Research report

Differences in suicide risk according to living arrangements in Japanese men and women – The Japan Public Health Center-based (JPHC) prospective study

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ABSTRACT

Background: Living alone has been suggested as a risk factor for suicide. However, the effect on suicide risk of living together with spouse, child(ren) and parent(s) is unclear. This study aims to examine the association between living arrangements with spouse, child(ren), and parent(s) and suicide in a Japanese men and women.
Methods: Altogether 104, 528 participants aged 40–69 years, who completed baseline questionnaire (1990–1994), were followed for death through December 2005. We used Cox proportional hazards regression model to estimate the hazard ratio (HR) and 95% confidence intervals (95% CI) for suicide according to living arrangements.
Results: During an average 13.2-year follow up, 406 suicidal deaths were recorded. Men living without a spouse and women living with a parent(s) only were at increased risk of suicide than those living with a spouse only. The multivariate HR (95% CI) in men were as follows: "living with a parent(s) only", 1.86 (1.03–3.36); "living with a child(ren) only", 2.20 (1.32–3.66); "living with a parent(s) and child(ren)", 1.95 (1.02–3.72); and "living alone", 1.80 (0.99–3.25); and in women was as follow "living with a parent(s) only", 3.80 (1.90–7.61). Suicide risk was significantly decreased among women living with a spouse and child(ren) as compared with women living with a spouse only (HR 0.58, 95%CI 0.34 to 0.98).
Conclusions: Men living without a spouse and women living with a parent(s) only were at increased risk of suicide. Women living together with a spouse and child(ren) were at decreased risk of suicide.

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1. Introduction

Suicide is one of the major causes of death globally (WHO, 2008). In Asia, for example, 60 million people commit or attempt suicide every year (Beautrais, 2006). Suicide risk is known to vary according to living arrangements, and variations in suicide risk according to marital or parental status have been reported. For example, an increased risk of suicide has been identified for those who are single (Qin et al., 2000), divorced (Inoue, 2009), separated (Kposowa, 2000; Qin et al., 2003), living with someone other than a partner (Koskinen et al., 2007) or have no children (Qin and Mortensen, 2003). These results suggest that living together with family members might be protective against suicide.

Less is known about the differences in suicide risk by more detailed classification of living arrangements which incorporate both partnership situation and household composition. Given that the level of social support, which is strongly associated with mental health (Pevalin and Goldberg, 2003; Almeida et al., 2009), differs by family member type, assessment of differences in suicide risk in different categories of living arrangements by spouse, child(ren) and parent(s) may be worthwhile. Living with a spouse can be protective of health, mainly via the social support and increased material well-being that it provides and the health-promoting behaviors that it encourages (Umberson, 1992; Waldron et al., 1996). Similarly, living with parent(s) can provide instrumental or emotional support (Yashiro et al., 1997), while living with child(ren) can provide better enjoyment of life to parent(s) (McDonough et al., 2002).

Thus, living together with a spouse, child(ren) and parent(s) ("multi-generational family") might be protective against suicide by providing substantial opportunities to share different aspects of social support among family members. Moreover, residing in such a family provides the opportunity to play multiple social roles that have been linked to positive mental and physical health (Thoits, 1983; Rodin and Ickovics, 1990). Several theoretical perspectives support the notion that playing multiple social roles promotes self-esteem and self-worth (Thoits, 1983; Cohen, 1988), enhances adaptation to stressful life events, promotes positive affect (Thoits, 1983; Rodin and Ickovics, 1990) and prevents depression (Cohen, 1988).

The suicide rate in Japan is already one of the highest in the world and is strongly increasing, from 17.0 to 21.0 per 100,000 between 1978 and 1997 to 25.2–27.0 from 1998 to 2006 (National Police Agency, 2005; Ministry of Health, Labour and Welfare, 2005). National figures suggest a decreasing trend in the ratio of "multi-generation families," from 16% in 1970 to 9% in 2000, and an increase in the proportion of people living alone, from 20% in 1980 to 28% in 2000 (Ministry of Public Management, 2000), with this rate expected to increase further to about 35% by 2025 (National Institute of Population and Social Security Research, 2006). These transformations in family structure may help explain the increasing patterns of suicide in Japan, where rapid development appears to have been accompanied by changes in family structure.

Here, we examined the association between the type of living arrangements and number of generations living together and death from suicide in a large prospective cohort of Japanese men and women.

2. Methods

2.1. Study cohort

The Japan Public Health Center-Based Prospective Study (JPHC) was conducted among Japanese residents registered in 11 public health centers areas in Cohort I (1990) and cohort II (1993). The five-year follow up survey was done for the collection of updated information on health-related behaviors and characteristics and for determination of incident disease outcomes. The age of the study cohorts was 40–59 years and 40–69 years, respectively. The Institutional

Review Board of the National Cancer Center, Japan approved the study protocol. The study design has been described in detail elsewhere (Tsugane and Sobue, 2001).

Of 140, 039 eligible subjects, 113, 282 (80.8%) responded to the questionnaire survey at baseline (1990–1994). We excluded those subjects who did not have information on living arrangements ($n = 827$); and those subjects who did not specify the name of family members such as "living with others" or "living with others + spouse or/and child(ren) or/and parent (s) ($n = 7,927$). Finally, 104,528 subjects (49,626 men, 54,902 women) were included in our analysis.

2.2. Assessment of living arrangements

The study participants completed a self-administered questionnaire which included queries on living arrangements, lifestyle, anthropometric, and socio-demographic parameters. The responses on baseline living arrangements were updated with responses from five-year follow-up survey. Each participant was asked a question on their current living arrangement: "Are you living with someone (alone, spouse, child(ren), parent(s), others)?" Those who responded that they were living with a spouse, child(ren) and/or parent(s) were further categorized into the following mutually exclusive categories: "living with a spouse only", "living with a parent(s) only", "living with a child(ren) only", "living with a spouse and child(ren)", "living with a spouse and parent(s)", "living with a parent(s) and child(ren)", and "living with a spouse, child(ren), and parent(s)".

Furthermore, responses were categorized according to the generation of family members living together into the one, two, and multi-generation family. "One-generation family" was defined as those living only with spouse; "two-generation family" as those "living with a parent(s) only", or "living with a child(ren) only", or "living with a spouse and child(ren)", or "living with a spouse and parent(s)"; "multi-generation family" as those " living with a parent(s) and child(ren)", or "living with a spouse, child(ren), and parent(s)".

2.3. Follow-up and identification of suicide

The Cohort I (1990) and II (1993) subjects were followed until December 31, 2005. The residential registry in each area was reviewed annually to obtain information on changes in residence status, including survival. The status of subjects who had moved out of the study area was assessed through the municipal office of the area to which they had moved. Mortality data for persons in the residential registry are forwarded to the Ministry of Health, Labour and Welfare and are coded for inclusion in the national Vital Statistics. The Basic Residential Register Law and Family Register Law require residency registration and death registration, respectively, and the registries are thought to be complete.

Information on deaths for subjects who remained in their original area was obtained from their public health center (PHC), and for subjects who died after moving from their original PHC area from death certificates maintained by the Ministry of Health, Labour and Welfare, Japan. Information on the cause of death was obtained from the death certificate, provided by the Ministry of Health, Labour, and Welfare with the permission of the Ministry of Internal Affairs and

Communications. Death from suicide was defined according to the International Classification of Diseases, 10th Revision (ICD-10), as codes X60–X84.

2.4. Statistical analyses

The number of person-years in the follow-up period was calculated from the date of response to the baseline questionnaire to the date of death or December 31, 2005, whichever came first. Hazard ratios and 95% confidence intervals (CI) were calculated for the categories of living arrangements and family generation for men and women separately, with the "living with a spouse only" and "living in a one-generation family", respectively, as the reference using Cox proportional hazards models. In our analysis, we updated the values of living arrangements when new data were available from the five-year follow-up survey and otherwise carried forward the values from the baseline survey. Dummy variables were created for missing data and body mass index (BMI) <14 or ≥ 40 kg/m^2.

We initially calculated hazard ratios for suicide risk adjusting for age at baseline (continuous) and study area (11 public health center areas) in model 1. Further, we additionally adjusted for self-reported stress (mild, moderate, and severe) in model 2. In the final multivariate model 3, we further adjusted for BMI (<21, 21–<23, 23–<25, 25–<27, or ≥ 27 kg/m^2), alcohol consumption (nondrinker, occasional drinker, or drinker with a consumption of <150, 150–299, 300–449, or ≥ 450 g ethanol/day for men; and nondrinker, occasional drinker, or drinker with a consumption of <150 or ≥ 150 g ethanol/day for women), smoking (lifetime non-

smoker, former smoker, or current smoker with a consumption of <20 or ≥ 20 cigarettes/day), leisure-time physical activity (<1 day/month, 1–3 days/month, or >1 day/week), history of any chronic disease such as cancer, cerebrovascular disease, ischaemic heart disease, and chronic liver disease (yes, no), current regular drug use prescribed by a doctor (yes, no), and unemployment (yes, no). We tested trends across categories of living arrangements using ordinal numbers 0–3 assigned to living arrangements from alone to multi-generation family and 0–2 assigned to living arrangements from one to multi-generation family. All reported p values are two-sided, and significance level was set at $p < 0.05$. All statistical analyses were performed with SAS software version 9.1 (SAS Institute, Inc., Cary, NC).

3. Results

A total of 290 and 116 suicide cases were recorded during 649,007 and 738,150 person years of follow up in 49,626 men and 54,902 women, respectively. We separately examined living arrangements in relation to suicide risk factors at baseline among men and women (Table 1). Men living alone or in other living arrangements of family members were more likely to smoke as compared with men living with a spouse only. Men living with a spouse, child(ren) and parent(s) were more likely to drink as compared with men living alone or in other living arrangements of family members. Women living alone and living with a parent(s) only were more likely to smoke and drink, respectively, as compared with women living in other living arrangements. Both men and women living with a parent(s) and child(ren) were less likely to

Table 1
Distribution of suicide risk factors of subjects at baseline according to the living arrangements.

	Living arrangements							
	Alone	Spouse only	Parents only	Child(ren) only	Spouse + Child(ren)	Spouse + Parents	Parents + Child(ren)	Spouse + Child(ren) + Parents
Men								
No. of subjects	1856	9763	1760	1749	22,391	1670	970	9467
Age, mean (years)	51.1	57.6	46.0	53.1	50.5	54.9	48.0	48.1
Body mass index, mean (kg/m^2)	23.5	23.4	23.4	23.3	23.5	23.4	23.5	23.5
Current drinkers (%)	73.9	72.4	70.9	71.5	78.5	76.8	78.9	81.4
Current smokers (%)	57.8	46.5	58.9	56.8	52.4	49.2	59.0	55.2
Sports and physical exercise during leisure time, ≥ 1 day/week (%)	20.6	21.6	14.9	16.7	20.1	15.7	13.5	16.5
Past history of any chronic disease (%)	6.4	8.9	4.4	7.0	5.4	5.8	4.7	4.1
Medication, any medicine (%)	17.8	28.9	12.2	10.9	15.7	21.9	3.7	11.1
Self-reported moderate or severe stressful (%)	82.6	79.7	85.1	86.4	86.7	83.0	90.3	88.8
Occupation, unemployed (%)	14.1	13.9	9.8	8.9	4.6	6.2	2.0	1.5
Women								
No. of subjects	2853	11,227	1115	5767	23,227	1706	1402	7605
Age, mean (years)	57.4	56.7	49.2	53.1	49.6	53.1	48.6	47.2
Body mass index, mean (kg/m^2)	23.3	23.5	22.9	23.6	23.4	23.1	23.3	23.1
Current drinkers (%)	24.8	19.2	28.2	24.5	25.9	22.0	23.9	26.1
Current smokers (%)	14.2	6.2	10.7	10.1	7.4	3.4	7.1	4.6
Sports and physical exercise during leisure time, ≥ 1 day/week (%)	22.4	22.1	17.2	16.6	19.2	16.1	12.7	15.6
Past history of any chronic disease (%)	6.8	5.9	4.3	5.1	3.9	4.3	4.5	3.2
Medication, any medicine (%)	29.0	26.6	13.8	15.9	13.4	17.5	7.3	10.4
Self-reported moderate or severe stressful (%)	76.4	78.5	85.1	84.1	82.9	85.7	90.4	88.6
Occupation, unemployed (%)	27.7	17.6	22.4	23.3	14.9	10.7	12.1	8.3

Table 2
Cox proportional hazard ratios and 95% confidence intervals for suicide according to living arrangements.

	Alone	Spouse only	Parent(s) only	Child(ren) only	Spouse + child(ren)	Spouse + parent(s)	Parent + child(ren)	Spouse + child(ren) + parent(s)
Men								
Number of suicide	15	65	18	18	114	10	10	40
Person-years	29378	163674	26380	31882	299596	22038	13510	116582
Model 1	1.85 (1.03–3.35)	1.00 (reference)	1.91 (1.06–3.44)	2.32 (1.40–3.85)	1.00 (0.70–1.43)	0.72 (0.32–1.61)	2.05 (1.07–3.90)	1.04 (0.68–1.59)
Model 2	1.86 (1.03–3.35)	1.00 (reference)	1.95 (1.08–3.50)	2.33 (1.40–3.87)	1.00 (0.69–1.43)	0.72 (0.32–1.60)	2.06 (1.08–3.93)	1.03 (0.67–1.58)
Model 3	1.80 (0.99–3.25)	1.00 (reference)	1.86 (1.03–3.36)	2.20 (1.32–3.66)	1.00 (0.70–1.44)	0.73 (0.33–1.62)	1.95 (1.02–3.72)	1.05 (0.69–1.61)
Women								
Number of suicide	9	35	12	12	32	1	2	13
Person-years	49510	189349	17600	98085	306220	22942	19512	90492
Model 1	0.86 (0.35–2.08)	1.00 (reference)	4.00 (2.00–8.01)	0.91 (0.49–1.70)	0.56 (0.33–0.95)	0.39 (0.09–1.65)	0.87 (0.30–2.55)	0.68 (0.34–1.36)
Model 2	0.84 (0.35–2.04)	1.00 (reference)	3.91 (1.95–7.82)	0.90 (0.48–1.68)	0.56 (0.33–0.95)	0.36 (0.08–1.55)	0.85 (0.29–2.47)	0.65 (0.33–1.30)
Model 3	0.79 (0.32–1.92)	1.00 (reference)	3.80 (1.90–7.61)	0.89 (0.47–1.66)	0.58 (0.34–0.98)	0.38 (0.09–1.62)	0.82 (0.28–2.41)	0.68 (0.34–1.36)

Model 1: Age at baseline (continuous) and areas (PHCs) were adjusted in the model.
Model 2: Age at baseline (continuous), areas (PHCs) and self-reported stress (mild, moderate, and severe) were adjusted in the model.
Model 3: Age at baseline (continuous), areas (PHCs), self-reported stress (mild, moderate, and severe), BMI (<21, 21–<23, 23–<25, 25–<27, or ≥27 kg/m²), alcohol consumption (nondrinker, occasional drinker, or drinker with a consumption of <150, 150–299, 300–449, or ≥450 g ethanol/day for men; and nondrinker, occasional drinker, or drinker with a consumption of <150 or ≥150 g ethanol/day for women), smoking (lifetime nonsmoker, former smoker, or current smoker with a consumption of <20 or ≥20 cigarettes/day), leisure-time physical activity (<1 day/month, 1–3 days/month, or >1 day/week), history of any chronic disease (yes, no), current regular drug use prescribed by a doctor (yes, no), and unemployment (yes, no) were adjusted in the model.

report doing physical exercise during leisure time than their counterparts living in other living arrangements. Men living with a spouse only and women living alone were less likely to report moderate or severe stress than their counterparts living in other living arrangements.

The association between living arrangements and the risk of suicide in the cohort by sex are shown in Table 2. We found gender difference in suicide risk according to categories of living arrangements. Men living without a spouse were at increased risk of suicide as compared with men living with a spouse only. The multivariate HR (95% CI) were as follows: "living with a parent(s) only", 1.86 (1.03–3.36); "living with a child(ren) only", 2.20 (1.32–3.66); "living with a parent(s) and child(ren)", 1.95 (1.02–3.72); and "living alone", 1.80 (0.99–3.25). In women, those living with a parent(s) only had more than thrice at risk of suicide (HR = 3.80, 95% CI 1.90 to 7.61) as compared with those living with a spouse only. Women living together with a spouse and children were at decreased risk of suicide as compared with women living with a spouse only; the multivariate HR (95% CI) was 0.58 (0.34–0.98).

Table 3 presents the hazard ratios of suicide according to family generation. There was no significant association between family generation and suicide risk in both sexes. However, the risk tended to decrease as the number of generations living in a family increased in women; the HR (95% CI) for "multi generation family" versus "one generation family" (spouse only) was 0.72 (0.38–1.36).

4. Discussion

Our study in a large prospective population-based Japanese cohort has identified gender differences in suicide risk associated with living arrangements. Men living without a spouse and women living with a parent(s) only had a two- or greater-fold increase in the risk of suicide compared with those living with a spouse only. Suicide risk was significantly decreased among women living with a spouse and child(ren) compared with those living with a spouse only. No significant association was seen between family generation and suicide risk. To our knowledge, this is the first study to examine in detail the relative importance of family structure, incorporating both partnership situation and household composition, on suicide while controlling for a wide range of individual and lifestyle factors known to influence suicide risk, such as BMI, history of chronic disease, stress, smoking, alcohol, and physical exercise.

Our study showed that men living without a spouse irrespective of parent(s) or child(ren) were at increased risk of suicide. This result suggests that living with a spouse is protective against suicide in men. This finding is consistent with a longitudinal study in the United States (Kposowa, 2000) which showed that living with a spouse had a significant protective effect on mortality from suicide as compared with divorce in men, but not in women. Our result might be explained by a gender difference in the perception of social support provided by a spouse. In western countries, men are more likely than women to obtain emotional (Fuhrer and Stansfeld, 2002) and instrumental support (Kendler et al., 2001; Bracke et al., 2008) from their spouse. In the context of Japan also, sex role differentiation, which places men as the

Table 3
Cox proportional hazard ratios and 95% confidence intervals for suicide according to family generation.

	Alone	One-generation family	Two-generation family	Multi-generation family	p for trend[a]	p for trend[b]
Men						
Number of suicide	15	65	160	50		
Person-years	29,378	163,674	379,896	130,092		
Model 1	1.84 (1.02–3.31)	1.00 (reference)	1.12 (0.79–1.58)	1.12 (0.74–1.68)	0.55	0.62
Model 2	1.84 (1.02–3.32)	1.00 (reference)	1.12 (0.79–1.58)	1.11 (0.74–1.67)	0.54	0.64
Model 3	1.77 (0.98–3.20)	1.00 (reference)	1.12 (0.79–1.58)	1.13 (0.75–1.70)	0.64	0.56
Women						
Number of suicide	9	35	57	15		
Person-years	49510	189349	444847	110004		
Model 1	0.86 (0.35–2.07)	1.00 (reference)	0.75 (0.47–1.19)	0.72 (0.38–1.36)	0.34	0.31
Model 2	0.84 (0.35–2.04)	1.00 (reference)	0.75 (0.47–1.19)	0.69 (0.37–1.31)	0.30	0.26
Model 3	0.77 (0.32–1.88)	1.00 (reference)	0.76 (0.48–1.21)	0.72 (0.38–1.36)	0.43	0.32

One-generation family: spouse; Two-generation family: spouse + parent(s); spouse + child(ren); parent(s); child(ren); Multi-generation family: spouse + child(ren) + parent(s); parent(s) + child(ren).
Model 1: Age at baseline (continuous) and areas (PHCs) were adjusted in the model.
Model 2: Age at baseline (continuous), areas (PHCs) and self-reported stress (mild, moderate, and severe) were adjusted in the model.
Model 3: Age at baseline (continuous), areas (PHCs), self-reported stress (mild, moderate, and severe), BMI (<21, $21-<23$, $23-<25$, $25-<27$, or ≥ 27 kg/m^2), alcohol consumption (nondrinker, occasional drinker, or drinker with a consumption of <150, $150-299$, $300-449$, or ≥ 450 g ethanol/day for men; and nondrinker, occasional drinker, or drinker with a consumption of <150 or ≥ 150 g ethanol/day for women), smoking (lifetime nonsmoker, former smoker, or current smoker with a consumption of <20 or ≥ 20 cigarettes/day), leisure-time physical activity (<1 day/month, $1-3$ days/month, or >1 day/week), history of any chronic disease (yes, no), current regular drug use prescribed by a doctor (yes, no), and unemployment (yes, no) were adjusted in the model.
p for trend[a]: Ordinal numbers 0–3 assigned to living status from alone to multi-generation family.
p for trend[b]: Ordinal numbers 0–2 assigned to living status from one to multi-generation family.

bread-winner and women as the sole caretaker of children, husband and, frequently, in-laws (National Institute of Population and Social Security Research, Japan, 1998), means that men may be more likely to obtain instrumental support from their spouse in taking care of themselves and their family. More than 80% of Japanese wives perform the majority of household tasks, such as preparing meals and maintaining the house (Cabinet Office Japan, 1992, 1997, 2002). Thus, men living without a spouse might experience stress in attending to the daily needs of self and family in the absence of the social support provided by a spouse, which might in turn affect their mental health.

Women living with a parent(s) only were at three-fold higher risk of suicide than those living with a spouse only in the present study. This increase might be due to the stress involved in meeting expectations concerning care provision to aging or disabled parents without the support of a spouse. In Japanese culture, frail or widowed older people are commonly cared for by relatives (Kono, 1991). A national based data showed that 64% of elderly Japanese co-resided with their children, and that functional impairment increased the likelihood of living with children (Brown et al., 2002). Japanese tradition expects women to take care for their elderly or disabled parents until their death, and 85% of those who care for elderly parents or relatives are women (Horlacher, 2002). The familial support ratio, defined as the female population aged 40–59 divided by the population of both sexes aged 65–84, was about 1.75 until 1960, but fell to 1.09 in 1995, and is projected to decline further to 0.6 by 2025 (Ogawa and Retherford, 1997). Such a decrease in familial support might place significant care giving demand pressures on women, which affect their mental health. Psychiatric morbidity, in the form of high levels of anxiety (Schulz et al., 1995) and depression (Livingston et al., 1996) has been observed among care providers to elderly in western countries.

Interestingly, we found that the risk of suicide was decreased by 42% in women living with a spouse and child (ren) compared with women living with a spouse only. The presence of children has been found to be protective in women in longitudinal studies in Denmark (Qin and Mortensen, 2003) and Norway (Hoyer & Lund, 1993). Further, we found that the decrease in risk tended to be inversely proportional to the number of children. In the Denmark study, furthermore, the impact of living with children on suicide did not differ among married, single or cohabiting women (Qin and Mortensen, 2003). In our study, however, the protective effect of living with children against suicide was more pronounced in married women. This difference in protective effect between single and married mothers in our study can be explained from an economic basis, at least in part. Low income is a major issue in single-mother households in Japan. The average annual income of an independent mother–child household is 2,480,000 yen, or only about 37% of the annual 6,690,000 yen of two-parent households (The Japan Institute of Labour, 2003). Although the employment rate of single mothers was high (90%), 60% of these employed single mothers felt that they had a difficult time making a living (The Japan Institute of Labour, 2003). This economic hardship might have put more stress on single than married Japanese mothers.

Regarding multigenerational co-residence, our initial hypothesis was that, by facilitating the exchange of emotional support and material and non-material resources among family members, living in a multigenerational family would benefit both middle aged men and women. Several Japanese studies have shown a favorable effect of living in a multi-generational family on women's health behaviors such as on smoking and drinking (Takeda et al., 2004, 2006); both are well known influencing risk factors of suicide or suicidality according to the result reported by various studies of Japan (Iwasaki et al., 2005; Akechi et al., 2006; Matsushita and

Higuchi, 2009) and other countries (Bronisch et al., 2008; Sher et al., 2009). Our analysis showed no significant association between family generation and suicide either with or without adjustment for smoking, drinking, or a history of any chronic disease, including heart disease and stress. Thus, our study suggests that the type of family member, but not the number of family generations, is a determinant of suicide risk.

We found a slightly decreased risk of suicide among women living in a multigenerational family, albeit that this was not statistically significant. Another study among the same JPHC cohort, however, reported a higher risk of coronary heart disease (CHD) among women living in such a family (Ikeda et al., 2009). These discrepancies in association may be due to effect of playing differential roles in multigenerational families on the pathogenesis of physical and mental diseases. While bearing multiple family roles can induce stress that may exacerbate the cardiovascular risk profile through neuroendocrine mechanisms (Rozanski et al., 2005), it can also provide self-satisfaction and emotional support, both of which are important in the maintenance of mental health. Confirmation of this idea requires further research.

The major strengths of the present study are its population-based prospective design, large sample size, gender-specific analysis of the association of living arrangement with mental health outcome, updating of baseline living arrangement via a follow-up survey, and adjustment for potential confounding variables. A number of important limitations should also be noted. First, living arrangements were assessed through questions relating to current living arrangements with a spouse, child(ren), and parent(s). Although we updated baseline information on living arrangements with that obtained at the five-year follow-up survey, living arrangements may have changed during the study period, which would probably have lead to attenuation of the magnitude of the association. Second, our study cohort included subjects with a history of chronic disease or medication and severe stress. These conditions may influence both living arrangements and suicide risk, and might thus have modified the association. Nevertheless, the significant association between living arrangements and suicide did not change even after adjustment for these variables in the model. Finally, our study subjects were a middle aged population who do not represent a random sample of the Japanese population, and caution is thus required in generalizing the present results to the young and elderly people.

In conclusion, we found that suicide risk was increased among men living without a spouse and among women living with parent(s) only. Women living together with their spouse and children were at decreased risk of suicide. Our findings provide implications for health policy against suicide prevention among the Japanese population, which is experiencing dramatic changes in family structure and an increase in suicide rate.

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