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Those Who Are Left Behind: An Estimate of the Number of Family Members of Suicide Victims in Japan

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Abstract This paper contributes to the literature of suicide studies by presenting procedures and its estimates of the number of family members who lose their loved ones to suicide. Using Japanese aggregate level data, three main findings emerge: first, there are approximately five bereaved family members per suicide; second, in 2006, there were about 90,000 children who had lost a parent to suicide; and third, in 2006, there were about three million living family members who had lost a loved one to suicide. The direct production loss of bereaved family members in 2006 alone is estimated at approximately 197 million USD. These results are valuable in evaluating the cost-effectiveness of suicide prevention programs and in designing appropriate policy instruments.

Keywords Suicide · Suicide prevention · Bereaved family members

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1 Introduction

In any suicide prevention program, a key to prevent suicides is to identify high suicide-risk groups. In the US National Strategy for Suicide Prevention, risk factors for suicide are divided into three categories. Among these, family history of suicide is one of the biopsychosocial risk factors, relational or social loss is one of the environmental risk factors, and exposure to and influence of others who have died by suicide is one of the socio-cultural risk factors (US Department of Health and Human Services 2001). Hence, the family members of a suicide victim belong to all three categories. In a resource for general physicians, the World Health Organization (WHO 2000) also itemizes eight clinically useful individual and socio-demographic risk factors associated with suicide as documented by Gunnell and Frankel (1999); among them is family history of suicide and bereavement in childhood. Yet, little is known about "those who are left behind"—family members. In particular, there is little published information on the number of family members of suicide victims.[1] Although there are some studies that attempted to estimate the costs of suicide, estimates of the families of suicide victims were made on the basis of *ad hoc* assumptions or small-scale case studies (Coggan et al. 1997; Clayton and Barcelo 1999; O'Dea and Ducker 2005). However, information on the number of family members of suicide victims is valuable in evaluating the cost-effectiveness of suicide prevention programs and in designing appropriate policy instruments.

The current study fills this gap in the existing information by providing procedures for estimating the number of family members of suicide victims based on aggregate level data and then applying it to the Japanese data. Indeed, among the 25 high-income Organization for Economic Cooperation and Development (OECD) countries, the male and female suicide rate in Japan was the second highest and highest, respectively, from 1998 to 2001, and vice versa from 2002 to 2004 (Chen, Choi, and Sawada 2009). As a countermeasure, the Japanese government enforced "The Basic Act of Suicide Prevention (*jisatsu taisaku kihon hou*)" in 2006 with a specific article addressing support for bereaved family members.

Three main findings emerge from the present study: First, there are approximately five bereaved family members per suicide; second, in 2006, there were about 90,000 children who had lost a parent to suicide; finally, in 2006, there were about three million bereaved family members who had lost a loved one to suicide. On the basis of these results and the assumption that each adult family member would be absent from work for a week (O'Dea and Ducker 2005), in 2006, the estimated direct loss in production due to family members' absence from work is around 197 million USD. This number can be interpreted as a lower bound estimate because it does not include indirect costs such as psychological counseling or other expenditures.

2 Estimation procedures

2.1 Estimating the number of people who became bereaved in 1993–2006

The number of suicide victims by gender and five-year age group from 1993 to 2006 was taken from "Vital Statistics," published by the Japanese Ministry of Health, Labour and Welfare.[2] The numbers of bereaved family members for each relationship, gender and age group, and year were estimated using the estimation procedures described below.

2.1.1 Spouses

Data for the marital status of suicide victims in 1995 and 2000 were published by the Ministry of Health, Labour and Welfare in the "2004 Special Report of Vital Statistics."[3] The number of spouses of suicide victims, *SP*, was estimated using equation (1):[4]

$$SP_{t,a,s} = \alpha_{t,a,s} \cdot SCD_{t,a,s} \tag{1}$$

where *t*, *a*, and *s* represent year, age group, and gender, respectively; α is the marriage rate of suicide victims; and *SCD* is the number of suicide victims. Note that because marriage rates are available only for 1995 and 2000, the marriage rates for other years were interpolated linearly using equation (2):

$$\alpha_{t,a,s} = \frac{\alpha_{t_2,a,s} - \alpha_{t_1,a,s}}{t_2 - t_1}(t - t_1) + \alpha_{t_1,a,s} \tag{2}$$

where t_1 = 1995 and t_2 = 2000. Note that equation (1) implicitly assumes that suicide victims and their spouses belong to the same age groups.

2.1.2 Siblings

The number of bereaved siblings was estimated using the total fertility rate in the year in which the suicide victims were born, taking into account the survival rate for the siblings.[5] The probability γ_{t_1,t_2} that a person who was born in t_1 was alive in t_2 was calculated using equation (3):[6]

$$\gamma_{t_1,t_2} = \frac{POP_{t_2,t_2-t_1}}{B_{t_1}} \tag{3}$$

where $POP_{t,\alpha}$ is the number of people of a years of age in year *t*, and B_t is the number of births in year *t*.[7] The number of bereaved siblings was then computed using equation (4):

$$BS_{t,a} = \gamma_{t-a,t}(\beta_{t-a} - 1)SCD_{t,a} \tag{4}$$

where β is the total fertility rate, and *SCD* is the number of suicide victims of both genders. Note that equation (4) implicitly assumes that suicide victims and their siblings belong to the same age groups.

2.1.3 Parents

The average age of women who give birth to median birth order children is about 30 years (Japan National Institute of Population and Social Security Research 2008).[8] The probability δ_{t_1,t_2} that a person who was 30 years old in t_1 was still alive in t_2 was calculated using equation (5):

$$\delta_{t_1,t_2} = \frac{POP_{t_2,t_2-t_1+30}}{POP_{t_1,30}} \tag{5}$$

The number of bereaved parents was then computed using equation (6):

$$PR_{t,a} = 2\delta_{t-a,t} SCD_{t,a} \tag{6}$$

2.1.4 Children

The fertility rate of women by five-year age group was used to estimate the number of bereaved children. Let $FR_{t,i}$ be the fertility rate in year t of women in age group i. The average number of children of a mother in age group i that committed suicide in year t was calculated using equation (7):[9]

$$\xi_{t,a_I} = \sum_{i=0}^{I-1} \Delta a FR_{t-a_I+i\Delta a,i} + \frac{\Delta a}{2} FR_{t-a_I+I\Delta a,I} \tag{7}$$

where $\Delta a = 5$ is the width of the age group interval and a_i is the midpoint of age group i. To take into account the discrepancy between the actual age at suicide and the upper cutoff for age group i, the width of the age group was divided in half. The average number of children of a father in age group i who committed suicide in year t can be safely assumed to be the same as that of a mother because the average age difference between husband and wife was about 3 years during the sample periods (Japan National Institute of Population and Social Security Research 2008).

Note that for some age groups, the average marital status is different between the suicide victims and the general population. To take that into account, the estimated number of bereaved children was adjusted by the ratio of the unmarried percentage of suicide victims, *NMS*, to that of the general population, *NM*:[10]

$$\eta_{t,a} = \frac{NMS_{t,a}}{NM_{t,a}} \tag{8}$$

Substituting in the results from equations (3), (7), and (8) above, the number of living bereaved children, *CH*, was computed using equation (9):[11]

$$CH_{t,a} = \eta_{t,a} \xi_{t,a} \gamma_{t-a+a_c,t} SCD_{t,a} \tag{9}$$

The number of minor children, children less than 20 years of age, was also calculated. The index function for minor children whose parents committed suicide in year t is defined by equation (10):

$$\theta_{t,a} = 1[a - a_c < 20] \tag{10}$$

where t and a index the year and age at which a person committed suicide. Therefore, the number of minor children who lost their parents to suicides was computed using equation (11):

$$CHJ_{t,a} = \theta_{t,a} CH_{t,a} \tag{11}$$

2.2 Estimating the total number of living bereaved family members in 2006

To estimate the total number of bereaved family members who were still alive in 2006, the family members who became bereaved from 1993 to 2006 were aggregated with an adjustment for survival rates. Next, the number of all family members who became bereaved before 1992 was estimated. Finally, the number of all the above family members who were still alive in 2006 was estimated.

2.2.1 Estimating the total number of living family members who became bereaved from 1993 to 2006

The "2000 Prefectural Life Tables" were used to calculate the survival rate in 2006, that is, the probability of bereaved person being alive in 2006.[12] The probability that a person who was a_1 years old at the time of the suicide becoming a_2 years old was calculated using equation (12):

$$p_{a_1,a_2} = \prod_{k=a_1+1}^{a_2} q_k \tag{12}$$

where q_k is the probability of survival from k-1to k years of age . This probability is accordingly applied to the estimation results on the number of family members who became bereaved from 1993 to 2006 (Table 1).

2.2.2 Estimating the total number of living family members who became bereaved before 1992

Due to data limitation, only the total number of bereaved family members was estimated, as opposed to the relationship-by-relationship estimates described above. By using the age assumptions in the previous section, together with the relationship-specific estimates of bereaved family members for 1993 to 2006 as calculated above (Table 1), the average age of bereaved family members was calculated to be 47. Since the average life expectancy of a Japanese individual is about 80 years, going back about 35–45 years provides a good estimate of the total number of family members alive in 2006.

The average numbers of bereaved family members per suicide are referred to as "bereavement coefficients" in the remainder of the paper. The bereavement coefficients of all family members decline gradually over time (Table 2). On the basis of the results for 1993 to 2006, the bereavement coefficients of all family members were assumed to be 5 in 1992 and to increase by 0.5 for each 15 years into the past. Multiplying the bereavement coefficients with the numbers of suicide victims, the number of all family members who became bereaved in and before 1992 was estimated. The last step was to account for the survival rates of those family members. First, the survival rate of bereaved family members in 1993 was set equal to the actual survival rate in 1993, which is approximately 0.847.[13] Second, three different geometric series for the survival rates were computed, which become zero at 81, 86, and 91 years, respectively.[14]

3 Results

3.1 Estimate of the number of people who became bereaved in 1993–2006

Estimates of the total and average numbers of family members of suicide victims are presented in Table 1 and 2. The bereavement coefficients for total family members are between 4 and 5 during the period of 1993–2006 and decline gradually. The bereavement coefficients for siblings and children both decline gradually; this may reflect the declining birth rate in Japan. The coefficients for parents increase gradually; this may reflect the prolonged life span in Japan. The coefficients of spouses are almost constant.

3.2 Estimate of the total number of bereaved family members who were living in 2006

As shown in Table 3, in 2006, there were 1.7 million family members who became bereaved in 1993–2006. Among them, the number of minor children who lost their parents to suicide is 86,000. Soeda (2001, 2002) also estimated the number of bereaved minor children to be about 92,000 from 1980 to 1999 and 77,000 in 14 years from 1986 to 1999. On the other hand, the present study estimates the number at 86,000 in 14 years from 1993 to 2006, which is about 10% more than that of Soeda (2001, 2002). The number of suicides for the present study period (1993–2006) is approximately 17% more than that for the period of 1986-1999, suggesting that Soeda's number may overestimate the number of total bereaved children. Soeda (2001, 2002) postulates that the age of bereaved children follows a uniform distribution. Yet, in reality, the age distribution of suicide victims is skewed to an older age, and thus the age distribution of the bereaved children is also skewed to an older age. Because the present study considers the age distribution explicitly, it is suggested that the discrepancy between Soeda (2001, 2002) estimate and the present estimate is due to the difference in treatment of the age distribution.

An estimate of the number of family members who became bereaved before 1992 is shown in Table 4. Combining Tables 3 and 4, it is estimated that the number of all bereaved family members alive in 2006 ranges from 2.92 to 3.46 million. Considering the population size of Japan is 127.77 million in 2006, 2.31% to 2.71% of Japanese are bereaved family members.

3.3 Costs of suicides in Japan

From Table 3, there were 123,482 (135,436 minus 11,954) Japanese working-age family members who were affected by suicide in 2006. O'Dea and Ducker (2005) assume that a working-age bereaved family member is absent from work for 5 to 10 days. In the present study, it was assumed that a family member would be away from work for a week. Japanese GNP per working-age population in 2006 was 7,644,962 JPY, which divided by 48 weeks, gives an average weekly income of 159,270 JPY or about 1,600 USD. The total direct cost was then computed as the product of 1600 USD and the estimated number of adult bereaved family members, or 197 million USD.

4 Conclusion

This paper contributes to the literature of suicide studies through providing procedures to estimate the number of family members who lost their loved ones to suicide. The method requires only aggregate level data and provides realistic estimates of the number of bereaved family members relationship-by-relationship. The estimation results are valuable in

evaluating the cost-effectiveness of suicide prevention programs and in designing appropriate policy instruments. We obtained three main results by using the Japanese data. First, there are about 5 bereaved family members for each suicide victim in Japan. Second, there are about 90,000 minor children who have lost their parents to suicide. Third, in 2006, there are about 2.92 to 3.46 million bereaved family members in Japan.

Despite its seriousness as a worldwide social problem, the costs associated with suicides and those who are left behind have not been studied rigorously because of the lack of data. This paper provides basis for future research on the cost of suicides. In 2006 alone, the estimated direct loss of production due to family members' absence from work was around 197 million USD. This number can be interpreted as a lower bound estimate of the costs associated with bereaved families because it does not include, among other things, indirect costs such as psychological counseling expenditures.

Notes

[1] In this paper, family members are defined as the first degree relatives, that is, spouses, parents, siblings, and children.
[2] Suicide victims of unknown age are excluded. This should not affect the estimates because they account for less than 1 percent of all suicide victims.
[3] Marital status is classified into 5 categories: married, single, widowed, divorced, and unknown.
[4] Data on the suicide victims are divided into 19 age groups up to age 90 years and above, while data on marital status are divided into only 17 age groups and up to age 80 years and above. To adjust for this difference, the same marital status was used for all suicide victims age 80 years and above.
[5] The birth year for suicide victims was calculated by subtracting the mid-point of their age group from the year of suicide. Note that suicide victims of age 90 years and above were treated as people of age 92 years.
[6] Whenever γ became larger than 1, it was set to 1. γ can be larger than 1 due to immigration and missing observations.
[7] Data on population and birth rates are taken from "Population Statistics of Japan 2008," published by the National Institute of Population and Social Security Research.
[8] The average age of women at childbirth was calculated based on "Average Age of Women at Birth by Birth Order" in Population Statistics of Japan 2008 by the National Institute of Population and Social Security Research.
[9] Data on fertility rates are divided into 7 age groups from 15 to 49 years.
[10] The average unmarried rates in 1995 and 2002 in Japan were taken from the "Census" of Ministry of Internal Affairs and Communications. The unmarried rate for suicide victims was taken from the "2004 Vital Statistics' Special Report of Japan" of the Ministry of Health, Labour and Welfare. The data for other years were calculated through linear interpolation in a similar manner as equation (2).
[11] By using this approach, children who lost a parent who was less than 30 years old are assigned an age of less than 0 years old. In these cases, the survival rate was set to one.
[12] These data were published by the Ministry of Health, Labour and Welfare.
[13] This number can be calculated using information from Tables 1 and 3.
[14] The "Prefectural life table 2000" shows that the probability of death for the elderly increases approximately in a geometric progression.

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Table 1 Estimated numbers of bereaved family members during 1993 to 2006

Year	Suicide victims	Spouses	Wives	Husbands	Siblings	Parents	Children	Minor children	Total
1993	20,516	10,070	6,896	3,174	35,970	16,990	35,583	9,284	98,612
1994	20,923	10,050	6,993	3,057	39,020	17,745	36,350	9,005	103,165
1995	21,420	10,350	7,127	3,223	39,429	18,189	37,441	9,304	105,409
1996	22,138	10,747	7,488	3,259	41,495	18,672	38,815	9,717	109,728
1997	23,494	11,434	8,045	3,389	41,547	19,860	41,075	10,199	113,916
1998	31,755	15,490	11,319	4,171	53,152	27,130	51,423	12,659	147,196
1999	31,413	15,255	11,258	3,997	57,017	27,150	51,557	12,684	150,979
2000	30,251	14,722	10,919	3,803	54,254	26,222	49,653	11,762	144,850
2001	29,375	14,290	10,643	3,647	52,888	25,598	48,598	11,374	141,375
2002	29,949	14,600	10,923	3,678	50,333	26,436	49,736	11,912	141,105
2003	32,109	15,397	11,576	3,821	48,746	29,466	49,354	12,344	142,963
2004	30,247	14,345	10,758	3,587	49,951	27,623	46,839	11,757	138,759
2005	30,553	14,338	10,780	3,558	48,813	28,730	46,745	12,345	138,626
2006	29,921	13,973	10,349	3,624	47,769	27,796	45,899	11,954	135,436
Total	384,064	185,062	135,074	49,988	660,386	337,604	629,067	156,300	1,812,119

Table 2 Estimated numbers of bereaved family members per suicide during 1993 to 2006

Year	Spouses	Wives	Husbands	Siblings	Parents	Children	Minor children	Total
1993	0.49	0.34	0.16	1.77	0.83	1.75	0.46	4.85
1994	0.48	0.34	0.15	1.88	0.86	1.75	0.43	4.97
1995	0.49	0.34	0.15	1.86	0.86	1.76	0.44	4.96
1996	0.49	0.34	0.15	1.89	0.85	1.77	0.44	5.00
1997	0.49	0.35	0.15	1.79	0.85	1.77	0.44	4.89
1998	0.49	0.36	0.13	1.69	0.86	1.63	0.40	4.68
1999	0.49	0.36	0.13	1.83	0.87	1.66	0.41	4.85
2000	0.49	0.36	0.13	1.81	0.87	1.66	0.39	4.83
2001	0.49	0.37	0.13	1.82	0.88	1.67	0.39	4.85
2002	0.49	0.37	0.12	1.69	0.89	1.67	0.40	4.75
2003	0.48	0.36	0.12	1.53	0.92	1.55	0.39	4.49
2004	0.48	0.36	0.12	1.66	0.92	1.56	0.39	4.62
2005	0.47	0.36	0.12	1.61	0.95	1.54	0.41	4.57
2006	0.47	0.35	0.12	1.60	0.93	1.54	0.40	4.55
Average	0.49	0.35	0.13	1.74	0.88	1.66	0.41	4.78

Table 3 Estimate of the total number of living family members who became bereaved during 1993 to 2006

Year	Suicide victims	Spouses	Wives	Husbands	Siblings	Parents	Children	Minor children	Total
1993	20,516	8,420	5,923	2,497	30,234	10,366	34,566	892	83,586
1994	20,923	8,522	6,065	2,457	33,625	11,532	35,396	2,559	89,074
1995	21,420	8,908	6,263	2,645	34,504	12,136	36,588	2,622	92,136
1996	22,138	9,396	6,678	2,717	36,869	12,889	38,077	2,746	97,230
1997	23,494	10,137	7,246	2,891	37,192	14,065	40,403	3,072	101,797
1998	31,755	14,076	10,449	3,627	48,297	20,332	50,765	3,445	133,470
1999	31,413	14,043	10,496	3,547	52,850	21,195	50,978	6,831	139,066
2000	30,251	13,732	10,301	3,431	50,935	21,181	49,205	6,619	135,053
2001	29,375	13,474	10,121	3,352	50,233	21,527	48,249	6,732	133,482
2002	29,949	13,928	10,491	3,437	48,253	22,940	49,470	7,190	134,591
2003	32,109	14,923	11,280	3,643	47,246	26,711	49,177	7,466	138,058
2004	30,247	14,042	10,565	3,477	48,952	25,988	46,722	11,757	135,704
2005	30,553	14,188	10,684	3,504	48,342	27,912	46,689	12,345	137,131
2006	29,921	13,973	10,349	3,624	47,769	27,796	45,899	11,954	135,436
Total	384,064	171,761	126,911	44,850	615,301	276,570	622,182	86,230	1,685,815

Table 4 Estimate of the total number of living family members who became bereaved before 1992

Year	Number of suicides	Factor	Bereaved family members	Survival rate1[a]	Survival rate2[a]	Survival rate3[a]	Bereaved family members1	Bereaved family members2	Bereaved family members3
1962	16,724	6	100,344			0.00			
1963	15,490	5.5	85,195			0.02			2,001
1964	14,707	5.5	80,889			0.08			6,642
1965	14,444	5.5	79,442			0.14			10,902
1966	15,050	5.5	82,775			0.19			15,647
1967	14,121	5.5	77,666		0.00	0.24			18,463
1968	14,601	5.5	80,306		0.04	0.28		2,928	22,766
1969	14,844	5.5	81,642		0.11	0.33		8,575	26,657
1970	15,728	5.5	86,504		0.17	0.37		14,595	31,743
1971	16,239	5.5	89,315		0.23	0.40		20,354	36,169
1972	18,015	5.5	99,083	0.00	0.28	0.44		28,024	43,664
1973	18,859	5.5	103,725	0.05	0.33	0.47	5,557	34,631	49,193
1974	19,105	5.5	105,078	0.14	0.38	0.51	14,317	40,064	53,152
1975	19,975	5.5	109,863	0.21	0.43	0.54	23,258	46,726	58,832
1976	19,786	5.5	108,823	0.28	0.47	0.56	30,532	50,735	61,310
1977	20,269	5.5	111,480	0.34	0.50	0.59	38,283	56,208	65,729
1978	20,199	5	100,995	0.40	0.54	0.61	40,475	54,486	62,036
1979	20,823	5	104,115	0.45	0.57	0.64	47,175	59,581	66,364
1980	20,542	5	102,710	0.50	0.60	0.66	51,445	61,904	67,705
1981	20,096	5	100,480	0.54	0.63	0.68	54,709	63,401	68,291
1982	20,668	5	103,340	0.58	0.66	0.70	60,379	67,919	72,222
1983	24,985	5	124,925	0.62	0.68	0.72	77,527	85,153	89,566
1984	24,344	5	121,720	0.65	0.70	0.73	79,572	85,727	89,337
1985	23,383	5	116,915	0.68	0.73	0.75	79,967	84,803	87,678
1986	25,667	5	128,335	0.71	0.74	0.76	91,321	95,595	98,169
1987	23,831	5	119,155	0.74	0.76	0.78	87,791	90,920	92,828
1988	22,795	5	113,975	0.76	0.78	0.79	86,595	88,890	90,305
1989	21,125	5	105,625	0.78	0.80	0.80	82,467	84,032	85,006
1990	20,088	5	100,440	0.80	0.81	0.82	80,343	81,368	82,011
1991	19,875	5	99,375	0.82	0.82	0.83	81,228	81,848	82,236
1992	20,893	5	104,465	0.83	0.84	0.84	87,055	87,352	87,530
Total	520,856		2,700,051				1,199,994	1,475,820	1,724,154

[a] Three different geometric series of survival rates were computed: Survivalrate1, Survivalrate2, and Survivalrate3, which become zero at 81, 86, and 91 years, respectively