferences and disseminate the results. I had developed an infographic that allows lay public and health care workers to easily understand my study results. Some critical messages are shown within the infographic:

- Child abuse was linked with suicide attempts.
- Child abuse patients were almost 5 times more at risk of attempting suicide compared with patients infected with influenza.

- There has been an increase in number of new child abuse cases over the past 20 years.
- Three percent of child abuse subjects will attempt suicide.
- Female or Chinese children, lower household income, smaller household size, and older children were also risk factors for suicide attempts.

Through the infographic picture, the public may quickly visualize the message. Therefore, I will proactively communicate with the hospital pediatric unit and request them to send the infographic to their unit and disclose it to the health care professionals and the patients also. The infographic will also be sent to different child health organizations and the Social Welfare Department that will allow the public health message to be disseminated to the community.

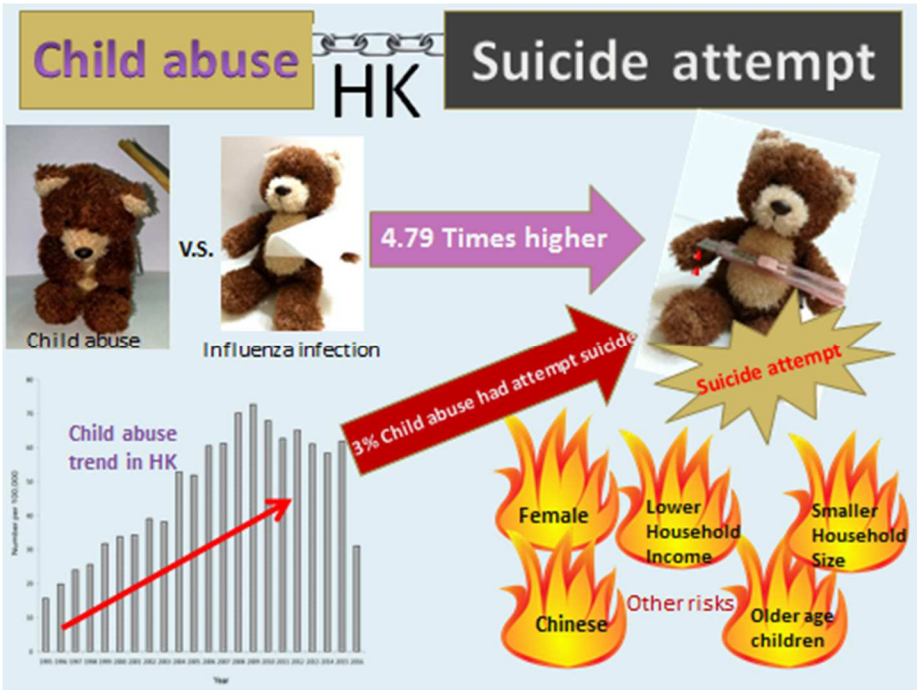

Figure 5. Infographic for child abuse and suicide attempts association

Implications

The study results may raise public awareness in Hong Kong that the children who have suffered child abuse may also potentially attempt suicide. The suicide prevalence rate among child abuse population was significant higher than the normal population infected with a common disease. Also, the society should provide more support to children who are exposed to child abuse and prevent the child from developing suicidal behavior. The community should provide more support to the children who have problem families. More education should be provided to the children, and also community should provide more support and intervention programs to the society to strengthen the parent-child relationship.

Local Stakeholder

A local stakeholder is an important agency or bridge between government and the society. The stakeholder should relay the problem to the government and ask for more resources to prevent child abuse and suicide attempts. Local stakeholder could also communicate with different organizers and seek their support to reduce the health problem in their society. They also may proactivity visit the affected families within their communities and provide holistic support to children and also their parents.

Policy Maker

Since child abuse was associated with suicide attempts, policy makers should understand this important relationship. Thus, if child abuse is reduced, then the suicide attempts rate may also decline. Child abuse is an intentional injury that can be addressed

by policies and intervention. Policy makers could set up a new regulation to prevent child abuse and provide more support to the children who have been exposed to child abuse.

Professional Scholar and Front Line Health Care Worker

The professional scholar may understand the main reason and the risk factors for suicide attempts and develop suitable prevention methods to reduce the suicide rate. The frontline health care worker could be trained in detecting and reporting of child abuse cases and should be made aware of its consequences of self-harm. Then health care professional should also check the medical record for any child abuse history when children attend emergency department with an injury. This procedure is critical to prevent the child attempt if they had been exposed to child abuse before.

Positive Social Change

Since children exposed to the child abuse are at a risk of suicide attempts, we should be aware that more attention and services should be provided to the child who has suffered from abuse. If a suitable program is implemented in the society, the prevalence of child abuse and suicide attempts will decrease. Once aware of the study results regarding the higher risk group for suicide attempts in Hong Kong, the public and policy makers therefore, target treatment and services to the focus group, which will be more effective in reducing suicide attempts in children. The suicide rate among children exposed to child abuse should decrease.

Conclusion

My study results showed that child abuse is a risk factor for suicidal attempts in Hong Kong. However, my study still have a lot of limitation as mention in the limitation

section. Researcher can carry out some more study to understand the linkage between child abuse and suicide attempts or develop suitable intervention programs in the community to see if the intervention programs can reduce child abuse and also the suicide attempt rate. Since my study demonstrated that child abused patients were the higher risk group for suicide attempt, the government can implement some new policies to reduce the prevalence of child abuse. Therefore, we should urge the policy makers to increase the punishment for child abuse perpetrators. The government should engage more stakeholders and community leaders to work on this issue provide more support and resources to setup the intervention programs for their community. More training should be provided to the front-line health care workers to detect child abuse cases. A standard mandatory follow-up and prevention program should be available to the victims and their families to improve family functioning and interpersonal relationships. My study result also demonstrates that sexual abuse had a higher risk of suicide attempt, so this group of the patient should have more attention and better follow-up services to prevent the suicide event happen. On the other hands, health care professional should also pay more attention to the female patient, Chinese patient and lower social class subject when they admitted to hospital. Especially, when these patients suffer from child abuse and they may develop suicide behavior compared with other patients. A nurse-family partnership can deliver a good health service program to first-time mothers while providing expert advice and coaching on child development. Evidence supports that the nurse-family partnership can reduce child maltreatment and injury, improve early childhood mental health, cognitive and language development, advance in school readiness, reduce

adolescent antisocial behavior, improve women's prenatal health and motivate the father to participate more in family life (Tonmyr, 2015). I hope my research result can advocate government provide this service to the children who had exposed to child abuse and reduced their suicidal behavior.

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