

Physical activity to overcome the adversity of widowhood

Benefits beyond physical health

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Abstract

Widowhood has been increasingly encountered because of increasing longevity of women, often characterized by social stigmatization and poor physical and mental health. However, applied research to overcome its adversity has been quite limited. The goal of this study is to explore the role of physical activity in improving the health of widows.

A cohort of 446,582 adults in Taiwan who successively participated in a comprehensive medical screening program starting in 1994, including 232,788 women, was followed up for mortality until 2008. Each individual provided detailed health history, and extensive lab tests results.

The number of widows increased with time trend. Every other woman above age 65 was a widow (44%). Widows were less active, more obese, and smoked and drank more, had sleep problems, were more depressed with taking sedatives or psychoactive drugs, leading to more suicides. In the global development of health policies by World Health Organization (WHO), physical activity is one of the main factors to reverse poor health. The poor health of inactive widow was mitigated when becoming fully active in this study. Exercise not only reduced the observed 18% increase in all-cause mortality, but also gained 4 years and as much as 14% mortality advantage over the married but inactive. More importantly, becoming physically active energized their mental status, improved sleep quality and quantity, reduced depressions and the need for psychoactive drugs, and increased socialization circles.

Widows, a rapidly growing and socially stigmatized group, suffered from social and financial inequality and tended to develop poorer health. Sustained physical activity could be one of the ways for them to overcome and reverse some of the physical and mental adversities of widowhood, and improve their quality and quantity of life.

Abbreviations: BMI = body mass index, CI = confidence interval, CKD = chronic kidney disease, COPD = chronic obstructive pulmonary disease, CVD = cardiovascular disease, EQ = emotional quotient, HR = hazard ratio, IRB = Institutional Review Board, LTPA = leisure time physical activity, MET = metabolic equivalent of task, MVA = motor-vehicle accident, NCEP-ATP III = The US National Cholesterol Education Programme Adult Treatment Panel III, NMVA = nonmotor-vehicle accident, UK = United Kingdom, U. S. = United States.

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1. Introduction

Widowhood is a dreaded word for all married couples, particularly for the newlyweds, but the reality is that 1 in 2 women above age 65 and 1 in 10 at all ages is expected to become a widow sooner or later, lasting for more than 10 years (see eTable 1, <http://links.lww.com/MD/B189> and eTable 2, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates the distribution of widows by age in Taiwan) (see eFigure 1, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates Taiwan life expectancy gap and first marriage gap between male and female).^[1–3] Asian women have a higher probability of becoming widows, by having a 6.8-year life expectancy advantage, by getting married at an age 3 to 4 years younger than men, and by facing the social reality of difficulty in remarriage after losing the spouse at a later age, when compared to their counterparts in the United States (U.S.) or United Kingdom (UK) (see eTable 2, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates the distribution of adults according to marital status in Taiwan, United States, and England and Wales). In Taiwan, the number of widows far outnumbered widowers by up to 6 to 1, with the gender gap increasing with age. The aging of the population accelerated the increase in widows, adding 36% more widows in the last decade, amounting to more than 1 million widows (see eFigure 2, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates the rise in the numbers and proportion of widows and widowers in Taiwan). This is a large disadvantaged and stigmatized group in society, and yet their health and welfare have been largely overlooked.

Many widows suffered financial and social loss and changed their lifestyles after bereavement. The downward change in socioeconomic status, the reduction in income and social circles and the limited support available from the society, the dynamic of which was often overlooked, led to poorer health.^[4–6] Some of them were seen to develop drinking habits, take sedatives for stress or become more sedentary, isolated. As a result, widows accelerated decline in physical and mental health. Reports showed increased mortality of widows from all-cause,^[7–11] cancer,^[12,13] cardiovascular,^[14,15] respiratory diseases,^[16] and others.^[17] Mental illnesses, like depression and suicide, were also higher among widows.^[18–20]

Few women are prepared for the probability of living as a widow for an average of 10 years in Asian countries. The inequality in social status, a key determinant of health, was overlooked by the society. Limited information or research is available to help them cope with the adversity of widowhood.^[21] Only occasionally, referral for counseling has been recommended, mostly limited to serious mental problems.

As physical activity was suggested by WHO as an important factor to reverse the adversity of health,^[22,23] in this study, we examined the effect of physical activity on widows from a large Asian cohort, relative to married women, and compared the long-term outcomes between those physically inactive and active widows. Quantifiable data are available on each individual for their exercise volume, which is a product of exercise intensity and exercise duration, given the previous publications on this subject.^[24] We assessed the possible role of minimal amount of physical activity, such as brisk walking, in modifying or reversing the adverse health outcome expected for widows.

2. Materials and methods

2.1. Study population and data collection

The total sample contains 446,582 healthy individuals aged 20 years or older, including 16,202 widows and 150,614 married

women, who participated in a standard medical screening program run by a private firm between 1996 and 2008. The cohort had 4.5 million person-years of observation, with a median follow-up period of 8.59 years (MJ Health Management Institution, Taipei, Taiwan). A self-administered questionnaire collected information on demographic characteristics, lifestyle, and health risk data. Automated lab tests were given and interpreted at the end of screening appointments in 4 hours by physicians. Informed consent was obtained to authorize the processing and analyzing of the data.

Hypertension was defined as systolic blood pressure ≥ 140 mm Hg, diastolic ≥ 90 mm Hg, or the use of hypertension drugs. Diabetes was defined as fasting glucose ≥ 126 mg/dL, or the use of diabetes drugs. Drinkers were those who indicated drinking 2 drinks 3 times a week or more. Metabolic syndrome was defined by The US National Cholesterol Education Programme Adult Treatment Panel III (NCEP-ATP III) criteria.^[25] By considering the frequency, duration, and intensity reported, the data on physical activity was converted into metabolic equivalent of task (MET)-h/wk, and classified each individual accordingly into “inactive,” “low active,” and “fully active.” “Low active” was equivalent to 15 minutes/d or 90 minutes/wk of moderate intensity activity (3.75–7.49 MET-h/wk), and “fully active” was equivalent to 30 minutes/d or 150 minutes/wk or more (≥ 7.5 MET-h/wk) of activity. A detailed description of this method has been reported earlier.^[24]

2.2. Follow-up

All participants in this study signed a consent form and Institutional Review Board (IRB) approval was obtained through the “Research Ethics Committee National Health Research Institutes” (approval number: EC0981201-E) in Taiwan. Individual identification was removed and remained anonymous during the entire study process.

Using unique national identification numbers, deaths and cancer cases in the cohort were ascertained by matching with the National Death File and National Cancer Registry, respectively. A total of 16,849 deaths and 11,802 of cancer cases for the cohort and 1392 deaths for widows were identified.

2.3. Statistical analysis

The Cox proportional hazard regression model was used to assess the hazard ratio (HR) and 95% confidence interval (CI) of mortality between marital status and outcomes, compared to those in the reference group. A value of $P < 0.05$ was used for statistical significance. The HRs were adjusted for 10 variables, including 6 continuous and 4 categorical variables. The continuous variables were age, body mass index (BMI), systolic blood pressure, blood glucose, total cholesterol, and urine protein; the categorical variables were education (low education and nonlow education), smoking (nonsmoker, ex-smoker, and current smoker), drinking (never or occasional drinker, and regular drinker) and physical activity (inactive, low active, and fully active). Life expectancy was calculated based on Chiang.^[26,27] Analyses were performed with SAS, version 9.4.

3. Results

Widows were less active (47% inactive), more obese, smoked and drank more, and used more sedatives and psychiatric drugs. Widows had higher rates of hypertension, diabetes, and chronic

Table 1**The distribution of the demographic characteristics of the MJ cohort by marital status.**

	Male							Female						
	Total cohort	(%)	Married	Single	Divorced	Widower		Total cohort	(%)	Married	Single	Divorced	Widow	
	213,794	(100)	(70)	(27)	(2)	(2)	3160	232,788	(100)	(65)	(25)	(3)	(7)	16,202
Age														
20–39	120,577	(100)	(53)	(46)	(1)	(0.1)	80	128,074	(100)	(54)	(43)	(2)	(0.3)	404
40–49	39,720	(100)	(92)	(4)	(3)	(0.5)	194	40,494	(100)	(83)	(7)	(7)	(4.1)	1662
50–64	37,630	(100)	(94)	(0.5)	(2)	(3)	1113	50,067	(100)	(79)	(1.0)	(4)	(16)	7935
≥65	15,867	(100)	(87)	(0.6)	(2)	(11)	1773	14,153	(100)	(55)	(0.3)	(1)	(44)	6201
Education														
Low education level	41,165	(19)	(25)	(3)	(23)	(66)	2054	71,822	(31)	(37)	(2)	(33)	(84)	13,444
Nonlow education level	171,169	(81)	(75)	(97)	(77)	(34)	1054	159,120	(69)	(63)	(98)	(67)	(16)	2534
BMI, kg/m ²														
<24.9	141,017	(66)	(63)	(74)	(63)	(67)	2130	185,680	(80)	(77)	(92)	(82)	(61)	9855
25–30	63,466	(30)	(33)	(21)	(33)	(30)	933	39,086	(17)	(19)	(6)	(15)	(32)	5243
≥30	9227	(4)	(4)	(5)	(4)	(3)	94	7934	(3)	(4)	(2)	(3)	(7)	1092
Smoking														
Smoker	107,231	(51)	(54)	(43)	(68)	(60)	1832	18,203	(8)	(6)	(12)	(27)	(7)	1124
Smoker (age >50)	28,714	(56)	(55)	(51)	(63)	(60)	1682	2755	(5)	(3)	(8)	(17)	(7)	905
Drinking														
Drinker	72,769	(35)	(39)	(24)	(49)	(42)	1254	19,138	(9)	(8)	(8)	(25)	(9)	1295
Drinker (age >50)	22,410	(44)	(44)	(40)	(47)	(42)	1141	4776	(8)	(8)	(8)	(18)	(8)	972
Physical activity														
Inactive	98,086	(46)	(47)	(43)	(51)	(43)	1339	134,402	(58)	(58)	(63)	(61)	(47)	7539
Low active	49,499	(23)	(22)	(27)	(19)	(15)	469	51,257	(22)	(22)	(25)	(20)	(18)	2895
Active	64,305	(30)	(31)	(29)	(30)	(42)	1308	44,571	(19)	(21)	(12)	(19)	(34)	5488
Hypertension	40,942	(19)	(22)	(9)	(23)	(50)	1595	36,789	(16)	(18)	(2)	(12)	(49)	7952
Diabetes	12,225	(6)	(7)	(1)	(9)	(16)	507	10,904	(5)	(5)	(1)	(4)	(15)	2391
Total cholesterol ≥240 mg/dL	15,825	(7)	(9)	(4)	(10)	(11)	349	16,220	(7)	(8)	(2)	(8)	(16)	2625
CKD	25,388	(12)	(14)	(6)	(15)	(34)	1061	22,798	(11)	(10)	(7)	(10)	(26)	4166
COPD	8955	(5)	(6)	(3)	(6)	(21)	444	8766	(5)	(5)	(3)	(4)	(13)	1307
Use of sedative or hypnotic drugs	3798	(2)	(2)	(1)	(3)	(4)	121	4197	(2)	(2)	(1)	(4)	(4)	663
Use of psychoactive drugs	1054	(0.7)	(0.7)	(0.6)	(1.0)	(1.5)	32	1496	(0.9)	(0.9)	(0.5)	(1.8)	(1.8)	203

BMI=body mass index, CKD=chronic kidney disease, COPD=chronic obstructive pulmonary disease.

Smoking was defined according to answer "Do you now smoke cigarettes"; drinking was defined according to answer "Had at least 12 alcohol drinks/1 year?"; physical activity = METs (metabolic equivalents) × time (h); active was defined when METs × time ≥7.5; hypertension defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or use of hypertension drugs; diabetes defined as fasting glucose ≥126 mg/dL or use of diabetes drugs; COPD was defined by Gold, the Global Initiative for Chronic Obstructive Lung Disease criteria.

kidney diseases (CDKs), when compared with married women (Table 1).

Widows had increased all-cause mortality with adjusted HR at 1.11 (HR: 1.11, 95% CI: 1.03–1.20) or 11% higher than married women. Most causes of death examined for widows in Table 2 show variable increases, but significant increases were only found in respiratory system diseases (HR: 1.64, 95% CI: 1.14–2.36) and chronic obstructive pulmonary disease (COPD) (HR: 1.99, 95% CI: 1.07–3.67). Suicide was also increased, with HR at 1.46, but failed to reach statistical significance.

Table 3 and Fig. 1 show the all-cause mortality by physical activity status. When compared with inactive married women, inactive widows had significant 18% increases (HR: 1.18, 95% CI: 1.06–1.31) in mortality. When widows were physically active, mortality risk reduced and improved to 1.03 (low active) and 0.86 (fully active). The reduction was most significant for the fully active group, but the initially significant increase in mortality for the inactive disappeared for the low active, and became similar to those inactive married women. Further analyses for different age groups are shown in Supplemental Content (see eTable 3, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates all-cause mortality risks by marital status and by

physical activity status in different age groups for females; see eFigure 3, <http://links.lww.com/MD/B189> Supplemental Content, which illustrates forest plot showing decreased mortality risk for active widows among different subgroups). Active widows had similar mortality reduction across age groups and across smoking status.

The quality and quantity of sleep, along with associated mortality risks for problem sleeping, by marital status, are shown in Table 4. There were more <4 and >8 hours of sleep, and more poor quality and needs drug, among inactive widow, when compared against the married. These characteristics of sleep of widow were associated with significantly increased mortality, as shown for the total women cohort. When widow became active, quality and quantity of sleep, such as too short or too long duration, improved.

The benefits of exercise are expressed in life expectancy in Table 5. The life expectancy is shown in Table 5. The top half showed the advantage of physical activity among widows with active widows living 4 years longer than inactive widows. The bottom half showed the differences between active widows and inactive married women with the former living 3.10 years longer than the latter.

Table 2

The comparison of mortality risks in females by marital status by different causes of deaths, with married women as the reference.

Cause of death	N	Married		Single		Divorce		Widowed		
		n	HR	95% CI	n	HR (95% CI)	n	HR (95% CI)	n	HR (95% CI)
All causes	4569	2915	1.00	—	160	1.31* (1.09, 1.58)	102	0.86 (0.69, 1.08)	1392	1.11* (1.03, 1.20)
All cancer	1861	1279	1.00	—	72	0.99 (0.75, 1.29)	39	0.78 (0.55, 1.11)	471	1.00 (0.88, 1.14)
Diabetes	345	201	1.00	—	1	0.60 (0.08, 4.40)	6	0.82 (0.34, 2.02)	137	1.18 (0.90, 1.54)
CVD	867	534	1.00	—	15	1.34 (0.72, 2.52)	10	0.65 (0.33, 1.25)	308	1.02 (0.86, 1.21)
Ischemic heart disease	206	115	1.00	—	3	0.75 (0.10, 5.55)	1	0.31 (0.04, 2.20)	87	1.27 (0.91, 1.76)
Stroke	380	236	1.00	—	6	1.25 (0.49, 3.19)	5	0.87 (0.35, 2.12)	133	1.03 (0.80, 1.33)
Respiratory system	188	91	1.00	—	3	1.27 (0.38, 4.26)	1	0.36 (0.05, 2.58)	93	1.64* (1.14, 2.36)
COPD	69	34	1.00	—	1	0.81 (0.10, 6.59)	0	—	34	1.99* (1.07, 3.67)
Accidents	364	234	1.00	—	43	1.24 (0.83, 1.85)	24	1.91* (1.16, 3.13)	63	1.31 (0.93, 1.85)
MVA	1	99	1.00	—	8	0.69 (0.31, 1.56)	3	0.88 (0.27, 2.84)	27	1.49 (0.89, 2.49)
NMVA	79	54	1.00	—	6	2.10 (0.74, 5.99)	3	0.63 (0.09, 4.64)	16	0.85 (0.43, 1.67)
Suicide	148	81	1.00	—	29	1.33 (0.79, 2.25)	18	3.33* (1.83, 6.09)	20	1.46 (0.77, 2.75)

CI=confidence interval, COPD=chronic obstructive pulmonary disease, CVD=cardiovascular disease, HR=hazard ratio, MVA=motor-vehicle accident, NMVA=nonmotor-vehicle accident.

Married females were reference group.

HRs were adjusted for age, education, smoking, drinking, physical activity, BMI, systolic blood pressure, blood glucose, total cholesterol, and urine protein in a multivariate Cox model.

* P<0.05.

4. Discussion

The number of widows in our society has been increasing rapidly and developing into a potential force with political power, due to increasing longevity, biologic advantages of women, and social disadvantages in their chances of re-marrying. The hardships endured by widows, however, have been overlooked. Both the society and the individual women could have been better prepared for this life-changing event. From the society standpoint, widow can be accorded and recognized as a disadvantage group, requiring financial and social support over and above what little is currently available. From the individual woman's standpoint, early planning before and after widowhood can minimize the hardships, preparing them for the "expected," normally considered as unexpected. Promoting husband's health, for example, is clearly in the best interest of the spouse. This requires lifelong endeavor to reduce his lifestyle risks and to develop mutually reinforcing exercise habits. To achieve the utopian dream of universal well-being requires a dynamic process of adaptation to a constantly changing environment of a marital life. As change is the only constant that would not change, plasticity of health should be addressed.^[28,29]

Physical activity has been suggested by WHO as a global strategy to improve health of people from all walks of life.^[23]

That widows have poorer health and higher mortality than married women has been reported^[7,8,10,20,30,31] but this study demonstrated that, by being physically active, widows could reverse their health adversity and improved not only their physical health but also their mental health. Physically, an active widow extended her life expectancy by 4 years and could outlive a married but inactive woman by up to 3 years, and mentally, exercise improved quality of life by preventing depression and enhancing self-image with expanded socialization. To our knowledge, this is the first report suggesting exercise as a practical modifier to improve the health of a widow's life. Physical activity was beneficial to all walks of life, but regular exercise was far more beneficial to widows than we expected, not only eliminating the 18% mortality disadvantage of the widows, but also reaped an additional 14% mortality advantage when compared to inactive married women, culminating in a combined 32% mortality reduction and extending life expectancy by 3 to 4 years. It is comforting to know that these additional years were spent in active and quality life.

4.1. Risk factors and comorbidities

Part of the reasons why widows have increased mortality was due to having more risk factors and comorbidities. In this cohort, as

Table 3

All-cause mortality risks (HR) in females by marital status and by physical activity status with different reference groups.

	Inactive			Low active			Fully active		
	N	Deaths	HR (95% CI)	N	Deaths	HR (95% CI)	N	Deaths	HR (95% CI)
HR relative to own group									
Married	85,701	1498	1.00 (Reference group)	32,394	589	0.96 (0.87, 1.07)	30,576	791	0.83* (0.75, 0.91)
Single	36,510	100	1.00 (Reference group)	14,398	36	0.84 (0.57, 1.25)	7067	23	0.98 (0.61, 1.56)
Divorce	4652	69	1.00 (Reference group)	1570	16	0.63 (0.34, 1.15)	1440	14	0.54 (0.29, 1.02)
Widowed	7539	710	1.00 (Reference group)	2895	250	0.86* (0.73, 1.00)	5488	417	0.72* (0.63, 0.82)
HR relative to married female									
Married	85,701	1498	1.00 (Reference group)	32,394	589	0.98 (0.88, 1.09)	30,576	791	0.83* (0.76, 0.92)
Single	36,510	100	1.32* (1.06, 1.66)	14,398	36	1.14 (0.80, 1.63)	7067	23	1.30 (0.85, 2.00)
Divorce	4652	69	1.03 (0.79, 1.35)	1570	16	0.68 (0.39, 1.17)	1440	14	0.52* (0.30, 0.92)
Widowed	7539	710	1.18* (1.06, 1.31)	2895	250	1.03 (0.89, 1.20)	5488	417	0.86* (0.76, 0.98)

CI=confidence interval, HR=hazard ratio.

HRs were adjusted for age, education, smoking, drinking, physical activity, body mass index, systolic blood pressure, blood glucose, total cholesterol, and urine protein in a multivariate Cox model.

* P<0.05.

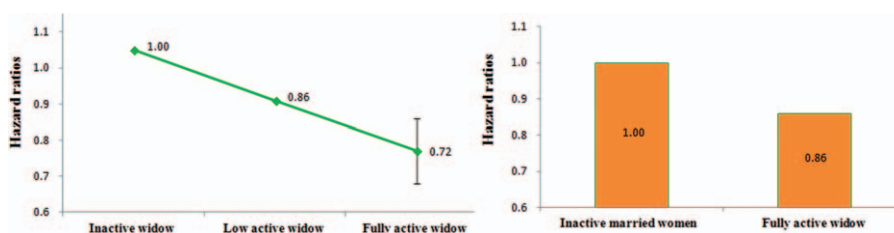


Figure 1. Mortality risk by physical activity status among widow with different reference groups, HRs were adjusted for age, education, smoking, drinking, physical activity, BMI, systolic blood pressure, blood glucose, total cholesterol, and urine protein in a multivariate Cox model.

in other studies, widows had more smoking,^[32,33] drinking,^[32,34] obesity,^[33,35,36] sleep problems,^[34,37] hypertension,^[38] and reduced their physical activity^[39] than married women. Either singly or in combination, these risks or comorbidities contributed to poorer health of the widows. However, they could be modified and reduced by increased physical activity, leading to an overall improvement in health.

It is of some interest to assess the timing of these risks, as they could have existed before or acquired after they became widowed. Obviously, both situations could have occurred. In our comparison with married women, we found the health risks of widows quite different from the married, and, in this regard, they must have acquired these habits afterwards (Table 1).^[30,40–42] This is consistent with the literature that bereaved women were more likely to pick up drinking^[32,34] and reduce their physical activity,^[39] due in part to an isolated environment and reduced social network.^[43,44] They required more psychoactive drugs to cope with depression. On the other hand, some risks of these widows may have been sustained concurrently with their spouses when they were alive, as “birds of a feather flock together.” In fact, some of these risks could have been associated with the death of their spouse.

4.2. Benefits beyond physical health

We listed a few items to illustrate that physical activity was beneficial beyond physical health. First, widow smoked more,

drank more, and used more sedatives or psychoactive drugs. Physical activity is known to be beneficial for smokers and for depressed or psychoneurotic subjects. Second, both quality and quantity of sleep by widow were worse than the married and could be an important element in affecting quality of life. We found physical activity had the potential to improve both quality and quantity of sleep. Third, being physically active will facilitate socialization process and improve one’s mental health.

4.3. Underrated benefits of physical activity

The benefits of exercise for improving physical health have been documented for singles and for the married, for males and for females, for the young and for the old, and for the healthy and for the diseased.^[24] Now we have demonstrated the benefits for the widows. In fact, physical activity has been touted as a miracle drug.^[45] Analysis of this cohort showed, by just brisk walking 15 to 30 minutes a day, average life span can be extended up to 3 years.^[24] At the same time, because physical activity has the advantage of socialization, we have witnessed that exercise cheered people up and reversed the state of isolation and depression.

While widows may have attracted a short-term sympathy from friends and relatives, society as a whole offered very little to them, in areas such as financial, social, or health care support. On the contrary, widows have largely been stigmatized and isolated. In

Table 4
The distribution and hazard ratios for duration and quality of sleep by marital status, with physical activity by sleep duration and quality for the widow.

	Total women cohort			Marital status				Widow physical activity status		
	Number of subjects	Deaths from all cause	HR (95% CI)	Married	Single	Divorce	Widow	Inactive	Low active	Active
				n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Sleep quantity, h										
<4	3090	189	1.29 [§] (1.07, 1.55)	2028 (0.01)	239 (0.00)	143 (0.02)	564 (0.04)	276 (0.04)	94 (0.03)	182 (0.03)
4–5.9	46,006	1215	0.87 (0.69, 1.08)	28,461 (0.19)	9592 (0.17)	1763 (0.23)	4714 (0.30)	2113 (0.29)	824 (0.29)	1703 (0.31)
6–7.9	159,111	2455	1.00 (—)	100,100 (0.68)	41,555 (0.73)	4636 (0.62)	8676 (0.55)	3877 (0.54)	1613 (0.57)	3038 (0.56)
>8	25,437	730	1.10 [§] (1.02, 1.19)	16,257 (0.11)	5688 (0.10)	978 (0.13)	1793 (0.11)	953 (0.13)	321 (0.11)	499 (0.09)
Sleep quality										
Poor*	157,821	3253	1.08 [§] (1.00, 1.17)	101,268 (0.69)	36,209 (0.64)	5219 (0.70)	10,800 (0.70)	5055 (0.71)	2027 (0.72)	3554 (0.67)
Good†	70,342	1095	1.00 (—)	42,192 (0.29)	20,344 (0.36)	1928 (0.26)	4076 (0.26)	1751 (0.25)	694 (0.25)	1562 (0.29)
Needs drug‡	3752	199	1.45 [§] (1.23, 1.72)	2296 (0.02)	413 (0.01)	284 (0.04)	618 (0.04)	310 (0.04)	101 (0.04)	200 (0.04)

CI=confidence interval, HR=hazard ratio.
 HRs were calculated with 6 to 7 hours of sleep and good quality of sleep as reference group, respectively, and were adjusted for age, education, smoking, drinking, physical activity, body mass index, systolic blood pressure, blood glucose, total cholesterol, and urine protein in a multivariate Cox model.
 * Poor: includes insomnia, wake up often, easily disturbed, often nightmare.
 † Good: includes sound asleep most of the time.
 ‡ Needs drug: requires sedatives or tranquilizers.
 § P < 0.05.

Table 5**Remaining years in life for widows and for married women by physical activity status.**

Age	Active widows	Inactive widows	D*	(95% CI)
Difference between active and inactive widows				
40	47.17	44.80	2.37	(1.34, 3.40)
50	39.05	35.05	4.00	(3.48, 4.52)
60	30.03	25.69	4.34	(3.91, 4.77)
70	21.26	17.25	4.01	(3.65, 4.37)
Age	Active widows	Inactive married women	D†	(95% CI)
Difference between widows and married women, when physical activity status was different				
40	47.17	45.92	1.25	(0.92, 1.58)
50	39.05	36.23	2.82	(2.51, 3.13)
60	30.03	26.93	3.10	(2.78, 3.42)
70	21.26	18.19	3.07	(2.74, 3.40)

CI = confidence interval.

Bold values mean $P < 0.05$.

* Difference of remaining years of life at different ages between active widowers and inactive widowers.

† Difference of remaining years of life at different ages between active widowers and inactive married women.

this cohort, widows had poor quality of sleep, drank more and resorted to increased use of sedatives and psychoactive medications, and committed more suicides. While these conditions cannot be changed overnight, they could be mitigated or even reversed by becoming physically active. As we all know, activity could trigger socialization. Exercisers can overcome depression and transform an introverted personality into a more upbeat and sociable attitude and improve emotional quotient (EQ).^[46–50] It can improve widow's self-image and restore self-confidence, thereby improving both quality and quantity of life. What's more, incorporating regular exercise such as brisk walking for 15 to 30 minutes a day is easy, inexpensive, free from side effects and do-able, for reversing the depression of the widow.

In this study, physical activity was limited to leisure time physical activity (LTPA), 1 of the 4 domains of physical activity.^[51,52] The other 3 domains were transportation-related physical activity, work-related labor, and household activity. LTPA is the only promotable activity most related to health benefits.^[24] The amount of exercise under LTPA would be most effective when a dedicated effort was committed for the sake of health.

Although widows tend to be older and retired, the incomes of widowed women have lagged behind their married counterparts across age groups, with needs-adjusted incomes averaged well-below similarly aged married couples.^[4] The loss of partner's income is particularly substantial, and could have a devastating effect. In addition, evidence suggests their wealth holdings are typically smaller than their married counterparts and cannot offset their lower income. On top of this, the death event may precipitate a large decline in wealth by liquidating assets to cover health care and/or burial costs. While a varying amount of annuity may be added from the death benefits, the data from Taiwan and elsewhere suggest that the gain is likely to be small and is unlikely to alter their social status. The extra-allowance for government employees or labor workers is, at most, 4 to 8 months of salary, earmarked for burial expenses and bereavement benefits.

In Taiwan, the number of widows increased by 36% in 10 years, amounting to more than 1 million in a population of 5.6 million adult women. Nearly half of all Asian women over age 65 + was a widow, a proportion larger than that of the U.S. or UK. While everyone should engage in regular exercise, the message

from this study should serve as added motivation for widows to heed and to engage. Parenthetically, encouraging husbands to exercise together, from day 1 and to extend their life span will be equally important so that husbands can also gain a healthier lifestyle and reduce their chance of becoming a widow maker. The policy implications of considering widows as a disadvantaged group and encouraging them to exercise could be profound.

4.4. Limitations

There are some limitations worth discussing. First, we only recorded the marital status at the time of first medical screening visit, and did not follow up for subsequent changes in marital status. Because there were more married women becoming widows than widows becoming married, the mortality risks for widows must have been underestimated by not considering those married losing their husband late on. Widows' benefits of physical activity were also underestimated. Second, since exercise is a desirable behavior, there is a tendency to over-report the level of exercise by everyone. This would inflate the true number of exercisers and lead to underestimating the benefits of physical activity. Third, abundant literature exists supporting the ability of exercise in modifying and improving one's mental health. Limitation of data in this cohort hampered any quantitative assessment of the role of physical activity in improving the mental well-being of widows. However, evidence exists showing the better physical health of those physically active widows are usually associated with better mental health. Fourth, the cohort was all Asians, and the applicability to the whites and blacks is not known. However, previous reports demonstrating similarly increased mortality risks of widows came mainly from the western countries,^[20,21] and the benefits of physical activity were also observed in western countries.^[52]

5. Conclusion

Widows, suffering from social and financial inequality, had a tendency to develop poorer health. The increased mortality of widows could be mitigated and reversed by physical activity. The physically active widows in our cohort outlived the married but inactive women. Benefits could go beyond physical health, as

mental health and quality of life will also be improved. The policy implications to promote exercise can be far reaching.

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