

A Longitudinal Study on Deliberate Self-Harm and Suicidal Behaviors Among Chinese Adolescents

Ben M.F. Law and Daniel T.L. Shek

Abstract This longitudinal study examined deliberate self-harm and suicidal behaviors among adolescents in junior secondary schools in Hong Kong. With specific reference to adolescents in Grade 9, the prevalence of deliberate self-harm behavior was 21.9 %, with preventing wounds from healing, self-scratching, and wrist cutting being the most prevalent self-harm behaviors; the prevalence of self-harm behavior was higher in girls than in boys. The prevalence of suicide attempts was 3.4 %, with girls manifesting more suicidal behaviors than boys. A path model with family functioning (mutuality, communication, and conflicts) at Time 1, positive youth development qualities at Time 2, and self-harm and suicidal behaviors at Time 3 was tested. The following results were obtained: (a) mutuality and communication at Time 1 predicted self-harm and suicidal behaviors at Time 3 via positive youth development at Time 2; (b) mutuality at Time 1 directly predicted self-harm behavior at Time 3; (c) family conflicts at Time 1 directly predicted suicidal behavior at Time 3. The proposed overall model was not entirely gender invariant. Although the paths were gender invariant, family conflicts at Time 1 predicted suicidal behavior at Time 3 for girls but not boys. The theoretical and applied implications of the findings are discussed in this work.

Keywords Deliberate self-harm • Suicidal behavior • Positive youth development • Family functioning • Path model

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Introduction

Using the data derived from a 3-year longitudinal study, this work examines the prevalence of deliberate self-harm and suicidal behaviors among Grade 9 Chinese adolescents as well as the related predictors. A causal model with family functioning at Wave 1 and positive youth development (PYD) qualities at Wave 2 as predictors as well as self-harm and suicidal behaviors at Wave 3 was tested. As gender differences are commonly found for deliberate self-harm and suicidal behaviors, the gender invariance of the proposed model is also tested.

Deliberate self-harm is an intentional act by an individual to harm himself or herself physically (Isacsson & Rich, 2001). Self-harm is more prevalent among adolescents than among adults (Fox & Hawton, 2004). Methods of self-harm include drug overdose, self-hitting, pinching, scratching, biting, self-cutting, burning, jumping from a high place, or self-poisoning (Yip, Ngan, & Lam, 2003). A study involving a large sample of adolescents in China (Wan, Hu, Hao, Sun, & Tao, 2011) showed that 17.0 % had harmed themselves in the past 12 months. The most common form of self-harm is self-hitting. In a recent study, Law and Shek (2013) reported that 23.5 % of Grade 8 students in Hong Kong had attempted deliberate self-harm in the past 12 months.

Self-harm behaviors are closely related to suicide. The percentage of people who have attempted suicide was 0.7 % of those who have exhibited self-harm behaviors during the past year; this value was 66 times higher than the suicide rate in the general population during the same period (Hawton, 2005). According to the World Health Organization (2008), almost one million people die from suicide yearly, with a mortality rate of 16 per 100,000. The suicide rates among young people have been increasing in the last 45 years. Youth suicide is currently at the highest risk of mortality in a third of all countries worldwide. Suicide is the second leading cause of death for those aged between 10 and 24 years. In Hong Kong, the suicide rates among adolescents are comparatively low. The suicide rate for young people under the age of 15 decreased from 1.0 to 0.3 % per 100,000 from 2000 to 2009, whereas the rate for those aged 15–24 years increased from 7.7 to 8.5 % per 100,000 (World Health Organization, 2008). The values of the 12-month prevalence of suicidal ideation and attempt across the three Asian cities of Taipei, Shanghai, and Hanoi were 8.4 % (Blum, Sudhinaraset, & Emerson, 2012). In a recent study, Law and Shek (2013) reported that almost 13 % of Grade 8 adolescents in Hong Kong had manifested suicidal thoughts, 5 % had made suicidal plans, and 4 % had attempted suicide. The figure in Hong Kong is relatively higher than the international figures.

Self-harm and suicidal behaviors have personal and social correlates. On the individual level, alcohol or substance use (Tuisku et al., 2014), difficulties in regulating personal emotions (Pisani et al., 2013), coping problems or impulsivity (Zhang, Li, Tu, Xiao, & Jia, 2011), depression or hopelessness (Mustanski & Liu, 2013), and history of abuse (Mota et al., 2012) are factors related to self-harm and suicidal behaviors. On the interpersonal level, peer support (Czyz, Liu, & King, 2012; Samuel & Sher, 2013; Tuisku et al., 2014), trusted adults (Pisani et al., 2013), and family support (Chan et al., 2009; Maimon, Browning, & Brooks-Gunn, 2010) could prevent self-harm and suicidal behaviors. One study concluded that family,

school, and peer relationships are significant protective factors. Another study found that social isolation predicts suicide attempts (Hall-Lande, Eisenberg, Christenson, & Neumark-Sztainer, 2007).

To reduce self-harm and suicidal behaviors, individual protective factors with psychosocial intervention implications have been explored in many studies. Among all protective factors, self-esteem is most widely studied in the area of adolescent suicide (Sharaf, Thompson, & Walsh, 2010). Strategies that promote good general coping skills and prevention efforts are highly needed (Lubell & Vetter, 2006). Psychosocial adjustment skills and adolescent resilience are likewise necessary in preventing self-harm and suicidal behaviors (Rew, Thomas, Horner, Resnick, & Beuhring, 2001; Zweig, Phillips, & Lindberg, 2002).

Several observations regarding studies on adolescent self-harm and suicidal behaviors have been noted. First, although several methods have been employed to study self-harm and suicidal behaviors, which consist of suicidal ideations, plans, or attempts, descriptive profiles of such behaviors among adolescents have not been systematically examined. Second, studies on self-harm among Chinese adolescents are rarely reported. In fact, most of the literature in the last 10 years has focused on suicidal behaviors, with the awareness of self-harm behavior emerging only in the last few years. Third, few longitudinal studies exploring the changes in or stability of self-harm and suicidal behaviors among adolescents have been conducted (e.g., Tuisku et al., 2014). Without longitudinal studies, we cannot examine the causal relationships among variables. Fourth, although self-harm and suicidal behaviors are closely related, no study has differentiated the possible different predictors or correlates involved. One possible reason for this knowledge gap is that most studies explore either self-harm or suicidal behaviors, while a few studies examine both behaviors (e.g., Tuisku et al., 2014). Fifth, many researchers (e.g., Chan et al., 2009) highlighted the importance of family functioning in preventing self-harm and suicidal behaviors. However, no studies to date have explored the critical domains within family functioning that can cause self-harm or suicidal behaviors. Sixth, although studies have highlighted the necessity of individual protective factors, such as self-esteem, optimism, and resilience, such studies are fragmented and have thus increased the need to propose an encompassing factor that can include all critical individual protective factors with psychosocial intervention implications. One possibility is the construct of PYD, which encompasses different PYD qualities. Seventh, although family functioning and PYD are equally important in affecting the prevalence of self-harm or suicidal behaviors, no study has explored these domains together.

In view of the above observations, the present study attempted to explore the descriptive profiles of self-harm and suicidal behaviors among junior secondary school students in Hong Kong. A longitudinal approach was adopted to examine how family functioning and PYD contribute to self-harm and suicidal behaviors over time.

One crucial issue addressed in this study is how family functioning predicts self-harm and suicidal behaviors. Family functioning is important in influencing the destructive thinking and behavior of adolescents. Siu and Shek (2005) suggested that mutuality among family members, communication and cohesiveness, conflict and harmony, parental concern, and parental control are significant dimensions in

understanding family atmosphere in Chinese communities. Destructive family dynamics can upset adolescent development, which may in turn result in self-harm and suicidal behaviors among adolescents. Conceptually speaking, good family functioning can be regarded as a protective factor that reduces the occurrence of deliberate self-harm and suicide in adolescents.

Another issue addressed in this study was how PYD relates to adolescent development. Along the line of positive psychology, the whole doctrine of PYD argues that “problem-free” is not adequate for youth development (Sun & Hui, 2007) and that youth workers must focus on the youth as resources. Benson (1997) proposed 40 developmental internal and external assets. The internal assets include commitment to learning, positive values, social competence, and positive identity. The external assets include positive family communication and support, parental involvement, other adult relationships, caring neighborhood and school climate, empowerment (e.g., from the community), youth as resources, family and school boundaries, and peer influence. In a large youth promotion program in Hong Kong, Shek, Sun, and Merrick (2013) highlighted the importance of 15 PYD qualities, namely, promotion of bonding, resilience, social competence, emotional competence, cognitive competence, behavioral competence, moral competence, self-determination, spirituality, self-efficacy, positive identity, belief in the future, recognition of positive behavior, prosocial involvement, and prosocial norms. In the present study, PYD qualities were hypothesized as capable of reducing self-harm and suicidal behaviors. Taken as a whole, a conceptual framework was tested in this study. Under this framework, family functioning was proposed to influence the development of PYD qualities, which would further affect deliberate self-harm and suicidal behaviors. Specifically, family functioning at Time 1 was proposed to affect PYD at Time 2, which would in turn influenced adolescent self-harm and suicidal behaviors at Time 3.

Another issue related to the understanding of adolescent self-harm and suicidal behaviors is gender issue. As the number of girls exhibiting self-harm and suicidal behaviors is greater than that of boys (Evans, Smith, Hill, Albers, & Neufeld, 1996; Lee, 2011), we must ask whether the proposed model is equally applicable to males and females. Thus, we enhance our understanding of the proposed model by examining its gender invariance.

Method

Participants and Procedures

The data reported in this paper were derived from the first three waves of a 6-year longitudinal study on adolescents' development and their families in Hong Kong. Schools were randomly sampled based on the list of secondary schools in Hong Kong as issued by the Hong Kong Education Bureau. At Wave 1, 3,325 Secondary 1 students (Grade 7) from 28 schools participated in the study. The mean age of

Table 1 Description of demographic variables ($n=2,489$)

	Overall %/ mean (SD)	Male ($n=1,231$)	Female ($n=1,258$)	Statistical test	Cohen's d
		%/mean (SD)	%/mean(SD)		
Gender		–	–	–	–
Male	49.5 %				
Female	50.5 %				
Age (in years)	12.56 (.70)	12.58 (.72)	12.54 (.68)	$t(2,464)=1.45$.06
Age range	10–17	10–17	11–16		
Household income (in HK\$)					–
≤\$10,000	19.5 %	18.3 %	20.9 %	$\chi^2(6)=16.07^*$	
\$10,001–\$20,000	30.1 %	25.2 %	35.7 %		
\$20,001–\$30,000	15.2 %	14.3 %	16.3 %		
\$30,001–\$40,000	8.9 %	10.6 %	6.8 %		
\$40,001–\$50,000	6.7 %	7.3 %	6.1 %		
\$50,001–\$60,000	5.3 %	6.6 %	3.8 %		
≥ \$60,001	14.3 %	17.7 %	10.4 %		

Note: Valid cases ranged from 2,239 to 2,489. Valid percentages are reported because of missing data

* $p < .05$

the participants was 12.6 years old ($SD=.70$). The demographic information of the respondents at Wave 3 is shown in Table 1. A total of 2,667 participants completed the questionnaires in all three waves. Only those who had completed all three waves were included in the analysis ($n=2,667$). However, cases with missing gender information ($n=28$) as well as those that lack all dependent variables ($n=8$) and any predictor variable ($n=142$) were excluded. Therefore, the final sample size was 2,489.

During data collection, the purpose of the study was mentioned, and the confidentiality of the collected data was assured. School, parental, and student consents had been obtained prior to data collection. All participants responded to all scales in the self-administered questionnaire within the adequate time provided.

Instruments

The Chinese Positive Youth Development Scale (CPYDS): The CPYDS was developed to assess PYD attributes (Shek, Siu, & Lee, 2007). The CPYDS has 15 subscales, namely, bonding, resilience, social competence, recognition of positive behavior, emotional competence, cognitive competence, behavioral competence, moral competence, self-determination, self-efficacy, clear and positive identity, beliefs in the future, prosocial involvement, prosocial norms, and spirituality. A 6-point Likert

scale (from 1=strongly disagree to 6=strongly agree) was used to assess the responses of the participants. Existing research findings showed that the CPYDS is a valid and reliable instrument. A composite score was calculated to obtain the mean scores of the 15 PYD constructs. The internal consistency of this scale was .96 for all three waves.

The Chinese Family Assessment Instrument (CFAI): The CFAI (Shek & Ma, 2010) was used to assess family functioning. Three subscales, namely, mutuality (mutual support, love, and concern among family members), communication (frequency and nature of interaction among family members), and conflicts and harmony (presence of conflicts and harmonious behavior in the family) were used to index family functioning. The five response options were “very similar,” “somewhat similar,” “neither similar nor dissimilar,” “somewhat dissimilar,” and “very dissimilar.” A high total score on the subscales indicated a high level of positive family functioning. The reliability and validity of the CFAI have been verified in previous studies. Three composite scores were computed to obtain the average scores of the three subscales of family functioning. All Cronbach alphas were at least .76 (i.e., mutuality .87, conflict .76, and communication .81 at Time 1; mutuality .86, conflict .78, and communication .81 at Time 2; mutuality .88, conflict .79, and communication .81 at Time 3).

Deliberate Self-Harm Behavior Checklist: A checklist of self-harm behavior was used. The list included wrist cutting, burning with cigarette or fire, carving words or marks on the body, self-scratching, self-biting, rubbing sandpaper against the body, acid dripping, bleach scrubbing, putting sharp objects into the body, rubbing glass against the body, breaking bones, head banging, self-punching, and preventing wounds from healing. The response options were “yes (within the past 12 months)” or “no (within the past 12 months).” The Cronbach alphas at Time 1, Time 2, and Time 3 were .83, .84, and .82, respectively.

Suicidal Behavior Checklist: Suicidal behaviors were assessed in terms of suicidal thoughts, plans, and attempts. The response options were “yes (within the past 12 months)” or “no (within the past 12 months).” The Cronbach alphas at Time 1, Time 2, and Time 3 were .68, .70, and .68, respectively.

Data Analysis

Descriptive statistics of self-harm and suicidal behaviors are reported in this paper with consideration of gender invariance. The path analyses were conducted using Mplus 7 (Muthén & Muthén, 1998–2012). Full information maximum likelihood estimation was employed to deal with missing data. The path analyses were conducted to examine the relationships among the four study variables. Specifically, we hypothesized a fully mediated model with family functioning variables at Wave 1 as the predictors, PYD qualities at Wave 2 as the mediator, and self-harm and suicidal behavior at Wave 3 as the outcome variables (see Fig. 1). The model would be revised based on modification indices and initial findings. As we anticipated that

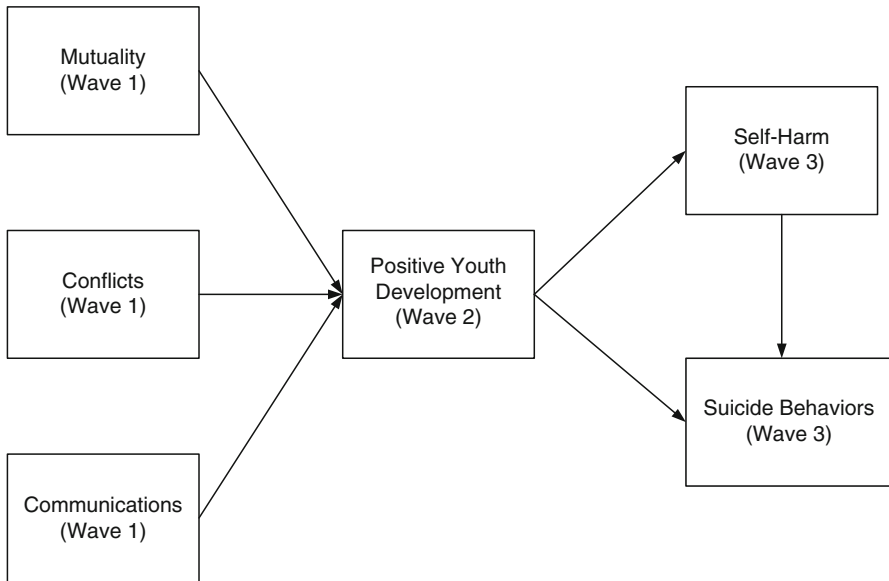


Fig. 1 Conceptual relationships among family functioning, positive youth development qualities, self-harm, and suicidal behaviors

gender might moderate the relationships among the study variables, we performed a multiple group path analysis to test the model across genders. Then, we conducted a series of invariance tests to determine whether each path was successively held invariant across genders.

Results

Among the 2,489 participants, approximately 49.5 % were male, and approximately 49.6 % reported that their household income was below HK\$20,000. The average age was 12.56 years ($SD=.70$), with ages ranging from 10 years to 17 years. Table 1 shows the demographic characteristics.

Profile of Self-Harm and Suicidal Behaviors

Table 2 presents the self-harm behavior of the participants. The prevalence for deliberate self-harm behavior at Grade 9 was 21.9 %, with the top three forms being *preventing wounds from healing* (9.5 %), *self-scratching* (9.1 %), and *wrist cutting* (6.9 %). The participants seldom performed acid dropping (0.2 %), bleach

Table 2 Self-harm behavior in the past 12 months by gender ($N=2,489$)

	Male (%)	Female (%)	Total (%)	χ^2
Wrist-cutting	40 (3.2)	134 (10.7)	174 (6.9)	53.09***
Burning with cigarette	7 (.5)	10 (.8)	17 (.7)	49 ns
Burning with fire	13 (1.1)	7 (.6)	20 (.8)	1.89 ns
Carving word on body	26 (2.1)	67 (5.3)	93 (3.7)	18.26***
Carving marks on body	30 (2.4)	63 (5.0)	93(3.7)	11.68***
Self-scratching	67 (5.4)	159 (12.6)	226 (9.1)	39.61***
Biting	50 (4.1)	97 (7.7)	147 (5.9)	15.25***
Rubbing sand paper	3 (.2)	4 (.3)	7 (.3)	.13 ns
Acid dripping	4 (.3)	1 (.1)	5 (.2)	1.85 ns
Bleach scrubbing	2 (.2)	2 (.2)	4 (.2)	.00 ns
Inserting sharp objects into the body	13 (1.1)	24 (1.9)	37 (1.5)	3.15 ns
Rubbing glass against skin	6 (.5)	8 (.6)	14 (.6)	.26 ns
Breaking bones	3 (.2)	1 (.1)	4 (.2)	1.03 ns
Head banging	29 (2.4)	32 (2.5)	61 (2.5)	.11 ns
Self-punching	38 (3.1)	66 (5.2)	104 (4.2)	7.50*
Preventing wounds from healing	96 (7.8)	141 (11.2)	237 (9.5)	8.77*
Other forms of self-harm	32 (2.6)	42 (3.3)	74 (3.0)	1.26 ns
Any form of self-harm	212 (17.2)	334 (26.6)	546 (21.9)	31.56***

* $p < .05$; *** $p < .001$

Table 3 Suicidal behavior in the past 12 months by gender ($N=2,489$)

	Male (%)	Female (%)	Total (%)	χ^2
Suicidal thoughts	94 (7.6)	194 (15.4)	288 (11.6)	37.66***
Suicidal plans	33 (2.7)	69 (5.5)	102 (4.1)	12.71**
Suicidal attempts	25 (2.0)	60 (4.8)	85 (3.4)	14.35***

** $p < .01$; *** $p < .001$

scrubbing (0.2 %), and sandpaper rubbing (0.3 %). The prevalence of self-harm behaviors for girls was higher than that for boys (girls=26.6 %, boys=21.97 %, $\chi^2=31.56$, $p < .001$). The girls manifested the following self-harm behaviors more than the boys did: wrist cutting, word or mark carving, self-scratching, biting, self-punching, and preventing wounds from healing ($p < .05$ in all cases). The largest differences were observed in wrist cutting and self-scratching.

The findings on suicidal behaviors are shown in Table 3. Almost 11.6 % of the adolescents manifested suicidal thoughts, 4.1 % made suicidal plans, and 3.4 % attempted suicide. The girls reported significantly more suicidal behaviors, particularly suicidal thoughts, than the boys did (girls=15.4 %, boys=7.6 %, $\chi^2=37.66$, $p < .001$).

Path Analysis in Overall Sample

Our hypothesized model (Fig. 1) was tested and found to fit the data adequately given the following indices: $\chi^2(6)=61.648, p<.001, RMSEA=.061$ (90 % CI=.048–.075), CFI=.947, TLI=.893, SRMR=.049. However, modification indices suggested the addition of the path from mutuality at Wave 1 to self-harm at Wave 3 (MI=35.754). As parents with children who have exhibited self-harm behaviors admitted their lack of skills in parenting adolescents as well as the significant difficulties they face in family communication, in parent–child relationships, and in the area of discipline following self-harm (Byrne et al., 2008), the expression of concern or mutuality might be a key factor that leads to self-harm. This assumption justifies the addition of the path.

The following fit indices improved after the addition of the path: $\chi^2(5)=21.165, p<.001, RMSEA=.040$ (90 % CI=.026–.057), CFI=.981, TLI=.954, SRMR=.024. The modification indices further suggested the addition of the path from conflicts at Wave 1 to suicidal behaviors at Wave 3 (MI=16.676). As the literature showed that suicide risk increases with high parent–child conflicts (Randell, Wang, Herting, & Eggert, 2006), the addition of the path was again justified. The revised model fitted the data very well after the addition of the path, as could be noted in the following: $\chi^2(4)=8.237, p=.0833, RMSEA=.021$ (90 % CI=.000–.041), CFI=.996, TLI=.988, SRMR=.010. With no other suggestions for improvement from the modification indices, the revised model was finalized (Fig. 2).

The final revised model showed that family functioning at Wave 1 was positively associated with PYD at Wave 2. However, only mutuality ($\beta=.185, p<.001$) and communication ($\beta=.226, p<.001$) significantly predicted PYD. Mutuality at Wave 1 negatively predicted self-harm at Wave 3 ($\beta=-.132, p<.001$). Similarly, conflicts at Wave 1 negatively predicted suicidal behaviors at Wave 3 ($\beta=-.079, p<.001$). PYD at Wave 2 was negatively associated with self-harm and suicidal behaviors at Wave 3. The participants who reported an increase in self-harm behaviors tended to exhibit a corresponding increase in suicidal behaviors ($\beta=.415, p<.001$).

We also examined the indirect effects among the study variables (see Table 4). We found that mutuality at Wave 1 ($\beta=-.026, p<.001$) and communication at Wave 1 ($\beta=-.032, p<.001$) were negatively associated with self-harm at Wave 3 via PYD at Wave 2. Mutuality at Wave 1 was negatively associated with suicidal behavior at Wave 3 via (1) PYD at Wave 2 ($\beta=-.011, p<.01$), (2) self-harm at Wave 3 ($\beta=-.055, p<.01$), and (3) both PYD at Wave 2 and self-harm at Wave 3 ($\beta=-.011, p<.001$). Communication at Wave 1 was negatively associated with suicidal behavior via (1) PYD at Wave 2 ($\beta=-.013, p<.01$) as well as (2) PYD at Wave 2 and self-harm at Wave 3 ($\beta=-.013, p<.001$). In sum, PYD was a mediator of the effects of mutuality and communication on self-harm and suicidal behaviors. No significant indirect effects of the path from conflicts to self-harm and suicidal behaviors via PYD were found.

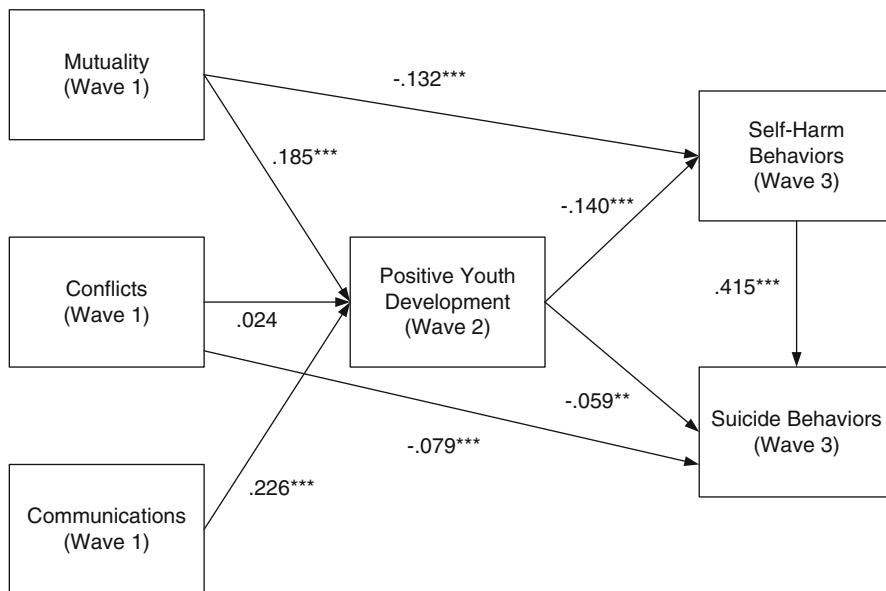


Fig. 2 Standardized coefficients of direct effects among study variables (Note: ** $p < .01$; *** $p < .001$)

Table 4 Standardized coefficients of indirect effects

	Standardized coefficients
(1) Time 1 Mutuality → Time 2 PYD → Time 3 Self-Harm Behavior	-.026***
(2) Time 1 Conflicts → Time 2 PYD → Time 3 Self-Harm Behavior	-.003
(3) Time 1 Communication → Time 2 PYD → Time 3 Self-Harm Behavior	-.032***
(4a) Time 1 Mutuality → Time 2 PYD → Time 3 Suicidal Behavior	-.011**
(4b) Time 1 Mutuality → Time 3 Self-Harm Behavior → Time 3 Suicide Behavior	-.055***
(4c) Time 1 Mutuality → Time 2 PYD → Time 3 Self-Harm Behavior → Time 3 Suicidal Behavior	-.011***
(4) Total indirect effects	-.077***
(5a) Time 1 Conflicts → Time 2 PYD → Time 3 Suicidal Behavior	-.001
(5b) Time 1 Conflicts → Time 2 PYD → Time 3 Self-Harm Behavior → Suicide Behavior	-.001
(5) Total indirect effects	-.003
(6a) Time 1 Communication → Time 2 PYD → Time 3 Suicide Behavior	-.013**
(6b) Time 1 Communication → Time 2 PYD → Time 3 Self-Harm Behavior → Time 3 Suicide Behavior	-.013***
(6) Total indirect effects	-.027***

PYD Positive Youth Development

** $p < .01$; *** $p < .001$

Multiple Group Path Analysis Across Genders

We conducted a multiple group path analysis to investigate how gender moderates the relationships among the study variables. The following fit indices indicated that the finalized model (see Fig. 2) fitted the data well across genders: $\chi^2(8)=19.023$, $p<.05$, RMSEA=.033 (90 % CI=.014-.053), CFI=.989, TLI=.968, SRMR=.013. Figure 3 shows the standardized coefficients of the model. In general, the patterns were similar to that of the model based on the total sample. In terms of gender effects, many parameters were similar across genders. However, two particular gender paths were quite different between males and females. Specifically, the path from conflicts at Wave 1 to suicidal behaviors at Wave 3 was not significant among males ($\beta=-.024$, $p=ns$) but was significant among females ($\beta=-.126$, $p<.001$). Meanwhile, the path from PYD at Wave 2 to suicidal behaviors at Wave 3 was significant among males ($\beta=-.072$, $p<.05$) but not among females ($\beta=-.057$, $p=ns$) (Table 5).

To determine if the paths estimated across genders were invariant, a fully constrained model (M2 in Table 6) was compared with the freely estimated final revised model presented above (M1). We used the criterion proposed by Cheung and Rensvold (2002) instead of the insignificance of the chi-square difference test between nested models to judge a lack of invariance (i.e., $\Delta CFI=$ or $<.01$) because

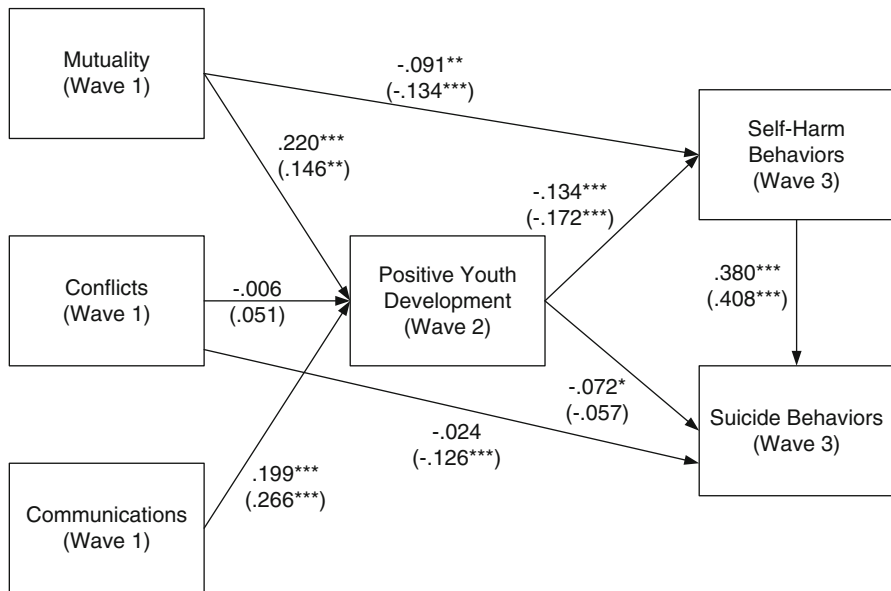


Fig. 3 Standardized coefficients of the final revised model across genders (Coefficients without parentheses represent the results for males. Coefficients with parentheses represent the results for females. * $p<.05$; ** $p<.01$; *** $p<.001$)

Table 5 Standardized coefficients of indirect effects across genders

	Male	Female
(1) Time 1 Mutuality → Time 2 PYD → Time 3 Self-Harm Behavior	-.029**	-.025*
(2) Time 1 Conflicts → Time 2 PYD → Time 3 Self-Harm Behavior	.001	-.009
(3) Time 1 Communication → Time 2 PYD → Time 3 Self-Harm Behavior	-.027**	-.046***
(4a) Time 1 Mutuality → Time 2 PYD → Time 3 Suicidal Behavior	-.016*	-.008
(4b) Time 1 Mutuality → Time 3 Self-Harm Behavior → Time 3 Suicidal Behavior	-.035**	-.055***
(4c) Time 1 Mutuality → Time 2 PYD → Time 3 Self-Harm Behavior → Time 3 Suicidal Behavior	-.011**	-.010*
(4) Total indirect effects	-.062***	-.073***
(5a) Time 1 Conflicts → Time 2 PYD → Time 3 Suicidal Behavior	.000	-.003
(5b) Time 1 Conflicts → Time 2 PYD → Time 3 Self-Harm Behavior → Time 3 Suicidal Behavior	.000	-.004
(5) Total indirect effects	.001	-.006
(6a) Time 1 Communication → Time 2 PYD → Time 3 Suicidal Behavior	.014*	-.015
(6b) Time 1 Communication → Time 2 PYD → Time 3 Self-Harm Behavior → Time 3 Suicidal Behavior	-.010**	-.019***
(6) Total indirect effects	-.024**	-.034**

PYD Positive Youth Development

* $p < .05$; ** $p < .01$; *** $p < .001$

this criterion is unaffected by both model complexity and sample size and is uncorrelated with the overall fit measures. The fully constrained model fitted the data well given the following indices: $\chi^2(16) = 51.036$, $p < .001$, RMSEA = .042 (90 % CI = .029–.055), CFI = .966, TLI = .949, SRMR = .061. However, it was significantly different from M1: $\Delta\chi^2(8) = 32.013$, $p < .001$, $\Delta\text{CFI} = -.023$. This result suggested the existence of a gender difference in the overall final revised model. Therefore, the model was not gender invariant.

We ran eight other models to verify which paths were variant across genders (M3 to M10 in Table 6). To compare with Model M1, one path was constrained to be equal across genders at one time in each model. In M3, the path from mutuality to PYD was held invariant across genders: $\chi^2(9) = 21.944$, $p < .01$, RMSEA = .034 (90 % CI = .016–.052), CFI = .987, TLI = .966, SRMR = .014; the path was not significantly different from M1: $\Delta\chi^2(1) = 2.921$, $p = ns$, $\Delta\text{CFI} = -.002$. In M4, the path from conflicts to PYD was held equal across genders: $\chi^2(9) = 20.066$, $p < .05$, RMSEA = .031 (90 % CI = .013–.050), CFI = .989, TLI = .971, SRMR = .014; the path was not significantly different from M1: $\Delta\chi^2(1) = 1.043$, $p = ns$, $\Delta\text{CFI} = .000$. In M5, the path from communication to PYD was held invariant: $\chi^2(9) = 19.200$, $p < .05$, RMSEA = .030 (90 % CI = .011–.049), CFI = .990, TLI = .973, SRMR = .013; the path was not significantly different from M1: $\Delta\chi^2(1) = .177$, $p = ns$, $\Delta\text{CFI} = .001$. In M6, the path from mutuality to self-harm was constrained to be equal: $\chi^2(9) = 21.442$, $p < .05$, RMSEA = .033 (90 % CI = .015–.052), CFI = .988,

Table 6 Invariance tests across genders

	Parameters constrained	χ^2	df	CFI	$\Delta\chi^2$	Δdf	Δp -value	ΔCFI
M1	None	19.023*	8	.989	–	–	–	–
M2	All	51.036***	16	.966	32.013***	8	<.001	-.023
M3	Mutuality → Positive Youth Development	21.944**	9	.987	2.921	1	.087	-.002
M4	Conflicts → Positive Youth Development	20.066*	9	.989	1.043	1	.307	.000
M5	Communication → Positive Youth Development	19.200*	9	.990	.177	1	.674	.001
M6	Mutuality → Self-Harm Behavior	21.442*	9	.988	2.419	1	.120	-.001
M7	Conflicts → Suicidal Behavior	30.282***	9	.979	11.259***	1	<.001	-.010
M8	Positive Youth Development → Self-Harm Behavior	24.125**	9	.985	5.102*	1	.024	-.004
M9	Positive Youth Development → Suicidal Behavior	19.153*	9	.990	.130	1	.718	.001
M10	Self-Harm Behaviors → Suicidal Behaviors	20.058*	9	.989	1.035	1	.309	.000

Note: M1 is the baseline model in which all parameters were freely estimated. From M2 to M10, the reference model is M1

* $p < .05$; ** $p < .01$; *** $p < .001$

TLI=.968, SRMR=.020; the path was not significantly different from M1: $\Delta\chi^2(1)=2.419, p=ns, \Delta CFI=-.001$. In M7, the path from conflicts to suicidal behaviors was held invariant: $\chi^2(9)=30.282, p<.001, RMSEA=.044$ (90 % CI=.027-.061), CFI=.979, TLI=.945, SRMR=.021; the path was significantly different from M1: $\Delta\chi^2(1)=11.259, p<.001, \Delta CFI=-.010$. In M8, the path from PYD to self-harm was significantly constrained: $\chi^2(9)=24.125, p<.01, RMSEA=.037$ (90 % CI=.019-.055), CFI=.985, TLI=.961, SRMR=.021; the path was not significantly different from M1: $\Delta\chi^2(1)=5.102, p<.05, \Delta CFI=-.004$. In M9, the path from PYD to suicidal behavior was held invariant: $\chi^2(9)=19.153, p<.05, RMSEA=.030$ (90 % CI=.010-.049), CFI=.990, TLI=.974, SRMR=.013; the path was not significantly different from M1: $\Delta\chi^2(1)=.130, p=ns, \Delta CFI=.001$. In M10, the path from self-harm to suicidal behavior was constrained to be equal: $\chi^2(9)=20.058, p<.05, RMSEA=.031$ (90 % CI=.012-.050), CFI=.989, TLI=.971, SRMR=.017; the path was not significantly different from M1: $\Delta\chi^2(1)=1.035, p=ns, \Delta CFI=.000$. In sum, only one parameter (i.e., from conflict to suicidal behavior) was significantly variant across genders.

Table 5 shows the indirect effects across genders. The patterns of indirect effects were similar to those reported above regardless of gender. Only two specific indirect effects were different between males and females. First, the indirect effect of PYD

from mutuality to suicidal behavior was significant in males ($\beta = -.016, p < .05$) but not in females ($\beta = -.008, p = ns$). Second, the indirect effect of PYD from communication to suicidal behavior was also significant in males ($\beta = -.014, p < .05$) but not in females ($\beta = -.015, p < .05$).

Discussion

The prevalence of self-harm behavior among the Grade 9 adolescents who participated in the study was around 21.9 %, which was lower than the percentage (23.5 %) when these students were in Grade 8 (Law & Shek, 2013). In fact, all kinds of self-harm behaviors among the adolescents decreased as they advanced to Grade 9 from Grade 8. Despite this decrease, the figure remains alarming because it implies that one in four to five adolescents have attempted to self-harm in the past 12 months. This percentage is higher than that in another study in China that reported that almost 17 % of adolescents have manifested self-harm behaviors in the past 12 months (Wan et al., 2011). The most common forms of self-harm among Chinese adolescents in Hong Kong are self-scratching and preventing wounds from healing. This finding varies from that of other studies in mainland China, in which self-hitting was reported as the most prevalent (Wan et al., 2011). The least common form of self-harm involves the use of chemicals. Self-harm does not entail sophisticated methods, and Chinese adolescents are not known to attempt using toxic chemicals.

In the present work, students became much more susceptible to suicidal attempts in Grade 8 than when they were in Grade 7 (Law & Shek, 2013). When they reached Grade 9, the percentage of suicidal behaviors decreased. The suicide rate among Hong Kong adolescents is relatively low and can be explained in terms of the social and economic environment. In general, the strongest predictive factors of population suicide rate are economic prosperity and political stability (World Health Organization, 2008). As Hong Kong has experienced economic prosperity and freedom for decades, not many adolescents have been exposed to economic hardships. Moreover, Hong Kong's educational system promotes moral education and PYD programs.

The lack of studies that explain the tendency of the prevalence of self-harm and suicidal behaviors to decrease from Grade 8 to Grade 9 leads us to put forward some conjectures within the unique sociocultural contexts of Hong Kong. Under the new educational system in Hong Kong, all secondary school students are required to study for 3 years in junior secondary school and another 3 years in senior secondary school. By the time they reach Grade 9, they are expected to have already adapted to the school environment. In addition, most adolescents actively select their favorite subjects at Grade 10. Thus, they explore many subjects at Grade 9 and grow increasingly concerned about planning their careers. A focus on academic plans might provide these students with a sense of purpose.

As indicated by the descriptive profile in the study, girls are more prone to self-harm and suicide attempts compared with boys. Puberty causes additional stress for

girls during this academic transition. Social comparison and the Hong Kong media exaggerate the importance of physical appearance and body image. These factors contribute to the relatively high prevalence of self-harm and suicidal behaviors among girls because self-harm is related to social stress. Compared with boys, girls are more sensitive to interpersonal relationships such as those with peers and family (Rodham, Hawton, & Evans, 2006). Meanwhile, girls are more inclined to internalize negative emotions compared with boys. The susceptibility to social stress and the internalization of negative emotions may lead to self-destructive behaviors such as self-harm and suicide.

One of the major breakthroughs of the study is the use of a longitudinal approach in exploring the relationships among family functioning, PYD, and self-harm and suicidal behaviors. The major thesis of the revised model is that family functioning influences self-harm and suicidal behaviors via positive youth development attributes. Figure 2 reveals several important observations. First, similar to the findings of Hawton (2005), the most critical predictor of suicidal behavior is self-harm. Second, although mutuality at Wave 1 directly influenced self-harm behavior at Wave 3, a similar path was not found from mutuality at Wave 1 to suicidal behavior at Wave 3. Third, although conflict at Wave 1 directly influenced suicidal behavior at Wave 3, the path from conflict at Wave 1 to self-harm behavior at Wave 3 was not significant. Fourth, only mutuality and communication (but not conflict) at Wave 1 influenced self-harm and suicidal behaviors at Wave 3 in terms of total indirect effects (Table 4).

This longitudinal study is the first to explore how family functioning and PYD influence self-harm and suicidal behaviors among adolescents over time. Self-destructive behaviors among adolescents have long been argued to be influenced by both personal and social factors (Sun & Hui, 2007). This study shows that both family functioning and PYD are important protective factors in reducing self-harm or suicidal behaviors. Using path analysis, we can clearly differentiate the impact of the different components of family functioning (mutuality, conflicts, and communications) on self-harm and suicidal behaviors. The final model suggests that mutuality, conflicts, communication, and PYD exert their influence on self-harm and suicidal behaviors in different manner. This study arrived at two different findings: mutuality directly affects self-harm behaviors, whereas conflicts affect suicidal behaviors. The literature in general (Isacson & Rich, 2001; Wan et al., 2011) shows that self-harm and suicide attempts operate differently, with self-harm originating from anxiety and suicide attempts originating from depression. In this manner, we can propose that the lack of mutuality or family cohesion can induce internal anxiety in adolescents, and this anxiety may lead to self-harm behaviors. However, overt parent-child conflicts can ultimately lead to adolescent depression, which may result in suicidal behaviors. Further studies can be performed in this direction to distinguish these two types of self-destructive behaviors.

Another contribution of this study is the gender invariance in the proposed model. The descriptive statistics have already shown that girls manifest self-harm and suicidal behaviors more than boys do. The results show that in general, the proposed model was not entirely gender invariant. One path was significantly

different, that is, conflicts for girls at Wave 1 led to suicidal behaviors at Wave 3; this path was not significant for boys. Otherwise, all other paths would be gender invariant. One explanation is that girls are more susceptible to social stress than boys (Rodham et al., 2006). Girls take conflicts personally, whereas boys opt to choose other coping methods. This result implies that we should focus on conflicts among girls.

The understanding of self-harm and suicide path models in adolescents in Hong Kong is critical in facilitating the design of culturally sensitive and community-based interventions (Goldston et al., 2008). Both medical and psychosocial interventions are necessary in bringing effective changes to people (Royal College of Psychiatrists, 2010). The prevention of self-harm and suicidal behaviors requires multidisciplinary cooperation among doctors, social workers, and educators. From the findings, we can develop programs that are aimed at enhancing both family functioning and PYD for early adolescents. Several service directions can be taken. First, we should focus on self-harm behaviors because they easily lead to suicidal behaviors. As mentioned previously, this topic is a neglected area in the literature. Second, gender-sensitive practice is in order. The findings suggest that we should focus on family mutuality and communication among boys as well as on family conflicts among girls. Third, psychosocial interventions in schools can come in the form of positive promotional programs or online programs. One example is the Project P.A.T.H.S. in Hong Kong, which is sponsored by the Hong Kong Jockey Club Charities Trust. According to its longitudinal evaluation, the project was able to promote holistic development and reduce risk behavior in adolescents (Shek & Ma, 2012).

Several research directions can be taken in the future. First, although family functioning and PYD come from two earlier waves, self-harm and suicidal behaviors belong to the same wave. As such, we cannot claim that self-harm can lead to suicidal behaviors. Hence, further waves of data are needed. Second, fully understanding the roles of PYD requires the use of the four second-order factors of PYD in model testing. In this sense, we can understand the interaction among the three components of family functioning, the four components of PYD, and two types of self-destructive behaviors. Third, low- and high-risk adolescents should be identified by latent class analysis, and different path models could be tested. We should work not only with low-risk adolescents using early identification strategies and PYD education but also with high-risk adolescents using active interventions and crisis prevention methods.

As Chinese adolescents in Hong Kong were chosen to participate in the study, the findings may not be generalizable to other Chinese communities. Despite this limitation, this study is the first to propose a path model to understand self-harm and suicidal attempts among adolescents in Hong Kong with reference to family functioning, PYD, and gender invariance. The study underscores the alarming prevalence rates of deliberate self-harm and suicidal behaviors and the potential role of family functioning and PYD in promoting the personal well-being of adolescents.

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References

- Benson, P. L. (1997). *All kids are our kid: What communities must do to raise caring and responsible children and adolescents*. San Francisco: Jossey-Bass.
- Blum, R., Sudhinaraset, M., & Emerson, M. R. (2012). Youth at risk: Suicidal thoughts and attempts in Vietnam, China, and Taiwan. *Journal of Adolescent Health, 50*(3 Supple), S37–S44.
- Byrne, S., Morgan, S., Fitzpatrick, C., Boylan, C., Crowley, S., Gahan, H., et al. (2008). Deliberate self-harm in children and adolescents: A qualitative study exploring the needs of parents and carers. *Clinical Child Psychology and Psychiatry, 13*(4), 493–504.
- Chan, W. S. C., Law, C. K., Liu, K. Y., Wong, P. W. C., Law, Y. W., & Yip, P. S. F. (2009). Suicidality in Chinese adolescents in Hong Kong: The role of family and cultural influences. *Social Psychiatry and Psychiatric Epidemiology, 44*(4), 278–284.
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 9*(2), 233–255.
- Czyz, E. K., Liu, Z., & King, C. A. (2012). Social connectedness and one-year trajectories among suicidal adolescents following psychiatric hospitalization. *Journal of Clinical Child & Adolescent Psychology, 41*(2), 214–226.
- Evans, W., Smith, M., Hill, G., Albers, E., & Neufeld, J. (1996). Rural adolescent views of risk and protective factors associated with suicide. *Crisis Intervention & Time-Limited Treatment, 3*(1), 1–12.
- Fox, C., & Hawton, K. (2004). *Deliberate self-harm in adolescence*. London: Jessica Kingsley.
- Goldston, D. B., Molock, S. D., Whitbeck, L. B., Murakami, J. L., Zayas, L. H., & Hall, G. C. N. (2008). Cultural considerations in adolescent suicide prevention and psychosocial treatment. *American Psychologist, 63*(1), 14–31.
- Hall-Lande, J. A., Eisenberg, M. E., Christenson, S. L., & Neumark-Sztainer, D. (2007). Social isolation, psychological health, and protective factors in adolescence. *Adolescence, 42*(166), 265–286.
- Hawton, K. (2005). *What happens to deliberate self-harm patients in the long term*. Oxford, UK: University of Oxford Centre for Suicide Research.
- Isacsson, G., & Rich, C. L. (2001). Management of patients who deliberately harm themselves. *BMJ, 322*(7280), 213–215.
- Law, B. M. F., & Shek, D. T. L. (2013). Self-harm and suicide attempts among young Chinese adolescents in Hong Kong: Prevalence, correlates, and changes. *Journal of Pediatric and Adolescent Gynecology, 26*(3 Suppl), S26–S32.
- Lee, S. (2011). Reasons for living and their moderating effects on Korean adolescents' suicidal ideation. *Death Studies, 35*(8), 711–728.
- Lubell, K. M., & Vetter, J. B. (2006). Suicide and youth violence prevention: The promise of an integrated approach. *Aggression and Violent Behavior, 11*(2), 167–175.
- Maimon, D., Browning, C. R., & Brooks-Gunn, J. (2010). Collective efficacy, family attachment, and urban adolescent suicide attempts. *Journal of Health and Social Behavior, 51*(3), 307–324.
- Mota, N., Elias, B., Tefft, B., Medved, M., Munor, G., & Sareen, J. (2012). Correlates of suicidality: Investigation of a representative sample of Manitoba First Nations adolescents. *American Journal of Public Health, 102*(7), 1353–1361.
- Mustanski, B., & Liu, R. T. (2013). A longitudinal study of predictors of suicide attempts among lesbian, gay, bisexual, and transgender youth. *Archives of Sexual Behavior, 42*(3), 437–448.

- Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles: Muthén & Muthén.
- Pisani, A. R., Wyman, P. A., Petrova, M., Schmeelk-Cone, K., Goldston, D. B., Xia, Y., et al. (2013). Emotion regulation difficulties, youth-adult relationships, and suicide attempts among high school students in underserved communities. *Journal of Youth and Adolescence*, *42*(6), 807–820.
- Randell, B. P., Wang, W. L., Herting, J. R., & Eggert, L. L. (2006). Family factors predicting categories of suicide risk. *Journal of Child and Family Studies*, *15*(3), 255–270. doi:[10.1007/s10826-006-9020-6](https://doi.org/10.1007/s10826-006-9020-6).
- Rew, L., Thomas, N., Horner, S. D., Resnick, M. D., & Beuhring, T. (2001). Correlates of recent suicide attempts in a triethnic group of adolescents. *Journal of Nursing Scholarship*, *33*(4), 361–367.
- Rodham, K., Hawton, K., & Evans, E. (2006). *By their own young hand: Deliberate self-harm and suicidal ideas in adolescent health*. Philadelphia: Jessica Kingsley.
- Royal College of Psychiatrists. (2010). *Self-harm, suicide and risk: Helping people who self-harm*. London: Author.
- Samuel, D., & Sher, L. (2013). Suicidal behavior in Indian adolescents. *International Journal of Adolescent Medicine and Health*, *25*(3), 207–212.
- Sharaf, A. Y., Thompson, E. A., & Walsh, E. (2010). Protective effects of self-esteem and family support on suicide risk behaviors among at-risk adolescents: Corrigendum. *Journal of Child and Adolescent Psychiatric Nursing*, *23*(1), 45.
- Shek, D. T. L., & Ma, C. M. S. (2010). The Chinese Family Assessment Instrument (C-FAI): Hierarchical confirmatory factor analyses and factorial invariance. *Research on Social Work Practice*, *20*(1), 112–123.
- Shek, D. T. L., & Ma, C. M. S. (2012). Impact of the Project P.A.T.H.S. in the junior secondary school years: Objective outcome evaluation based on eight waves of longitudinal data. *The Scientific World Journal*, *2012*, 170345.
- Shek, D. T. L., Siu, A. M. H., & Lee, T. Y. (2007). The Chinese positive youth development scale: A validation study. *Research on Social Work Practice*, *17*(3), 380–391.
- Shek, D. T. L., Sun, R. C. F., & Merrick, J. (2013). Positive youth development constructs: Conceptual review and application. In D. T. L. Shek, R. C. F. Sun, & J. Merrick (Eds.), *Positive youth development: Theory, research and application* (pp. xv–xix). New York: Nova.
- Siu, A. M. H., & Shek, D. T. L. (2005). Psychometric properties of the Chinese Family Assessment Instrument in Chinese adolescents in Hong Kong. *Adolescence*, *40*(160), 817–830.
- Sun, R. C. F., & Hui, E. K. P. (2007). Psychosocial factors contributing to adolescent suicidal ideation. *Journal of Youth and Adolescence*, *36*(6), 775–786.
- Tuisku, V., Kiviruusu, O., Pelkonen, M., Karlsson, L., Strandholm, T., & Marttunen, M. (2014). Depressed adolescents as young adults – Predictors of suicide attempt and non-suicidal self-injury during an 8-year follow-up. *Journal of Affective Disorders*, *152–154*, 313–319.
- Wan, Y. H., Hu, C. L., Hao, J. H., Sun, Y., & Tao, F. B. (2011). Deliberate self-harm behaviors in Chinese adolescents and young adults. *European Child & Adolescent Psychiatry*, *20*(10), 517–525.
- World Health Organization. (2008). *Suicide prevention web release*. Geneva, Switzerland: Author. Retrieved from http://www.who.int/mental_health/prevention/suicide/suicideprevent/en.
- Yip, K. S., Ngan, M. Y., & Lam, I. (2003). Pattern of adolescent self-cutting in Hong Kong: Reports from school social workers. *International Journal of Adolescence & Youth*, *11*(2), 135–155.
- Zhang, J., Li, N., Tu, X. M., Xiao, S., & Jia, C. (2011). Risk factors for rural young suicide in China: A case control study. *Journal of Affective Disorders*, *129*(1–3), 244–251.
- Zweig, J. M., Phillips, S. D., & Lindberg, L. D. (2002). Predicting adolescent profiles of risk: Looking beyond demographics. *Journal of Adolescent Health*, *31*(4), 343–353.