

Review Article

Suicide in the Global Chinese Aging Population: A Review of Risk and Protective Factors, Consequences, and Interventions

XinQi Dong^{1*}, E-Shien Chang¹, Ping Zeng², Melissa A. Simon³

¹Rush Institute for Healthy Aging, Rush University Medical Center, Chicago, Illinois

²Peking Union Medical College Hospital, Beijing, China

³Feinberg School of Medicine, Northwestern University, Chicago, Illinois

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ABSTRACT: As one of the leading causes of death around the world, suicide is a global public health threat. In the Chinese population, suicides constitute one-fifth of all recorded suicides in the world. Despite the factual data on suicide rates, the understanding of various causal factors behind suicide, including risk and protective factors and adverse health care, remained incomplete among the global Chinese aging population. To fill in the knowledge void, this paper reviews the epidemiology of suicide among Chinese older adults globally as well as explores the existing intervention strategies. Using the PRISMA statement, we performed a systematic review of exiting research on the topic, including studies describing suicide among Chinese older adults in communities outside of Asia. A literature search was conducted online by using both medical and social science data-bases. Our findings highlighted that elderly suicide in Chinese populations is significantly affected by the social, cultural, and familial contexts within which the individual lived prior to committing suicide. Reviewing such research indicated that while reducing risk factors may contribute to lowering suicides amongst Chinese older adults, measures to improve protective factors are also critical. Support through ongoing family and community care relationships is necessary to improve resilience in older adults and positive aging. Future longitudinal studies on the risk factors and protective factors, and adverse health consequences are called for to devise culturally and linguistically appropriate prevention and intervention programs in global Chinese aging populations.

Key words: Psychological distress, older adults, Chinese population

Suicides in the Chinese population constitute one-fifth of all recorded suicides in the world. Evidence suggests that the prevalence of suicide among Chinese older adults approaches, or even surpasses the prevalence estimates in Western countries. A suicide mortality rate of 23 per 100,000, or 287,000 deaths, is reported annually in China [1]. In addition, suicide is the leading cause of deaths from injury among all aging groups in China, in which the elderly population is particularly susceptible [2]. The Chinese elderly population has a higher prevalence of suicide than the general population. The over-65 age group has the highest rate of completed suicide, reaching 44.3-

200 per 100,000, which is four to five times higher than the general population [3]. Suicide rates are reported to dramatically increase with age; with the rate peaking for those over 75 years old.

Where China has one of the highest suicide rates in the world, Chinese Americans over the age of 65 have the highest rate of completed suicide in the U.S. over any other racial groups nationwide. Specifically, the suicide rate among Chinese American older women is higher when compared with the general population. A prior study noted a 3-fold higher suicide rate among U.S. Chinese women aged 65-74 years; 7-fold higher suicide rate

*Correspondence should be addressed to: XinQi Dong, MD, MPH, Medicine, Nursing, and Behavioral Sciences, Rush University Medical Center, Chicago, IL 60612, USA. Email: xinqi_dong@rush.edu

among the U.S. Chinese women aged 75-84 years; and 10-fold higher suicide rate among the U.S. Chinese women over age 85 compared to white women of the same age groups [4].

Despite the factual data on suicide rates, the understanding of various causal factors behind suicide, including risk and protective factors and adverse health care, remained incomplete. In the U.S., Chinese older immigrants have been identified as an underserved group with low acculturation level and high cultural and social isolation. Prior studies suggest that there are significant health disparities among Chinese persons, including chronic diseases, cancer screening and treatment, and psychological distress after having relocated and losing contact with their native support network [5]. In addition, Chinese immigrants experience more pronounced migratory and psychosocial distress, which is further exacerbated by the vast cultural and linguistic barriers, as well as physical frailty and stressful life events [6]. The psychological distress experienced by this population imposes significant health related consequences, and further impedes the quality-of-life of Chinese older adults.

Therefore, this paper aims to illuminate factors specific to the Chinese immigrant aging population through reviewing the epidemiology of suicide amongst this group. Ultimately, this review study aims to bring new insights on cultural and contextual factors unique to Chinese aging populations in the U.S. and worldwide.

Literature Search

The purpose of this article is to provide a critical review of the research on the epidemiology of suicide among Chinese older adults, including risk and protective factors, health consequences associated with suicidal ideation, attempts and behaviors, as well as to suggest directions for future research and ways to improve care for the Chinese aging population.

The study design was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Studies eligible for inclusion in this review were studies assessing suicide risk and protective factors, and adverse health outcomes associated with suicidal behaviors among Chinese older adults in diverse communities, including Chinese elderly in China, as well as overseas Chinese communities. As such, original research articles related to Chinese aging populations around the world were included. The search was limited to studies available in full-text, and written either in English or in Chinese. Manuscripts published over 2 decades ago (pre-1990's) were excluded.

We conducted literature searches online using both medical and social science data bases, including MEDLINE, PubMed, PsychInfo, China journals full-text

database (www.cnki.net), Wan Fang data and Google). Search terms used included "suicidal ideation", "suicide attempts", "suicidal behavior", "Chinese", "suicide and elderly", "suicide and older people," in English and "zi sha" ("suicide") in Chinese.

Risk Factors Associated with Suicide

We reviewed evidence on risk factors for suicidal ideation and suicidal behaviors. Given the inherent diversity among global Chinese communities, we presented the findings according to different geographic regions (Table 1, 2. & 3).

Demographic Risk Factors

Research on elderly suicide in China reveals several specific findings. For instance, older age and female gender were associated with increased suicidal behavior. Interestingly, while most studies reported that the risk of suicide increases with age [7], one study in metropolitan China revealed that younger age was associated with higher odds of suicidal ideation [8]. Research also shows that the urban/rural divide poses as a risk factor for suicide; those living in Northern China and in rural areas were found to be at a higher risk of suicide [9]. In addition, social status was found to predispose individuals to a greater risk of suicide and lower education was suggested to increase the risk of suicide. Furthermore, financial constraint is evidenced as a main influencing factor for suicidal ideation and behavior [10].

Psychological and Social Risk Factors

A significant correlation exists between depressive symptoms, suicide attempts, and suicide mortality among Chinese older adults. Depressive symptoms have been associated with previous suicide attempts. Negative events in family life and social well-being, including a number of stressful events and life changes were also found to be relevant to suicide [11]. In addition, researchers have begun to examine specific forms of psychological distress that are associated with suicidal behaviors. As such, the loss of a partner and feelings of hopelessness may both increase distress to a point that a senior person feels that life has become unbearable and in turn, seek suicide.

Regarding social risk factors, the experience of severe interpersonal conflict before death is associated with previous suicidal behavior. Having relatives, friends or associates with suicidal behavior was also found to increase the risks for suicide [12;13]. One qualitative study with older veterans in Taiwan reported that family conflict also triggers suicidal behavior [14].

Table 1. Risk and Protective Factors Associated with Suicidal Ideation, Suicide Attempts, and Death by Suicide in Chinese Aging Population in Mainland China with Prospective Study or Case Control Study Design.

Author, Year	Study Design	Population and Setting	Key Independent Variables	Confounding Factors	Outcomes	Key Findings
Hong Kong						
Sun, 2011 [37]	PS	56,088 comm older adults 65+	Dep	Age, edu, monthly expenditure, smoking, alcohol drinking, physical activity, body mass index, health status, self-rated health	SD	Depressive symptoms were associated with COS in men OR=2.81(1.13-7.01) and women OR=2.40(1.18-4.82)
Sun, 2011 [38]	PS	55,946 comm older adults 65+	Dep	Age, edu, monthly expenditure, smoking, alcohol drinking, physical activity, body mass index, health status, self-rated health	SD	Depressive symptoms were associated with suicide Men :HR=2.03(0.96-4.29) Women: HR = 2.36(1.31-4.24).
Cheung, 2008 [20]	PS	Comm data of older adults 65+	SARS	SDE psychiatric profile, medical profile and personal issues	SD	Annual rate in 2003 was significantly higher than those in 1996 (IRR=0.698, p<0.001), 1998 (IRR=0.826, p=0.026), 1999 (IRR=0.723, p<0.001), 2000 (IRR=0.762, P=0.002)
Lee, 2007 [39]	CS	1,226 comm older adults	Age	SDE	SI	Older group (51-75 years) were more likely to consider suicide (OR=2.3) than the youngest age group (<25 years).
Yip, 2003 [40]	CS	917 older adults 60+	Health Status	SDE	SD	Number of diseases OR=1.76(1.07-2.90); vision problem OR=3.34 (1.24-9.04); hearing problem OR= 2.74 (1.13-6.64); court case OR=57.42(1.29-2557.9) Dep OR=7.23(1.52-34.38)
Chi, 1998 [25]	CS	279 comm suicide cases of older adults 60+	Gender, severe or painful illness	SDE	SD	The gender ratio: 1.4:1, severe or painful illness (80%), from terminal illness (25%), had a history of receiving psychiatric treatment (25%).indicated suicidal idea before their fatal acts (68%)
Tsoh, 2005 [41]	CC	224 older adults aged 65+	SDE, circumstances of the suicide act, SA	SDE , Circumstances of the suicide act and suicide intent, Psychiatric morbidities	SA	Current major dep OR=59.2(6.4-546.6), past SA OR=39.1(1.2-1,244.7), arthritis OR=22.6(3.2-157.3), living with children OR=0.2(0.03-0.9), conscientiousness OR=0.7(0.5-0.9), IADL OR=0.3(0.1-0.7)
Chiu, 2004 [42]	CC	70 suicide cases and 100 controls	Mental illness, history of SA, health care utilization	SDE	SA	SA history :OR=39.6 p< 0.0001, depressive disorders OR=59.24(20.68-169.65); major depression OR=36.25(10.48-125.41)
Taiwan						
Chan, 2011 [43]	CS	3,853 comm older adults over 65+	Gender, income, smoke, dep, heart disease	SDE, Physical Disorders, Pain Symptoms	SI	SI Predictor: Female OR=2.27(1.29-4.00), No income OR=1.68(1.11- 2.53), Former smoker OR=2.05(1.09-3.85), Depressive symptoms OR=34.30(21.89- 53.76), Heart disease OR=1.63(1.06-2.49)
Yan, 2009 [14]	CS	19 older adults over 65+ with SA in veterans' homes	Reasons that cause suicide	SDE	SI, SA	Qualitative data indicated five major themes related to suicide triggers: illness and pain, death of close relatives or friends, family conflicts, disputes with friends or workers, and difficulty adapting to institutional life
Yen, 2005 [44]	CS	1,000 older adults aged 65-74	Suicidal thoughts	Sex, edu, religious belief, employment status, marital status, living arrangement, and family monthly income	SI	Dep OR=15.47 (9.76-24.53), lower level of edu OR=2.04 (3.31-1.25), community participation in the past 6 months OR=1.72 (1.07-2.96)

Note: CS: Cross sectional study; PS: Prospective study; CC: Case control study; OR: odds ratio; RR: Relative risk; Hazard ratio; HR: IRR: Incident rate ratio. SA: Suicide attempt; SI: Suicide ideation; SD: Death by Suicide; Com: Community-dwelling; SDE: Sociodemographic variables; Edu: Education, Dep: Depression; QOL: Quality of Life; Manuscripts are ordered according to the year of publication

Table 2. Risk and Protective Factors Associated with Suicidal Ideation, Suicide Attempts, and Death by Suicide in Chinese Aging Population in Mainland China with Cross Sectional Study Design.

Author, Year	Study Design	Population and Setting	Key Independent Variables	Confounding Factors	Outcomes	Key Findings
Rehholz, 2011(10)	PS	169,871 comm adults 40+ in China	Age, gender, geographic region, urbanization	SDE	SD	Male (RR=1.56, 1.03-2.38), aged above 70 (RR=2.27, 1.29-3.98), north China (RR=1.68, 1.20-2.36), rural (RR=2.82, 1.76-4.51) were associated with increased mortality
Xu, 2000 (33)	PS	Comm older adults 60+ and older in urban and rural China	Health, family conflict	SDE	SD	Urban: chronic illness and life embarrassment (45.3%), family conflicts (37.7%) and psychiatric disease (16.9%). Rural: family conflicts (76.3%) chronic illness and life embarrassment (20%), difficulty of life (3.5%).
Lu, 2004 (34)	CC	134 rural comm suicide older adults 60+ in China	Edu, marital status, economic condition	SDE	SD	Educational level was lower ($X^2=16.1, P=0.001$), partner-lost rate was higher ($X^2=5.9, P=0.015$), medical cost was higher ($X^2=7.2, P=0.03$), family income was lower ($X^2=10.0, P=0.02$) in accident death elderly..
Tao, 2011 (35)	CC	670 rural comm. adults 60+ in Hunan, China	Family status, spousal relationship, children relationship, physical health	SDE, social Support	SI	Source of finance: OR=0.59(0.36- 0.96), children relationship: OR=0.31 (0.13-0.72); physical health: OR=0.17(0.04-0.80)
Zhang, 2010 (36)	CC	454 comm. male suicides in China	Alcohol use disorder, Acute alcohol use	Age, marital status, employment status, major depression, prior SA, functioning, and acute life events	SA	Alcohol use disorder is more likely to predict previous SA (OR=1.94, 1.07- 3.53), Age>60y, Alcohol use disorder, Acute alcohol use OR=1. Elderly alcohol: non-alcohol=16(23.5%): 100(31.9%)
Jun, 2006 (37)	CC	915 comm. older adults 60+	Female gender	SDE	SI	Significant difference between male and female older adults ($\chi^2 =9.09, P<0.01$)
Phillips, 2002 (13)	CC	519 comm suicide adult and 536 controls in China	Dep, previous SA, acute stress, QOL, chronic stress, severe life event, other's suicidal behavior	Sex, age, location of residence, and geographic site	SA, SD	Dep: score >37: OR=41.5(17.2-100.2), previous SA: OR=12.9(4.0-41.0), acute stress: high score OR=9.3(4.2-20.6), QOL: low score OR=7.9(3.7- 16.8), chronic stress: high score: OR=7.6 (3.7- 15.8), Experienced severe life event: OR=7.4(3.3-16.3), Blood relative had suicidal behavior: OR=3.4(1.6-7.2), Friends or associates had suicidal behavior: OR=3.3(1.9-5.8).
Qin, 2002 (12)	CC	80 women with dep aged 60-82, discharged from a mental disease hospital	Edu, physical disease, life event, dep	Age, positive family history, character, marital status, mental disorder	SA	Higher education level($x^2 = 8.83, P < 0.05$), physical disease ($P < 0.05$), main depression ($P < 0.005$), higher HAMD score($P < 0.01$)

Note: CS: Cross sectional study; PS: Prospective study; CC: Case control study; OR: odds ratio; RR: Relative risk; Hazard ratio; HR: IRR: Incident rate ratio. SA: Suicide attempt; SI: Suicide ideation; SD: Death by Suicide; Com: Community-dwelling; SDE: Sociodemographic variables; Edu: Education, Dep: Depression; QOL: Quality of Life; Manuscripts are ordered according to the year of publication.

Psychiatric Risk Factors

The presence of a psychiatric disorder is among the most consistently reported risk factors for suicidal behavior. Researchers have begun to examine more specific constructs that may explain exactly why psychiatric disorders are associated with suicidal behavior. Several such risk factors include mood, anxiety, bi-polar, and other mental disorders [15;16].

Biological Risk Factors

Genetic association studies have suggested that genes including serotonin transporter, tryptophan hydroxylase

2, and brain-derived neurotrophic factor are related to suicide behaviors. However, most research in Chinese elderly or adult populations did not report the associations and some researchers speculated that the relevance of genetic factors could be ethnicity dependent [17]. When Hwang et al. [18] genotyped APOE in 111 older inpatients diagnosed with major depression and 144 normal controls in Taiwan, he found that depressed subjects who were APOE4 carriers showed a higher suicide attempt history than depressed subjects lacking the APOE epsilon 4 allele ($p = 0.012$). On the other hand, Jia et al. [19] revealed catechol-O-methyltransferase (COMT) Val/Val 158/108 as a susceptible genetic factor for attempted suicides.

Table 3. Risk and Protective Factors Associated with Suicidal Ideation, Suicide Attempts, and Death by Suicide in Chinese Aging Population in Hong Kong and Taiwan.

Author, Year	Study Design	Population and Setting	Key Independent Variables	Confounding Factors	Outcomes	Key Findings
Hong Kong						
Sun, 2011 (41)	PS	56,088 comm older adults 65+	Dep	Age, edu, monthly expenditure, smoking, alcohol drinking, physical, activity, body mass index, health status, self-rated health	SD	Depressive symptoms were associated with COS in men OR=2.81(1.13-7.01) and women OR=2.40(1.18-4.82)
Sun, 2011 (42)	PS	55,946 comm older adults 65+	Dep	Age, edu, monthly expenditure, smoking, alcohol drinking, physical activity, body mass index, health status, self-rated health	SD	Depressive symptoms were associated with suicide Men :HR=2.03(0.96-4.29) Women: HR = 2.36(1.31-4.24).
Cheung, 2008 (21)	PS	Comm data of older adults 65+	SARS	SDE psychiatric profile, medical profile and personal issues	SD	Annual rate in 2003 was significantly higher than those in 1996 (IRR=0.698, p<0.001), 1998 (IRR=0.826, p=0.026), 1999 (IRR=0.723, p<0.001), 2000 (IRR=0.762, P=0.002)
Lee, 2007 (43)	CS	1,226 comm older adults	Age	SDE	SI	Older group (51-75 years) were more likely to consider suicide (OR=2.3) than the youngest age group (<25 years).
Yip, 2003 (44)	CS	917 older adults 60+	Health Status	SDE	SD	Number of diseases OR=1.76(1.07-2.90); vision problem OR=3.34 (1.24-9.04); hearing problem OR= 2.74 (1.13-6.64); court case OR=57.42(1.29-2557.9) Dep OR=7.23(1.52-34.38)
Chi, 1998 (26)	CS	279 comm suicide cases of older adults 60+	Gender, severe or painful illness	SDE	SD	The gender ratio: 1.4:1, severe or painful illness (80%), from terminal illness (25%), had a history of receiving psychiatric treatment (25%).indicated suicidal idea before their fatal acts (68%)
Tsoh, 2005 (45)	CC	224 older adults aged 65+	SDE, circumstances of the suicide act, SA	SDE, Circumstances of the suicide act and suicide intent, Psychiatric morbidities	SA	Current major dep OR=59.2(6.4-546.6), past SA OR=39.1(1.2-1,244.7), arthritis OR=22.6(3.2-157.3), living with children OR=0.2(0.03-0.9), conscientiousness OR=0.7(0.5-0.9), IADL OR=0.3(0.1-0.7)
Chiu, 2004 (46)	CC	70 suicide cases and 100 controls	Mental illness, history of SA, health care utilization	SDE	SA	SA history :OR=39.6 p< 0.0001, depressive disorders OR=59.24(20.68-169.65); major depression OR=36.25(10.48-125.41)
Taiwan						
Chan, 2011 (47)	CS	3,853 comm older adults over 65+	Gender, income, smoke, dep, heart disease	SDE, Physical Disorders, Pain Symptoms	SI	SI Predictor: Female OR=2.27(1.29-4.00), No income OR=1.68(1.11- 2.53), Former smoker OR=2.05(1.09-3.85), Depressive symptoms OR=34.30(21.89-53.76), Heart disease OR=1.63(1.06-2.49)
Yan, 2009 (15)	CS	19 older adults over 65+ with SA in veterans' homes	Reasons that cause suicide	SDE	SI, SA	Qualitative data indicated five major themes related to suicide triggers: illness and pain, death of close relatives or friends, family conflicts, disputes with friends or workers, and difficulty adapting to institutional life
Yen, 2005 (48)	CS	1,000 older adults aged 65-74	Suicidal thoughts	Sex, edu, religious belief, employment status, marital status, living arrangement, and family monthly income	SI	Dep OR=15.47 (9.76-24.53), lower level of edu OR=2.04 (3.31-1.25), community participation in the past 6 months OR=1.72 (1.07-2.96)

CS: Cross sectional study; PS: Prospective study; CC: Case control study; OR: odds ratio; RR: Relative risk; Hazard ratio; HR: IRR: Incident rate ratio. SA: Suicide attempt; SI: Suicide ideation; SD: Death by Suicide; Com: Community-dwelling; SDE: Sociodemographic variables; Edu: Education, Dep: Depression; QOL: Quality of Life; Manuscripts are ordered according to the year of publication.

Other Factors

The list of risk factors outlined above is not exhaustive, and there is emerging evidence suggesting a range of other

correlative factors. Research in Hong Kong found associations between SARS and adult suicide rate [20;21]. In addition, physical health including chronic illness and physical disabilities, were also found to increase the

likelihood of suicide. As such, improvement in the ability to predict suicidal behavior through the continued identification of specific risk factors represents one of the most important directions for future studies in this area.

Consequences Associated with Suicide

Evidence suggests that suicide mortality increases the years of life lost and disability-adjusted life years lost (Table 4). In Taiwan, research suggests that suicide deaths in older adults account for 28.9% of total suicide deaths, representing 12.4% of the total population [22]. In Hong Kong, the total years of life lost due to suicide increased by 96.0% in 30 years, from about 9,900 years in 1981 to 19,400 years in 2001 [23].

Over time, suicide behaviors could lead to increased hospitalization, including prolonged stays in an intensive care unit, in addition to further suicide attempts, and also completed suicides (12.9-39.6 folds risk) [24]. It was reported that most suicide attempts and completed suicide deaths were associated with past histories of suicide attempt(s). In a study of elderly suicides in 279 communities, 68% indicated suicide ideation before their fatal acts [25].

Interventions in Chinese Elderly Suicide

Understanding the interactive relationship between risk and protective factors in suicidal behavior and how the interaction can be modified are challenges to suicide prevention and intervention. In addition, suicide intervention is a relatively under-researched area among Chinese elderly. There have been several suicide prevention and intervention programs initiated to serve this population, but evidence is limited on the effectiveness of prevention and intervention programs (Table 5).

The Chinese Association of Mental Health (CMHA) has recently set up a suicide prevention committee that offers counseling services over telephone hotlines. However, due to the large population size and limited manpower, its effectiveness remains to be seen. The Hong Kong SAR has taken an alternate approach through the Opportunities for the Elderly Project (OEP). Reaching out to older adults with high risks of suicide through early detection and screening, OEP fosters a sense of community to care for the elderly population [26]. Another government-funded multifaceted model including treatment of depression, gatekeeper training, aftercare for suicide attempters, and care management also shows evidence of reducing suicide rates of completed suicide in old-age suicide attempters [27].

Elderly suicide intervention programs were also implemented in international Chinese communities. In

Singapore, early detection and public awareness were widely publicized through media. Primary care and specialized care for those older adults experiencing high risk factors is also provided. In addition, community support is reinforced through the Center for Enabled Living (CEL), a multi-disciplinary community case management program. The Center helps connect individuals to different community resources and also provides hotline services for the elderly in crisis [28].

Discussion

Among the Chinese elderly population factors such as, older age, female, living in rural area, depressive symptoms, previous suicide attempts, negative life events and medical complications were found to correlate strongly with suicide completion. Alternatively, high levels of self-esteem, living with children, and high Instrumental Activities of Daily Living (IADL) score were found to be protective factors. Suicide attempts could lead to hospitalization, a 12-33 fold increase in risk of completed suicide, and potential detrimental effects to loved ones.

Several issues relating to the unique risk factors in Chinese communities warrant further attention. First, with respect to age distribution in China, high incidence of older adult suicides is dissonant to important Chinese traditional values of filial obligations of respect for older adults. Confucian philosophy has strongly influenced Chinese lifestyle and social interaction for thousands of years. However, in the face of rapid industrialization, modernization and social-cultural changes brought about by economic reforms, family structures and support may undergo significant transformations, potentially resulting in older adults perceiving insufficient filial support and care. Whereas stressful life events including family conflicts were found to be an important risk factor to suicide, the importance of familial integration cannot be overemphasized. Providing a sense of community and social support to the vulnerable older adult may serve as a buffer against suicide risks.

In addition, rural older adults may be at higher risks of suicide compared to their urban counterparts. Suicide in China has been historically perceived as a final act in response to social distress [29]. Given that many believe traditional values and practices to be more deeply-rooted in the countryside, the importance of such beliefs warrants particular attention. Effects of economic reform, poverty, cultural changes and the one-child policy may all contribute to the phenomenon.

Table 4. Consequences Associated with Suicide among Chinese Aging Population.

Author, Year	Study Design	Population and Setting	Predictor	Outcomes	Confounding Factors	Key Findings
Chi, 2011 (23)	PS	Taiwan, 1997- 2007.	COS	PYLL		Suicide deaths in older adults account for 28.9% of suicide deaths while representing only 12.4% of the total population, only accounted for 7.1% for the total PYLL.
Lam, 2010 (25)	PS	265 acute poisoning patients admitted to an intensive care unit, Hong Kong,	Poison (Intent of Suicide 84.9%)	Hospitalization	Demographic and clinical characteristics	Age>65, ICU length of stay >1 day: OR=4.95 (1.52-16.13). Hospital length of stay >3 days: OR= 6.64 (1.40-31.44)
Yip, 2005 (49)	PS	Hong Kong 1981-2002	COS	YLL		Older adults' suicides in all: 25%; disease burden in YLL: less than 6%
Yip, 2003 (50)	PS	Hong Kong,1981-2001	COS	YLL		The total years of life lost due to suicide increased by 96.0%, from about 9900 years (1981) to 19,400 years (2001), The total share of YLL attributable to suicide deaths has increased from 3.6% to 8.1%
Phillips, 1999 (51)	PS	China: 1990-1994.	COS	DALYs		DALYs: over 60y age 1.6-8, 20-30y 2-27;
Chiu,1996 (52)	PS	55 elderly age>65 with SA in a psychiatric unit, Hong Kong	SA	Further SA COS		Further SA:3.6% COS:5.5%
Liu, 2005 (53)	CS	Community data in Beijing	COS	DALY		Total: 1.10, aged >65: 1.05
Shen, 2002 (54)	CS	333 self poisoning in-patients, Wu han, China	SA	COS COST		Aged 60-85 had the highest fatality rate of 15.9%, and the highest average cost of (P<0.01)
Chi, 1998 (26)	CS	279 community suicide elderly age>60y, Hong Kong	SI	COS		68% indicated SI before their fatal acts
Tsoh,2005 (45)	CC	224 elderly aged >65y, (66 SA-er referred to the Department of Psychiatry (PWH), 67 COS-er from a psychological autopsy study), 91 community controls, Hong Kong	SA	COS	Socio-demographic variables , Circumstances of the suicide act and suicide intent, Psychiatric morbidities	Past SA: OR=32.9(3.2-339.7)
Chiu, 2004 (46)	CC	Age>60 ,70 suicides,100 controls, Hong Kong	SA	COS		SA : OR= 39.6
Phillips, 2002 (55)	CC	519 suicide adult, 536 community controls, China.	SA, other's suicidal behavior;	COS	Sex , age, location of residence, and research site,	Previous SA: OR=12.9(4.0-41.0); Blood relative had suicidal behavior: OR=3.4 (1.6-7.2), Friends or associates had suicidal behavior: OR= 3.3(1.9-5.8).

Note: CS: Cross sectional study; PS: Prospective study; CC: Case control study; COS: Complete suicide; SI: Suicide ideation; SA: Suicide attempt; OR: odds ratio; RR: Relative risk. PYLL: Potential Years of Life lost, DALYs: Disability Adjusted Life Years lost per 1,000 populations. Manuscripts are ordered according to the year of publication

Furthermore, cultural considerations in suicidal behaviors of overseas Chinese elderly immigrants should also be noted. It was reported that more than 80% of Chinese older adults were foreign born and more than 30% of Chinese older adults immigrated after the age of 60. Suffering from the loss of tradition, lack of acculturation and aging, the older Chinese population in the U.S. often lives in isolation, far away from their families in China. Hindered by cultural and language barriers, they experienced much difficulty in communication with others, let alone the ability to seek help. Therefore, it was not surprising that studies suggested that older Chinese immigrants have poorer

quality of life than the national norms [30]. Other studies also pointed out that the prevalence of depressive symptoms among Chinese older adults was higher than that of general aging population in North America [31]. Coupled with the increasing social stressors and culturally valued imperatives of maintaining personal honor, older adults may consider themselves as "burden" to their families, and thus opt to suicide as means to resolve conflict.

Table 5. Intervention on Suicide among Chinese Older Adults.

Author, Year	Study Design	Population and Setting	Type of Intervention	Outcomes of Interest	Key Findings
Chan, 2011 (28)	CC	Older adults 65 years and above, 351 SA in intervention group, 66 SA in pre-intervention group Hong Kong.	A multifaceted model (treatment of depression, gatekeeper training, aftercare for suicide attempters, and care management) operating at two levels. The first tier is predominantly primary care, and the second tier is the old-age psychiatric service at tertiary care level.	COS, re-SA	The 2-year COS rates was 7.58% in the pre-intervention group, 1.99% in the ESPP group; re-SA rates were not different
Zhang, 2006 (56)	CC	131 aged 60-85 inpatients with depression in Shanghai Mental Health Center.	Modified electroconvulsive therapy	SA	MECT SA: 22/31, Non-MECT SA 11/18, X^2 4.6 P=0.032
Wong, 2011 (27)	No control group	1,230 older adults age > 64y with high risk of suicide (SA) in Elderly Suicide Prevention Program, Hong Kong	The doctors and CPNs monitoring all the patients by means of tele-check or home visits, trace details about elderly persons classified to be suicide cases.	COS	The first 2 months of treatment is associated with the highest risk of suicide. 8 COS.
Hendin, 2008 (57)	Evaluation	Hong Kong SAR's Elderly Suicide Prevention Program	The doctors and CPNs monitoring all the patients by means of telecheck or home visits, trace details about elderly persons classified to be suicide cases.	COS	Findings demonstrated an improvement in the psychological profile of older adults and its Suicide Crisis Intervention Center reports reduced levels of suicide risk among those using the service

Note: CS: Cross sectional study; PS: Prospective study; CC: Case control study; COS: Complete suicide; SA: Suicide attempt; SI: Suicide ideation

Implications

Suicide among the Chinese elderly is an important public health issue. Current research highlights that elderly suicide is deeply affected by the socio, cultural, and familial contexts within which it takes place. With respect to prevention and intervention strategies, educational outreach through programs targeted to Chinese older adults with suspected suicidal inclination or risk factor of suicide, may serve as an effective measure.

Early detection and prevention of elder suicide is necessary. In addition, mental health and health professionals at the front line should consider outreach programs that are particularly designed to increase familial, social, and community support for vulnerable older adults. Medical professionals should also consider screening older patients for suicidal risk factors by integrating questions on suicidal thoughts into routine medical history questions for older adults.

These findings have important implications not only for geriatricians, but also for multiple disciplines that

work with older adults with suicide risk. Other relevant disciplines such as nursing, social work, and social services agencies are also in unique positions to identify and intervene on predisposing factors that might lead to completed suicide. Direct suicide prevention strategies with culturally and linguistically sensitive services including hotlines and counseling programs should be expanded.

In addition, our review findings call for improved health and social welfare programs for the older adults, particularly for those in the rural areas and those that lack of financial support. Whereas reducing risk factors may contribute in lowering suicides, measures to improve protective factors are also critical. The prevention of elderly suicide needs to be a joint effort by family members, and communities at large. Support through ongoing family and community care relationships is necessary to improve resilience and positive aging.

Conclusion

In sum, Chinese older adults reported the highest suicide rate in the world. This statistic is the result of multiple factors including biological, social, economic, and cultural contexts, and should be given high priority with regard to prevention, intervention and research. Rigorous research on the prevalence of suicidal ideation, attempts and plans in different Chinese aging population are urgently called for. Future longitudinal studies on the risk factors and protective factors, and adverse health consequence will be useful to devise culturally and linguistically appropriate prevention and intervention programs.

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