

## Social and Cognitive Functioning as Risk Factors for Suicide: A Historical-Pro prospective Cohort Study

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### ABSTRACT

*Objectives-* Previous studies have shown that poor cognitive and social functioning are associated with increased risk of suicide. This study aimed to examine the association between social and cognitive functioning in adolescence and later completed suicide.

*Design-* Historical prospective cohort study

*Setting and Participants-* Data from the Israeli Draft Board Register for 756,223 Israeli male adolescents aged 16-17 was linked to a causes-of-death data registry, enabling up to 20 year follow-up (mean 10.4 year) for completed suicide (N=993). *Results-* Poorer cognitive and social functioning were both associated with increased risk of later suicide (adjusted HR=1.44, 95% CI: 1.18-1.76 and adjusted HR=2.3, 95% CI: 1.53-3.4, respectively). Regardless of their level of social functioning, adolescents who scored one point or more below their siblings on the social functioning scale had increased risk of later suicide (adjusted HR=1.41, 95% CI: 1.09-1.82). *Conclusions-* In adolescent males, poor cognitive and social abilities are associated with a slightly increased risk of later suicide. Male adolescents who function poorly compared to their brothers are also at increased risk for later suicide. These data underscore the importance of cognition and social abilities in understanding the phenomenon of suicide, and particularly indicate the significance of sibling rivalry in the etiology of suicide. However, because suicide is a rare event and poorer cognitive and social function in the general population is very prevalent, these characteristics are not useful as clinical predictors of suicide.

### 1.0 INTRODUCTION

Suicide is the third most common cause of death in individuals aged 15-44 years <sup>1</sup>, and is a complex outcome of multiple, inter-related genetic and environmental factors [2, 3]. Several investigators have studied the association between social isolation and risk of suicidal thoughts and behaviour [4-6]. Johnson et al. [7] reported that severe interpersonal difficulties, including difficulty making new friends, loneliness and interpersonal isolation, lack of close friends, and poor relationships with friends and peers, were significantly associated with risk for suicide attempts during late adolescence or early adulthood.

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14. ABSTRACT

**Objectives- Previous studies have shown that poor cognitive and social functioning are associated with increased risk of suicide. This study aimed to examine the association between social and cognitive functioning in adolescence and later completed suicide. Design- Historical prospective cohort study Setting and Participants- Data from the Israeli Draft Board Register for 756,223 Israeli male adolescents aged 16-17 was linked to a causes-of-death data registry, enabling up to 20 year follow-up (mean 10.4 year) for completed suicide (N=993). Results- Poorer cognitive and social functioning were both associated with increased risk of later suicide (adjusted HR=1.44, 95% CI: 1.18-1.76 and adjusted HR=2.3, 95% CI: 1.53-3.4, respectively). Regardless of their level of social functioning, adolescents who scored one point or more below their siblings on the social functioning scale had increased risk of later suicide (adjusted HR=1.41, 95% CI: 1.09-1.82). Conclusions- In adolescent males, poor cognitive and social abilities are associated with a slightly increased risk of later suicide. Male adolescents who function poorly compared to their brothers are also at increased risk for later suicide. These data underscore the importance of cognition and social abilities in understanding the phenomenon of suicide, and particularly indicate the significance of sibling rivalry in the etiology of suicide. However, because suicide is a rare event and poorer cognitive and social function in the general population is very prevalent, these characteristics are not useful as clinical predictors of suicide.**

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Findings regarding cognitive functioning have been inconclusive, with some suggesting that those with higher IQ are more prone to suicide [8-12], while others reporting an inverse [13-16], or no [17] association between IQ and suicide. Gunnell et al. [14], in a cohort study of approximately one million Swedish men found that low cognitive functioning was strongly related to subsequent risk of suicide, and that the highest risk was found among those with low cognitive abilities whose parents were highly educated.

Most previous studies used suicidal ideation or attempts as the main outcome measure rather than completed suicide [4-7, 15]. Further methodological problems include relatively short follow-up [4, 5, 15], small sample size [12], and the use of ecological data rather than individual based data [9-11].

The purpose of this study was to examine the association between social and cognitive functioning and later completed suicide. Using a historical-prospective method, we utilized data routinely collected in a standardized method by the Israeli military Draft Board on a large cohort of Israeli male adolescents, including assessments of social and cognitive functioning. Later suicide was ascertained using the Israeli Death Registry, which includes records of all deaths in the country.

## **2.0 METHOD**

### **2.1 Draft Board Assessment**

All 16 to 17 years old Israeli males undergo cognitive, behavioral, and psychiatric assessments by the Draft Board in order to determine their eligibility and aptitude for military service. The cognitive test battery yields a total score which is a highly valid measure of general intelligence equivalent to a normally distributed IQ score. Tests are administered by a trained psychometrician. The cognitive assessment is comprised of four sub-tests: (a) Arithmetic - R, which assesses cognitive reasoning, concentration, and concept manipulation. This sub-test is similar to the 'arithmetic' sub-test from the Wechsler Intelligence Scales. The test is in a multiple-choice format and contains twice as many items, and therefore includes harder test items; (b) Similarities - R, which assesses verbal abstraction and categorization (i.e. the ability to understand the relationship between words and the use of this relationship in several contexts). This is a multiple-choice test. This test is a revised version of the 'similarities' sub-test from the Wechsler Intelligence Scale. Unlike the Wechsler test, subjects are requested not only to identify and report the semantic of causal relationships between the test items, but also to apply these relations to target items; (c) A spatial analogies test, which measures non-verbal abstract reasoning and problem-solving abilities. This test is also a multiple-choice test; (d) OTIS - R, a modified, Otis-type verbal intelligence test adapted from the US Army Alpha Instructions Test, which measures the ability to understand and carry out verbal instructions [18]. Tests are progressive, beginning with relatively simple items and becoming more difficult. Tests are group-administered and are time-limited. All scores are based on the number of correct answers. In the many validation studies conducted by the Draft Board, the summary score of the cognitive test battery has been found to be a highly valid measure of general intelligence [19].

After the cognitive assessments are performed, a semi-structured, thirty minutes, interview is held. The purpose of the interview is to assess personality and behavioral traits that will lead to an estimation of the conscript's suitability to military service, particularly service in combat units [19]. The interview is administered by trained enlisted individuals (most of them female soldiers) who participated in a 3 months training course. The interviewers are under constant supervision by senior interviewers and participate in ongoing training. The behavioral assessment, administered only to males, includes a subscale assessing social functioning. Based on structured questions, social functioning is then scored on a scale of 1-5: 1) Very poor: complete withdrawal, 2) Poor: weak interpersonal contacts, 3) Adequate: can form relationships with individuals and in a group, 4) Good: good interpersonal relationships and 5) Exceptional: superior interpersonal relatedness. The test-retest reliability of the behavioral assessment for

inductees interviewed after several days by different interviewers is above 0.8, and population-based norms are available [19, 20]. The draft board screening is described in detail in previous publications [17].

## **2.2 The Israeli Central Bureau of Statistics**

For all deaths in the country, the treating physician must fill out a form describing all illnesses, and the cause of death. For cases of suicide, the method used is specified. The Israeli Central Bureau of Statistics receives these reports and encodes the causes of death, including suicide and method used, using standard ICD criteria. After receiving approval from the local IRB, the Draft Board data were linked to the death register, and the Central Bureau of Statistics provided mortality data including the causes and dates of deaths.

As in other similar studies [14], death by suicide was defined to comprise both those deaths which were officially classified as suicide/intentional self harm (ICD9 E950-959; ICD10 X60-84) and also deaths 'undetermined whether accidentally or purposely inflicted' (ICD9 E980-989; ICD10 Y10-34) [14]. This was done in order to reduce misclassification biases.

## **2.3 Study Population**

Data was available on 875,097 Israeli male adolescents who were consecutively screened by the Israeli Draft Board. Our analyses are based on the 757,216 (87%) conscripts with complete data on both cognitive and social functioning. The 117,881 individuals with missing data had higher suicide rates than those with complete data (0.2% vs. 0.1%,  $\chi^2=13.12$ ,  $p<.001$ ). Of the conscripts included in the analyses, during a mean follow-up time of 10.4 years (SD=6 years), 993 (0.1%) were identified in the Central Bureau of Statistics as having committed suicide. These rates are compatible with the gender and age adjusted rates in Israel published annually by the Israeli Central Bureau of Statistics[21].

## **2.4 Statistical Analyses**

As individuals assessed by the Draft Board were followed up to different ages, Cox regression analysis was used. Data on individuals with no record in the Death Registry were censored on the last day of follow-up, which was the date when the Draft Board data were merged with the Death Registry.

For purposes of analysis, cognitive functioning was categorized into three groups: 1 SD or more below population mean (low), 1 SD or more above population mean (high), and within 1 SD of population mean (normal). Social and cognitive functioning were entered into a Cox regression model once as the sole predictor, and then controlling for birth order. Immigration was not found to be associated with suicide, and thus was not entered as a covariate in the full model (see Table 1). Next, as suicide is strongly associated with mental disorders [22], we stratified the analyses according to the presence of psychiatric illness at the draft board assessment (available for 99% of the conscripts). For both social and cognitive functioning, the intermediate group (including the mean/median value) was used as the reference category. Regression analyses yielded hazard ratios and 95% confidence intervals.

In additional analyses we used data on socioeconomic status (SES) that was available for a sub-sample of 636,861 adolescents (of which 595 – 0.1% - committed suicide). A third regression model was fitted for this population, including SES as a covariate. The SES measure is derived from census data, based on the number of persons/room in the home, number of computers per household, number of motor vehicles per household, and per capita income level [23].

Finally, we identified a sub-group of adolescents for whom the social and cognitive data of siblings was available (N=403,416; 322 suicides). We used this data to assess whether cognitive and/or social

functioning significantly lower than one's siblings affected risk of later suicide, regardless of the absolute IQ or social functioning score of the conscript.

### 3.0 RESULTS

Unadjusted analyses revealed that both low and high cognitive functioning were associated with increased risk of later suicide (HR=1.36, 95% CI: 1.16-1.58 and HR=1.25, 95% CI: 1.05-1.48, respectively). Adjusting for birth order did not change these findings (adjusted HR=1.44, 95% CI: 1.18-1.76 and adjusted HR=1.25, 95% CI: 1.0-1.55, respectively). When stratifying the analysis by the presence of psychiatric illness at age 17, the association between IQ and later suicide held only for adolescents without mental illness (Table 1). We attempted to further stratify according to psychotic/non-psychotic disorder but this was not possible as there were only 3 psychotic individuals who later committed suicide. Similarly, both poor and high social functioning were associated with increased risk of later suicide (very poor SF: HR=2.41, 95% CI: 1.77-3.29, poor SF: HR=1.85, 95% CI: 1.6-2.15, exceptional SF: HR=1.65, 95% CI: 1.07-2.52). When adjusting for birth order, only those with poor social functioning were at risk for later suicide (very poor SF: adjusted HR=2.3, 95% CI: 1.53-3.29, poor SF: adjusted HR=1.65, 95% CI: 1.44-2.11). As with cognitive functioning, this association was only observed among adolescents without mental illness (Table 2). Results were similar when controlling for SES among the sub-sample for whom SES data was available (data not shown).

**Table 1: Association between cognitive functioning and risk for suicide – stratified by psychiatric illness**

	Mentally healthy conscripts				Mentally ill conscripts			
	No suicide (N=715,125)	Suicide (N=769)	HR (95% CI)	Adjusted* HR (95% CI)	No suicide (N=35,285)	Suicide (N=85)	HR (95% CI)	Adjusted* HR (95% CI)
<b>Low</b>	16.5%	20.2%	1.37 (1.14-1.64)	1.39 (1.1-1.76)	40.5%	36.5%	1.02 (0.41-2.57)	0.99 (0.53-3.1)
<b>Normal</b>	68.5%	62.8%	1	1	53.6%	57.6%	1	1
<b>High</b>	15.0%	17.0%	1.22 (1.01-1.49)	1.23 (0.96-1.58)	5.9%	5.9%	0.86 (0.55-1.35)	1.03 (0.62-1.68)

\*Adjusted for birth order

**Table 2: Association between social functioning and risk for suicide in crude and birth order – stratified by psychiatric illness**

	Mentally healthy conscripts				Mentally ill conscripts			
	No suicide (N=715,125)	Suicide (N=769)	HR (95% CI)	Adjusted* HR (95% CI)	No suicide (N=35,285)	Suicide (N=85)	HR (95% CI)	Adjusted* HR (95% CI)
<b>Very poor</b>	1.8%	3.8%	3.03 (2.08-4.42)	2.46 (1.43-4.21)	14.7%	10.6%	0.77 (0.37-1.61)	0.83 (0.38-1.83)
<b>Poor</b>	17.1%	27.0%	1.95 (1.65-2.31)	1.81 (1.46-2.26)	39.5%	44.7%	1.04 (0.65-1.66)	0.86 (0.5-1.48)
<b>Adequate</b>	58.4%	49.5%	1	1	35.8%	37.6%	1	1
<b>Good</b>	20.7%	17.1%	1.03 (0.85-1.26)	0.96 (0.74-1.23)	8.9%	5.9%	0.67 (0.26-1.72)	0.83 (0.32-2.15)
<b>Exceptional</b>	2.0%	2.6%	1.89 (1.21-2.97)	1.65 (0.9-3.03)	1.1%	1.2%	1.29 (0.18-9.43)	0.91 (0.42-2.7)

\*Adjusted for birth order

### 3.1 Siblings

Scoring one point or more below one's brothers on the social functioning scale significantly increased the risk of later suicide (Table 3), irrespective of the conscript's absolute social functioning score. No such association was observed between poorer scoring on the cognitive functioning scale and later suicide.

**Table 3: Risk for suicide by social and cognitive differences between siblings**

		<b>HR (95% CI)</b>	<b>Adjusted* HR (95% CI)</b>
<b>IQ</b>	Within 1 SD of brothers	1	1
	1 SD or more above brothers	0.94 (0.66-1.33)	0.92 (0.65-1.31)
	1 SD or more below brothers	1.06 (0.76-1.5)	1.1 (0.77-1.52)
<b>Social Functioning</b>	Within 1 point of brothers	1	1
	1 point or more above brothers	1.19 (0.91-1.56)	1.18 (0.9-1.55)
	1 point or more below brothers	1.42 (1.09-1.83)	1.41 (1.09-1.82)

\*Adjusted for birth order

## 4.0 DISCUSSION

The main finding of this paper is the association between poor social and cognitive functioning in adolescents aged 17-21 and the risk of later suicide. Adolescents functioning at high levels were also at increased risk, though this was attenuated or no longer significant when controlling for birth order.

To our knowledge, this association between poor social functioning and later suicide has never been published before. Some authors reported a correlation between suicidality and different variables related to social functioning, such as family and friend's support, social isolation, emotional neglect [3], number of close friends [24], marital status [17], and number of children [25]. Our subjects were followed for completed suicide, and their social functioning was prospectively assessed systematically and graded [19]. One might speculate that at least some of the persons with poor social functioning are at increased risk for completed suicide because they are subject to rejection by their peers. Another related possibility is that this poor social functioning reflects poor social skills, which might be a source of stress and hence suicidality. However, the data presented here do not enable us to examine this hypothesis.

The findings regarding cognitive functioning are similar. Lower IQ predicted higher rates of suicide later in life. This is consistent with previous reports of a negative correlation between IQ and risk of suicide [17]. This can partly be explained by the known finding that low IQ is a predictor of future psychiatric illness, a known risk factor for suicide [26], however this finding remained significant when examining persons without psychiatric illness. The hazard ratio (1.37, CI: 1.11-1.69) is also consistent with previous cohort studies [13, 15]. One might speculate that being less intelligent in today's world is a source of constant stress, which might then lead to suicidality. A trend towards high suicide risk in subjects with high IQ was also found. A similar association between high IQ and risk for suicide was previously reported in several studies [8-11]. It is harder to explain this finding, given that in most studies high IQ is associated with positive outcomes such as low mortality risk [27].

Gunnell et al. [14] compared the intelligence of subjects to that of their parents (using parents' years of education as a proxy) and concluded that in cases where the parent performed better than the offspring, higher suicide risk was evident. In the current analysis on siblings we did not replicate this finding

regarding IQ but did find that scoring significantly lower than one's siblings on the social functioning scale slightly but significantly increased risk for later suicide (Table 2). It is plausible that the stress that such gaps in social functioning impose may cause sibling rivalry and envy, and thus increase frustration and risk of later suicide.

#### **4.1 Limitations**

This study uses data collected on adolescents inducted to the military; thus, lower functioning adolescents considered not fit to be drafted, including those with severe psychiatric disorders, are not included in these data. However, these excluded adolescents have lower scores on the cognitive and social tests administered by the draft board (data not shown), and higher risk of suicide [28]; hence their exclusion probably leads to an underestimation of the association between cognitive and social abilities and later suicide. In addition, since the information we have on the subjects was collected between the ages of 17 to 21, we only know of cognition, social functioning and psychiatric illness recorded during this period. It is possible that some of these individuals were later diagnosed with mental illness, a possibility we could not control for. A third important limitation is that completed suicides as drawn from the registry are probably an underestimation of actual suicide rates [29].

#### **5.0 CONCLUSION**

In summary, in adolescent males, poor cognitive and social abilities are associated with increased risk of later suicide. Male adolescents whose social functioning is poorer than that of their siblings are also at increased risk for later suicide. These data underscore the importance of cognition and social abilities in understanding the phenomenon of suicide, and particularly indicate the significance of sibling rivalry in the etiology of suicide. However, due to the low prevalence of suicide, these characteristics do not enable prediction of later suicide.

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