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# Marital status, marital transition and health behaviour and mental health outcomes among middle-aged and older adults in Thailand: A national longitudinal study

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## HIGHLIGHTS

- Being single was positively associated with current smoking among men and transitioning to widowed or divorced was associated with incident current smoking among women.
- Being single or widowed was positively associated with underweight and negatively associated with obesity among women.
- Men who were divorced, single, or widowed had higher odds of having depressive symptoms and among women, transitioning to being widowed or divorced or separated was associated with incident depressive symptoms.
- Among both men and women, being divorced, single or widowed were positively associated with poor quality of life/happiness.

## ARTICLE INFO

### Keywords:

Mental health  
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Longitudinal study  
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## ABSTRACT

**Objectives:** The aim of this study was to assess the longitudinal association between marital status, marital transition, mental ill-health, and health risk behaviours among middle-aged and older adults in Thailand.

**Methods:** We analyzed prospective cohort data of participants 45 years and older from three consecutive waves in 2015, 2017, and in 2020 (analytic sample,  $n = 2863$ ) of the Health, Aging and Retirement in Thailand (HART) study. Sociodemographic and health variables were assessed by self-report.

**Results:** Being single was positively associated with current smoking among men and transitioning to widowed or divorced was associated with incident current smoking among women. Divorced or separated was positively associated with current alcohol use among men and transitioning to marriage was associated with incident alcohol use among women.

Being single or widowed was positively associated with underweight and negatively associated with obesity among women. Men who were divorced, single, or widowed had higher odds of having depressive symptoms and among women, transitioning to being widowed or divorced or separated was associated with incident depressive symptoms. Among both men and women, being divorced, single or widowed were positively associated with poor quality of life/happiness, and among men being divorced, single or widowed was positively associated with loneliness, and among women, being single or widowed was positively associated with loneliness. Among men, being single was positively associated with having an emotional or psychiatric disorder.

**Conclusion:** We found among men and/or women that being unmarried was associated with several health risk behaviours and mental-ill health indicators.

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**Table 1**  
Sample characteristics by study year and sex, HART 2015–2020.

Variables	Study year 2015 (N = 2863)			Study year 2017 (N = 2834)			Study year 2020 (N = 2863)			Study years 2015–2020	Study years 2015–2020
	Male (n = 1270)	Female (n = 1593)	Sex differences	Male (n = 1224)	Female (n = 1610)	Sex differences	Male (n = 1639)	Female (n = 1224)	Sex differences	Male differences	Female differences
	N (%)	N (%)	p-value <sup>1</sup>	N (%)	N (%)	p-value <sup>1</sup>	N (%)	N (%)	p-value <sup>1</sup>	p-value <sup>1</sup>	p-value <sup>1</sup>
<b>Exposure variable</b>											
<b>Marital status</b>											
Married	1000 (79.4)	770 (49.1)	<0.001	965 (78.8)	802 (49.8)	<0.001	925 (75.6)	726 (44.3)	<0.001	0.098	0.399
Divorced/separated	41 (3.3)	79 (5.0)	0.002	39 (3.2)	82 (5.1)	0.013	43 (3.5)	84 (5.1)	<0.001		
Single/never married	43 (3.4)	92 (5.9)	<0.001	54 (6.6)	106 (6.6)	<0.001	41 (6.4)	105 (6.4)	<0.001		
Widowed	175 (13.9)	627 (40.0)		166 (13.6)	620 (38.5)		214 (17.5)	723 (44.1)			
<b>Covariates</b>											
Age (70 plus)	457 (36.0)	583 (36.6)	0.735	499 (40.8)	650 (40.4)	0.832	632 (51.6)	809 (49.4)	0.228	<0.001	<0.001
Education (>elementary)	263 (20.7)	186 (11.7)	<0.001	301 (24.8)	237 (14.8)	<0.001	259 (21.4)	211 (13.0)	<0.001	0.150	0.340
Residence (urban)	610 (48.0)	782 (49.1)	0.574	592 (48.4)	772 (48.0)	0.826	592 (48.4)	783 (47.8)	0.753	0.003	<0.001
Subjective economic status (low)	291 (23.9)	471 (30.7)	<0.001	422 (36.2)	600 (38.3)	0.259	409 (34.6)	569 (36.5)	0.311	<0.001	<0.001
Religion (Buddhist)	1158 (91.2)	1461 (91.8)	0.536	1100 (90.8)	1469 (91.4)	0.582	1102 (90.9)	1483 (91.2)	0.795	0.048	0.138
Self-rated poor physical health	301 (24.2)	445 (28.6)	0.008	354 (28.9)	546 (33.9)	0.005	298 (24.3)	436 (26.6)	0.172	<0.001	<0.001
Activities of Daily Living (ADL) disability	33 (2.6)	39 (2.5)	0.802	48 (3.9)	59 (3.7)	0.721	83 (6.8)	135 (8.2)	0.148	<0.001	<0.001
<b>Health behavior</b>											
Current smoking	325 (25.7)	14 (0.9)	<0.001	345 (28.2)	35 (2.2)	<0.001	290 (23.7)	26 (1.6)	<0.001	0.300	0.022
Current alcohol use	303 (24.0)	49 (3.1)	<0.001	378 (31.2)	125 (7.8)	<0.001	271 (22.2)	90 (5.5)	<0.001	<0.001	<0.001
Physical inactivity	692 (55.2)	914 (58.3)	0.094	546 (44.9)	710 (44.3)	0.773	616 (50.4)	828 (50.5)	0.923	<0.001	<0.001
Meal skipping	71 (5.8)	85 (5.6)	0.822	182 (15.1)	278 (17.6)	0.088	160 (13.3)	219 (13.6)	0.815	<0.001	<0.001
Underweight	128 (11.0)	127 (9.0)	0.085	130 (11.1)	133 (8.7)	0.040	157 (12.9)	170 (10.4)	0.039	0.441	0.358
Obesity	323 (27.8)	524 (37.1)	<0.001	310 (26.4)	587 (38.4)	<0.001	562 (46.3)	889 (54.6)	<0.001	0.398	0.285
Non-participation in annual health check-up	636 (50.1)	728 (45.7)	0.020	590 (48.7)	655 (41.0)	<0.001	520 (43.3)	622 (39.9)	0.075	<0.001	<0.001
<b>Mental health</b>											
Depressive symptoms	121 (10.4)	213 (14.6)	<0.001	99 (8.2)	180 (11.3)	0.006	70 (5.7)	90 (5.5)	0.796	<0.001	<0.001
Self-rated poor mental health	339 (27.1)	459 (29.6)	0.149	332 (27.1)	492 (30.6)	0.048	293 (23.9)	392 (23.9)	0.990	0.003	<0.001
Poor quality of life/happiness	300 (25.0)	469 (30.7)	<0.001	411 (35.2)	639 (40.6)	0.004	415 (34.2)	568 (34.8)	0.710	<0.001	<0.001
Loneliness	237 (18.9)	349 (22.3)	0.027	238 (19.5)	408 (25.4)	<0.001	248 (20.3)	362 (22.1)	0.239	0.825	0.008
Insomnia symptoms	157 (12.5)	289 (18.3)	<0.001	140 (11.4)	278 (17.3)	<0.001	132 (10.8)	204 (12.5)	0.172	0.045	<0.001
Emotional/psychiatric disorder	5 (0.4)	7 (0.4)	0.851	5 (0.3)	4 (0.3)	0.969	10 (0.8)	12 (0.7)	0.797	0.163	0.150
Brain diseases, dementia	7 (0.6)	10 (0.6)	0.791	13 (0.8)	12 (1.0)	0.671	16 (1.3)	21 (1.3)	0.952	0.203	0.058

<sup>1</sup> Chi-square statistics.

### 1. Introduction

Various studies showed that compared to married individuals, divorced, never married and widowed persons generally report poorer health and have a higher mortality (Hughes & Waite, 2009; Robards et al., 2012; Zhao et al., 2022). This phenomenon may be explained by a “social causation theory (marital status influences health) and the

selection theory (health influences marital status)” (Joung, 1997). Social control theory may explain dual effects leading to better health practices and also affect older adults’ feelings of autonomy or personal control (Lewis & Rook, 1999; Rook & Ituarte, 1999). Longitudinal studies seem to confirm that marital transition from marital union to marital dissolution predict poorer health behaviour (Josefsson et al., 2018; Vinther et al., 2016) and poorer mental health (Recksiedler & Stawski,

**Table 2**  
Sample characteristics by marital transitions and sex, HART 2015–2020.

Exposure variable	Remained married		Sex differences p-value <sup>1</sup>	Remained unmarried		Sex differences p-value <sup>1</sup>	Became widowed/ divorced		Sex differences p-value <sup>1</sup>	Became married		Sex differences p-value <sup>1</sup>
	Male N (%)	Female N (%)		Male N (%)	Female N (%)		Male N (%)	Female N (%)		Male N (%)	Female N (%)	
All	884 (70.3)	624 (39.8)	<0.001	209 (16.6)	715 (45.6)	<0.001	116 (9.2)	145 (9.3)	0.976	49 (3.9)	83 (5.3)	0.079
<b>Covariates</b>												
Age (70 plus)	248 (28.1)	93 (14.9)	<0.001	109 (22.6)	387 (54.1)	0.615	69 (59.5)	47 (32.4)	<0.001	26 (83.1)	47 (56.6)	0.691
Education (>-elementary)	194 (21.9)	92 (14.7)	<0.001	42 (20.1)	69 (9.7) (20.1)	<0.001	16 (13.8)	12 (8.3) (13.8)	0.152	8 (16.3)	10 (12.0)	0.489
Residence (urban)	400 (45.2)	271 (43.4)	0.484	125 (59.8)	361 (50.5)	0.018	52 (44.8)	75 (51.7)	0.268	26 (53.1)	59 (71.1)	0.037
Subjective economic status (low)	191 (22.6)	148 (24.4)	0.412	64 (31.5)	243 (35.7)	0.269	23 (20.5)	51 (35.7)	0.008	11 (23.4)	19 (23.5)	0.995
Religion (Buddhist)	799 (90.4)	579 (92.8)	0.101	198 (94.7)	653 (91.3)	0.108	110 (94.8)	133 (91.7)	0.326	41 (83.7)	79 (91.6)	0.167
Self-rated poor physical health	188 (21.7)	140 (22.6)	0.677	55 (26.6)	216 (31.5)	0.174	38 (33.3)	54 (37.2)	0.514	19 (40.4)	25 (30.5)	0.252
Activities of Daily Living (ADL) disability	16 (1.9)	4 (0.6) (1.9)	0.048	11 (5.3)	23 (3.3) (5.3)	0.183	2 (1.7) (1.7)	4 (2.8) (2.8)	0.569	4 (8.2) (8.2)	6 (7.3) (7.3)	0.860
<b>Health behavior</b>												
Incident current smoking	98 (15.7)	11 (1.8) (15.7)	<0.001	33 (20.2)	13 (1.9) (20.2)	<0.001	6 (7.4) (7.4)	10 (7.3) (7.3)	0.976	10 (22.7)	3 (3.7) (3.7)	<0.001
Incident current alcohol use	145 (22.4)	69 (11.9)	<0.001	30 (19.7)	31 (4.5) (19.7)	<0.001	13 (14.8)	16 (11.8)	0.513	9 (24.3)	13 (15.9)	0.271
Incident physical inactivity	235 (60.6)	138 (53.7)	0.084	41 (50.0)	194 (63.6)	0.025	39 (66.1)	25 (51.0)	0.112	10 (58.8)	12 (50.0)	0.577
Incident meal skipping	170 (22.1)	132 (24.4)	0.335	43 (24.4)	140 (22.9)	0.667	20 (19.2)	32 (25.6)	0.252	10 (25.0)	18 (20.8)	0.612
Incident underweight	68 (9.8)	27 (5.2) (9.8)	0.003	26 (16.7)	69 (13.7)	0.355	11 (13.8)	13 (11.3)	0.609	3 (8.2) (8.2)	2 (3.3) (3.3)	0.302
Incident obesity	98 (18.4)	84 (27.5)	0.002	22 (16.1)	79 (20.6)	0.246	20 (24.1)	18 (20.7)	0.594	6 (23.3)	12 (28.6)	0.618
Incident non-participation in annual health check-up	262 (61.1)	153 (51.4)	0.008	53 (58.9)	211 (57.2)	0.769	40 (67.8)	49 (67.1)	0.935	14 (51.9)	25 (58.1)	0.606
<b>Mental health</b>												
Incident depressive symptoms	69 (9.7)	58 (11.9)	0.220	30 (17.6)	62 (11.4)	0.032	13 (14.6)	22 (22.2)	0.180	6 (17.6)	8 (12.9)	0.529
Incident self-rated poor mental health	189 (40.0)	253 (38.9)	0.690	46 (36.2)	192 (42.7)	0.193	46 (56.1)	46 (48.9)	0.343	15 (48.4)	20 (37.0)	0.306
Incident poor quality of life/happiness	302 (50.1)	212 (47.9)	0.476	81 (63.3)	240 (57.7)	0.261	47 (59.5)	56 (59.6)	0.991	11 (47.8)	26 (50.0)	0.862
Incident loneliness	203 (27.8)	168 (33.5)	0.033	68 (46.3)	198 (38.0)	0.071	39 (44.8)	49 (47.6)	0.705	12 (38.7)	21 (35.0)	0.727
Incident insomnia symptoms	145 (18.8)	119 (23.4)	0.047	38 (22.9)	134 (23.3)	0.903	17 (17.3)	26 (25.2)	0.172	11 (25.6)	14 (21.5)	0.626
Incident emotional/psychiatric disorder	5 (0.8) (0.8)	6 (0.7) (0.7)	0.792	2 (1.0) (1.0)	6 (0.9) (0.9)	0.853	0 (0)	0 (0)	—	1 (2.4) (2.4)	1 (1.5) (1.5)	0.740
Incident brain diseases, dementia	15 (1.8)	12 (2.0) (2.0)	0.770	7 (3.4) (3.4)	12 (1.7) (1.7)	0.131	2 (2.4) (2.4)	1 (0.08) (0.08)	0.327	0 (0)	1 (1.5) (1.5)	0.428

<sup>1</sup> Chi-square statistics.

2019).

Several studies (Hilz & Wagner, 2018), mainly in high-income countries, showed evidence that married individuals have lower morbidity and mortality risks than unmarried people due to poor health behaviour and poor mental health factors. However, scanty information exists on marital status and health behaviour and mental health outcomes in Southeast Asia, including Thailand, which prompted the study. According to the 2017 Survey of Older Persons in Thailand, in the population aged 50 years and older, 70.9% were married, 19.1% widowed, 5.7% never married and 4.3% divorced or separated (Teerawichitchainan et al., 2019). The proportion of people who never married in Thailand at the age of 50 increased over time both for men and for women, but the changes were more significant for women than for men (Williams et al., 2006). The divorce and/or separation rate in Thailand also increased over time and appeared to be matched by an increase in remarriage rates (Phananiramai, 1997; UNFPA, 2015). The

increases in never married, divorce and remarriage rates may be partially attributed to the higher economic and financial independence of women (Phananiramai, 1997). Richter and Podhisita (1991–1992) state that divorce is fairly common in Thailand and there is little social stigma associated with divorce and remarriage, while the UNFPA, 2015 reports that much stigma associated with divorce or separation remains and widowhood has certain expectations and social attitudes that seem to be strongly biased towards women. Causes of divorce in Thailand may include domestic violence (Laeheem & Boonprakar, 2014). Concerning marriage stability in Thailand, one fifth of women stated that they had not chosen their spouse or partner, but that the alliance had been organised by their parents or for economic reasons, and only half of couples living in unions had registered their marriage (UNFPA, 2015). Women who remarry in Thailand reported significantly lower life satisfaction than those who did not remarry (Pothisiri et al., 2023). It is hypothesized that compared to people in a marital union, middle-aged

**Table 3**  
Longitudinal associations between marital status and health behavior, HART 2015–2020, among men.

Outcome variables	Marital status	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Health behavior</b>					
Current smoking	Married	1 (Reference)		1 (Reference)	
	Divorced	1.07 (0.75 to 1.53)	0.717	1.06 (0.71 to 1.56)	0.789
	Single	1.50 (1.06 to 2.13)	0.022	1.52 (1.05 to 2.19)	0.025
	Widowed	0.67 (0.54 to 0.83)	<0.001	0.97 (0.77 to 1.23)	0.818
Study wave	Time 1			1 (Reference)	
	Time 2			1.14 (1.01 to 1.28)	0.032
	Time 3			0.97 (0.84 to 1.13)	0.686
Current alcohol use	Married	1 (Reference)		1 (Reference)	
	Divorced	1.89 (1.34 to 2.67)	<0.001	1.71 (1.18 to 2.48)	0.004
	Single	1.18 (0.83 to 1.66)	0.356	1.04 (0.71 to 1.51)	0.845
	Widowed	0.60 (0.48 to 0.75)	<0.001	1.10 (0.86 to 1.41)	0.453
Study wave	Time 1			1 (Reference)	
	Time 2			1.77 (1.54 to 2.03)	<0.001
	Time 3			1.19 (1.01 to 1.41)	0.036
Physical inactivity	Married	1 (Reference)			
	Divorced	1.33 (0.90 to 1.80)	0.059	—	
	Single	1.00 (0.76 to 1.33)	0.987		
	Widowed	1.10 (0.94 to 1.29)	0.244		
Meal skipping	Married	1 (Reference)		1 (Reference)	
	Divorced	1.27 (0.78 to 2.07)	0.339	1.19 (0.71 to 1.99)	0.519
	Single	1.56 (1.07 to 2.27)	0.020	1.41 (0.96 to 2.09)	0.087
	Widowed	0.97 (0.74 to 1.26)	0.805	0.99 (0.74 to 1.31)	0.922
Study wave	Time 1			1 (Reference)	
	Time 2			2.96 (2.38 to 3.69)	<0.001
	Time 3			2.59 (2.03 to 3.30)	<0.001
Underweight	Married	1 (Reference)		1 (Reference)	
	Divorced	1.27 (0.74 to 2.17)	0.383	1.40 (0.78 to 2.52)	0.258
	Single	1.15 (0.72 to 1.82)	0.557	1.39 (0.86 to 2.29)	0.181
	Widowed	1.64 (1.29 to 2.09)	<0.001	1.21 (0.93 to 1.59)	0.159
Study wave	Time 1			1 (Reference)	
	Time 2			0.94 (0.79 to 1.12)	0.499
	Time 3			0.99 (0.81 to 1.22)	0.920
Obesity	Married	1 (Reference)		1 (Reference)	
	Divorced	0.93 (0.64 to 1.34)	0.691	0.86 (0.58 to 1.27)	0.860
	Single	0.98 (0.67 to 1.43)	0.915	0.94 (0.64 to 1.38)	0.940
	Widowed	0.67 (0.54 to 0.85)	<0.001	0.78 (0.62 to 0.98)	0.042
Study wave	Time 1			1 (Reference)	
	Time 2			0.96 (0.85 to 1.09)	0.519
	Time 3			0.98 (0.85 to 1.13)	0.761
Non-participation in annual health check-up	Married	1 (Reference)			
	Divorced	1.28 (0.95 to 1.72)	0.110	—	
	Single	1.16 (0.87 to 1.54)	0.314		
	Widowed	0.99 (0.85 to 1.14)	0.844		

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability, and study wave; CI: Confidence Interval.

and older adults who never married, are divorced or separated or who are widowed have poorer health behaviour and poorer mental health.

In terms of health behaviour, being unmarried was associated with smoking (Cho et al., 2008; Jee & Cho, 2019; Hilz & Wagner, 2018; Kim et al., 2018; Joung et al., 1995; Ramsey et al., 2019; Watt et al., 2014) and problem drinking (Keenan et al., 2017; Kim et al., 2018; Joung et al., 1995; Yim et al., 2012; Watt et al., 2014). Some studies found that being married was associated with physical inactivity (Hilz & Wagner, 2018; Jee & Cho, 2019), while other studies showed an association between being unmarried and physical inactivity (Joung et al., 1995; Keenan et al., 2017; Pettee et al., 2006). Regarding dietary behaviour, some studies found that being unmarried increased the odds of meal skipping (Joung et al., 1995; Yim et al., 2012). A number of studies found that being married was associated with a higher body mass index (Hilz & Wagner, 2018; Keenan et al., 2017; Lee et al., 2020), and being unmarried was associated with underweight and malnutrition (Besora-Moreno et al., 2020; Lee et al., 2020). In a study among aging adults in Germany found that being separated, divorced, or never married decreased their likelihood to attend to health check-ups (Hilz & Wagner, 2018), and in Korea among unmarried men health examinations (Kim et al., 2018).

Regarding mental health outcomes, a systematic review found that

separated/divorced marital status was associated with major depressive disorder (Gutiérrez-Rojas et al., 2020). The same result was also found among middle-aged Koreans (Kim et al., 2018), while Jang et al. (2009) found among aging adults in Korea these differences converged as women aged. In terms of sleep problems, in a large study among middle-aged persons in Japan, among men being divorced and among women being single or divorced was associated with insomnia symptoms (Kawata et al., 2020). Among middle-aged Koreans (Kim et al., 2018) being unmarried increased the odds of inadequate sleep (Kim et al., 2018). In a further large study among adults in Korea, single and separated or divorced women had poorer quality of life (QOL) than married women (Han et al., 2014), and in a small study among older adults in Thailand being married was associated with better subjective well-being (Jingmark et al., 2019). In a systematic review in older adults in China found that being unmarried increased the risk of loneliness (Zuo et al., 2023). Furthermore, some study seems to show that people who were unmarried and transitioned out of marriage had increased odds of cognitive decline and dementia (Nerobkova et al., 2022). The aim of this study was to assess the associations between marital status categories and health risk behaviour and poor mental health indicators in a longitudinal study among aging adults in Thailand.

**Table 4**  
Longitudinal associations between marital status and health behavior, HART 2015–2020, among women.

Outcome variables	Marital status	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Health behavior</b>					
Current smoking	Married	1 (Reference)			
	Divorced	1.79 (0.83 to 3.84)	0.135	—	
	Single	1.04 (0.42 to 2.59)	0.937		
	Widowed	1.02 (0.63 to 1.65)	0.943		
Current alcohol use	Married	1 (Reference)		1 (Reference)	
	Divorced	0.72 (0.44 to 1.17)	0.179	0.79 (0.48 to 1.31)	0.366
	Single	0.39 (0.21 to 0.74)	0.004	0.32 (0.16 to 0.65)	0.002
	Widowed	0.42 (0.31 to 0.58)	<0.001	0.82 (0.59 to 1.15)	0.253
Study wave	Time 1			1 (Reference)	
	Time 2			3.16 (2.43 to 4.10)	<0.001
	Time 3			2.30 (1.70 to 3.09)	<0.001
Physical inactivity	Married	1 (Reference)			
	Divorced	0.98 (0.78 to 1.24)	0.886	—	
	Single	0.85 (0.68 to 1.06)	0.147		
	Widowed	1.11 (0.99 to 1.25)	0.076		
Meal skipping	Married	1 (Reference)		1 (Reference)	
	Divorced	1.38 (1.00 to 1.91)	0.047	1.29 (0.90 to 1.82)	0.155
	Single	1.19 (0.85 to 1.67)	0.320	1.11 (0.76 to 1.60)	0.591
	Widowed	0.87 (0.72 to 1.04)	0.131	0.93 (0.75 to 1.14)	0.485
Study wave	Time 1			1 (Reference)	
	Time 2			2.95 (2.42 to 3.58)	<0.001
	Time 3			2.41 (1.95 to 2.97)	<0.001
Underweight	Married	1 (Reference)		1 (Reference)	
	Divorced	1.40 (0.83 to 2.34)	0.204	1.30 (0.76 to 2.22)	0.333
	Single	3.39 (2.28 to 5.05)	<0.001	2.97 (1.93 to 4.58)	<0.001
	Widowed	2.83 (2.23 to 3.58)	<0.001	1.62 (1.26 to 2.08)	<0.001
Study wave	Time 1			1 (Reference)	
	Time 2			0.80 (0.67 to 0.96)	0.017
	Time 3			0.84 (0.69 to 1.03)	0.095
Obesity	Married	1 (Reference)		1 (Reference)	
	Divorced	1.05 (0.79 to 1.39)	0.743	1.10 (0.82 to 1.46)	0.531
	Single	0.60 (0.45 to 0.82)	<0.001	0.67 (0.49 to 0.92)	0.013
	Widowed	0.60 (0.52 to 0.69)	<0.001	0.82 (0.70 to 0.96)	0.018
Study wave	Time 1			1 (Reference)	
	Time 2			1.10 (0.99 to 1.22)	0.077
	Time 3			1.05 (0.93 to 1.18)	0.439
Non-participation in annual health check-up	Married	1 (Reference)			
	Divorced	0.86 (0.69 to 1.08)	0.190	—	
	Single	1.13 (0.90 to 1.43)	0.301		
	Widowed	0.97 (0.86 to 1.08)	0.540		

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability, and study wave; CI: Confidence Interval.

## 2. Methods

The longitudinal data of three consecutive waves of Thailand's Health, Aging and Retirement (HART) study (2015, 2017 and 2020) were analyzed. Of 5616 participants at baseline, 361 died, 336 refused and 2056 were not traced from 2015 to 2020. In a national multi-step sampling design, one adult (45 years or older) was selected randomly per household; see details (Anantanasuwong et al., 2019). The trained field workers conducted face-to-face interviews in the home of the participants. The "Ethics Committee in Human Research, National Institute of Development Administration – ECNIDA (ECNIDA 2020/00012)" approved the study protocol, and participants gave written informed consent.

## 3. Measures

All variables were assessed in 2015, 2017 and 2020.

### 3.1. Exposure variables

*Marital status* was assessed as a time-varying variable reflecting marital status at the time of the survey, with four categories: "married or cohabiting, divorced or separated, widowed, and never married."

*Marital transition* included a five-year period and was categorized as follows: remain married (married or cohabiting at both in 2015 and

2020, reference group), remain unmarried (single, divorced or separated or widowed at both 2015 and 2020), became divorced/separated (married in 2015 and separated or divorced or separated or widowed in 2020), and became married (single, widowed, divorced, or separated in 2015 and married/cohabiting in 2020).

### 3.2. Outcome variables-health risk behaviour

*History of substance use* included current tobacco smoking and current alcohol use. Tobacco smoking was assessed with the question, "Have you ever smoked cigarettes?" (response options: "1 = yes, and still smoke now, 2 = yes, but quit smoking, and 3 = never" (Anantanasuwong et al., 2022)). *Alcohol use* was assessed with the question, "Have you ever drunk alcoholic beverages such as liquor, beer or wine?" (response options: "1 = yes, and still drinking now, 2 = yes, but do not drink now, and 3 = never") (Pengpid & Peltzer, 2022).

*Physical inactivity* was defined as no exercise in the past week, based on question about the frequency and duration of any type of exercise in the past week (Kim, 2022), categorized as "none = inactivity, 1–149 min/week = low activity, and  $\geq 150$  min/week = high activity" (Huffman et al., 2012).

*Meal skipping* was assessed with questions on "How many meals have you had in the last 2 days? Yesterday (breakfast, lunch, dinner; yes/no) and the day before yesterday (breakfast, lunch, dinner; yes/no)". Meal skipping was defined as skipping any breakfast, lunch, or dinner in the

Table 5

Longitudinal associations between marital transitions and incident health behavior, HART 2015–2020, among men.

Outcome variables	Marital transitions	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Incident Health behavior</b>					
Incident current smoking	Remained Married	1 (Reference)		—	
	Remained unmarried	1.37 (0.88 to 2.12)	0.162		
	Became widowed/divorced	0.43 (0.18 to 1.02)	0.055		
	Became married	1.59 (0.76 to 3.31)	0.221		
Incident current alcohol use	Remained Married	1 (Reference)		—	
	Remained unmarried	0.85 (0.55 to 1.32)	0.468		
	Became widowed/divorced	0.60 (0.32 to 1.11)	0.103		
	Became married	1.11 (0.51 to 2.41)	0.790		
Incident physical inactivity	Remained Married	1 (Reference)		—	
	Remained unmarried	0.65 (0.40 to 1.05)	0.079		
	Became widowed/divorced	1.27 (0.71 to 2.26)	0.417		
	Became married	0.93 (0.35 to 2.50)	0.886		
Incident meal skipping	Remained Married	1 (Reference)		—	
	Remained unmarried	1.14 (0.78 to 1.68)	0.500		
	Became widowed/divorced	0.84 (0.50 to 1.41)	0.509		
	Became married	1.18 (0.56 to 2.46)	0.665		
Incident underweight	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	1.85 (1.13 to 3.01)	0.014	1.62 (0.96 to 2.73)	0.072
	Became widowed/divorced	1.47 (0.74 to 2.92)	0.268	1.33 (0.65 to 2.71)	0.432
	Became married	0.82 (0.24 to 2.72)	0.740	0.66 (0.19 to 2.28)	0.508
Incident obesity	Remained Married	1 (Reference)		—	
	Remained unmarried	0.85 (0.51 to 1.41)	0.532		
	Became widowed/divorced	1.41 (0.82 to 2.45)	0.217		
	Became married	1.34 (0.52 to 3.41)	0.546		
Incident non-participation in annual health check-up	Remained Married	1 (Reference)		—	
	Remained unmarried	0.91 (0.58 to 1.45)	0.700		
	Became widowed/divorced	1.34 (0.75 to 2.40)	0.320		
	Became married	0.69 (0.32 to 1.50)	0.344		

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

last two days (Wild et al., 2023).

*Body Mass Index* (BMI) was sourced from body weight/height by self-report, and classified as follows: “underweight (< 18.5 kg/m<sup>2</sup>), normal weight (18.5–22.9 kg/m<sup>2</sup>), overweight (23–24.9 kg/m<sup>2</sup>), obesity class I (25–29.9 kg/m<sup>2</sup>) and obesity class II (30+ kg/m<sup>2</sup>).” (Wen et al., 2009).

Obesity class I or II was used as outcome variable.

*Participation in health check-up* was sourced from the question. “Did you have a medical check-up last year?” (Yes/No)

### 3.3. Outcome variables-mental health

*Depressive symptoms* ( $\geq 10$  scores) were evaluated using the CES-D-10 (Andresen et al., 1994); Cronbach’s alpha was 0.7 in all waves of the study.

*The self-rated mental health status* was assessed with the question, “In general, how would you rate your mental health status?” reported on a 0 (= very poor) to 10 (= excellent) visual analogue scale. Self-rated poor mental health was defined as 0–7.0 (8.0 being the median).

*Quality of life or happiness* was sourced from the question, “In general, how satisfied are you with your quality of life (or how happy do you feel)?” reported on a 0 (= very poor) to 10 (= excellent) visual analogue scale. Self-rated poor quality of life/happiness was defined as 0–7 (8 being the median).

*Loneliness* was measured with one item from the CES-D-10 scale,” (Andresen et al., 1994), “In the past week, how often did you experience feeling lonely?” defined as “almost always (5–7 days), often (3–4 days) or sometimes (1–2 days)”=1 and “very rarely (less than one day) or none” = 0.

*Insomnia symptoms* were defined as almost always (5–7 days) or often (3–4 days) (versus sometimes-1–2 days or very rarely/ never) “having trouble falling asleep/insomnia in the past week”.

The presence of mental conditions was determined by medical diagnoses reported by participants, including emotional-psychiatric disorder, and brain diseases, including dementia.

### 3.4. Independent variables

*Sociodemographic factors*, including, age group (45–69 and 70 years and more), sex (male, female), education ( $\leq$  and  $>$  elementary education), residence (urban and rural), religion (Buddhist and other), and subjective economic status (“How satisfied are you with your economic situation?” Rated from 1 to 10, and low defined as 1–5).

*Poor self-rated physical health status* reported on a 0 (= very poor) to 10 (= excellent) scale was defined as 0–6.0 (7.0 being the median).

*ADL disability* was sourced from a 4-item (dressing, washing, eating, and bathing) modified ADL scale (Katz et al., 1964). Response options ranged from “0 = able to do it all by myself to 3 = need help for all steps”. ADL disability was defined as one of the four elements that cannot be done alone. (Cronbach’s  $\alpha = 0.93$  at wave 1, 0.90 at wave 2 and 0.92 at wave 3).

#### 3.4.1. Data analysis

To assess the longitudinal associations between marital status and health risk behaviour and mental ill-health outcomes between 2015 (baseline), 2017 (first follow-up) and 2020 (second follow-up), we conducted Generalized Estimating Equations analysis (GEE). GEE is a

**Table 6**  
Longitudinal associations between marital transitions and incident health behavior, HART 2015–2020, among women.

Outcome variables	Marital transitions	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Incident health behavior</b>					
Incident current smoking	Remained Married	1 (Reference)		1 (Reference)0.88 0.88 (0.36 to 2.15)	
	Remained unmarried	1.03 (0.46 to 2.32)	0.939		0.771
	Became widowed/divorced	4.30 (1.79 to 10.33)	<0.001	3.92 (1.59 to 9.69)	0.003
	Became married	2.10 (0.57 to 7.68)	0.263	1.77 (0.46 to 6.89)	0.408
	Became married				
Incident current alcohol use	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	0.35 (0.23 to 0.55)	<0.001	0.46 (0.29 to 0.75)	0.002
	Became widowed/divorced	0.99 (0.55 to 1.76)	0.961	1.08 (0.59 to 1.98)	0.810
	Became married	1.39 (0.73 to 2.65)	0.313	2.02 (1.02 to 4.02)	0.045
	Became married				
Incident physical inactivity	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	1.51 (1.07 to 2.11)	0.018	1.21 (0.83 to 1.77)	0.316
	Became widowed/divorced	0.90 (0.49 to 1.66)	0.731	0.71 (0.37 to 1.34)	0.288
	Became married	0.86 (0.37 to 1.99)	0.729	0.69 (0.29 to 1.67)	0.411
	Became married				
Incident meal skipping	Remained Married	1 (Reference)		—	
	Remained unmarried	0.92 (0.70 to 1.21)	0.555		
	Became widowed/divorced	1.07 (0.68 to 1.67)	0.771		
	Became married	0.82 (0.45 to 1.49)	0.511		
	Became married				
Incident underweight	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	2.89 (1.82 to 4.59)	<0.001	1.62 (0.97 to 2.73)	0.068
	Became widowed/divorced	2.32 (1.16 to 4.65)	0.018	1.64 (0.78 to 3.45)	0.191
	Became married	0.63 (0.15 to 2.71)	0.533	0.34 (0.08 to 1.52)	0.158
	Became married				
Incident obesity	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	0.69 (0.48 to 0.98)	0.037	0.71 (0.47 to 1.05)	0.089
	Became widowed/divorced	0.69 (0.39 to 1.23)	0.206	0.65 (0.36 to 1.18)	0.160
	Became married	1.06 (0.52 to 2.16)	0.879	0.99 (0.47 to 2.12)	0.996
	Became married				
Incident non-participation in annual health check-up	Remained Married	1 (Reference)		1 (Reference)	
	Remained unmarried	1.27 (0.94 to 1.73)	0.121	1.24 (0.88 to 1.75)	0.225
	Became widowed/divorced	1.95 (1.14 to 3.34)	0.015	1.93 (1.11 to 3.38)	0.021
	Became married	1.33 (0.69 to 2.53)	0.393	1.32 (0.66 to 2.62)	0.430
	Became married				

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

kind of regression analysis that examines the correlations between repeated measures in a person, including subjects regardless of missing values (Liang & Zeger, 1993). Two models are presented for the development of health risk behaviour and mental ill-health outcomes. The first model regressing marital status (being married as reference category and being divorced or separated, single or never married and widowed as predictors) on each health outcome is unadjusted, and in the second model was adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status and ADL disability for each health outcome, for men and women separately. Furthermore, to assess the longitudinal associations between marital transitions and health risk behaviour and mental ill-health outcomes between 2015 (baseline), 2017 (first follow-up) and 2020 (second follow-up), logistic regressions were applied on each incident health outcome (without condition at baseline and having the condition in 2017 and/or 2020). Covariates were selected based on previous research (Han et al., 2014; Hilz & Wagner, 2018; Kawata et al., 2020; Kim et al., 2018; Jee & Cho, 2019; Lee et al., 2020; Yim et al., 2012). Collinearity was assessed with Variation Inflation Factors (VIFs) statistics but none was found. StataSE 15.0 (College Station, TX, USA) was used for the statistical analyses;  $p < 0.05$  was accepted as significant, missing values were discarded.

#### 4. Results

The loss to follow-up sample differed from the follow-up sample in terms of being older, being male, higher education, urban residence, Buddhist religion, being divorced or single, lower economic status, a higher rate of ADL limitations and did not differ in terms of self-rated

poor physical health. The mean/median age at baseline was 66.4/66.0 years for men (range from 45 to 99 years) and 66.6/65.5 years for women (range from 45 to 117 years). The prevalence of being married at baseline in 2015 was higher among men (79.4%) than women (49.1%) ( $p < 0.001$ ), while the proportion of widowed was higher among women (40.0%) than men (13.9%) ( $p < 0.001$ ). The rate of never married ( $p = 0.002$ ) and divorced or separated ( $p = 0.020$ ) was slightly higher among women than men. The marital status categories were similar across the three study waves. The distribution of the covariates, health risk behaviour and poor mental health indicators by study year, and sex are shown in Table 1, and by age group in Supplementary Table 1.

Table 2 describes the sample characteristics by marital transitions and sex. More men (70.3%) than women (39.8%) remained married ( $p < 0.001$ ), and more women (45.6%) remained unmarried (single, or divorced or separated or widowed) from 2015 to 2020 ( $p < 0.001$ ). The proportion of people who transitioned from married in 2015 to divorced or separated or widowed in 2020 was similar among men (9.2%) and women (9.3%), and the proportion of people who transitioned from being divorced or separated or widowed in 2015 to became married in 2020 was higher among women (5.3%) than men (3.9%), but this was not significant ( $p = 0.079$ ) (see Table 2).

##### 4.1. Longitudinal associations between marital status and health risk behaviour

In the final adjusted GEE logistic regression model, being single was positively associated with current smoking among men but not among women, and divorced or separated was positively associated with current alcohol use among men and being single was negatively associated

Table 7

Longitudinal associations between marital status and mental health, HART 2015–2020, among men.

Outcome variables	Marital status	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Mental health</b>					
Depressive symptoms	Married	1 (Reference)		1 (Reference)	
	Divorced	2.26 (1.49 to 3.43)	<0.001	2.37 (1.53 to 3.67)	<0.001
	Single	2.21 (1.49 to 3.27)	<0.001	2.25 (1.49 to 3.38)	<0.001
	Widowed	1.57 (1.23 to 1.99)	<0.001	1.31 (0.99 to 1.74)	0.055
Study wave	Time 1			1 (Reference)	
	Time 2			0.64 (0.51 to 0.80)	<0.001
	Time 3			0.38 (0.28 to 0.51)	<0.001
Self-rated poor mental health	Married	1 (Reference)		1 (Reference)	
	Divorced	1.37 (0.99 to 1.90)	0.057	1.62 (1.14 to 2.31)	0.008
	Single	1.19 (0.87 to 1.63)	0.289	1.30 (0.93 to 1.82)	0.119
	Widowed	1.46 (1.24 to 1.72)	<0.001	1.23 (1.00 to 1.50)	0.047
Study wave	Time 1			1 (Reference)	
	Time 2			0.80 (0.68 to 0.93)	0.005
	Time 3			0.66 (0.55 to 0.79)	<0.001
Poor quality of life/happiness	Married	1 (Reference)		1 (Reference)	
	Divorced	1.78 (1.32 to 2.40)	<0.001	2.14 (1.53 to 2.98)	<0.001
	Single	1.72 (1.28 to 2.32)	<0.001	1.93 (1.43 to 2.61)	<0.001
	Widowed	1.55 (1.32 to 1.81)	<0.001	1.29 (1.07 to 1.55)	0.008
Study wave	Time 1			1 (Reference)	
	Time 2			1.22 (1.05 to 1.41)	0.009
	Time 3			1.12 (0.95 to 1.33)	0.187
Loneliness	Married	1 (Reference)		1 (Reference)	
	Divorced	2.33 (1.69 to 3.26)	<0.001	2.42 (1.70 to 3.37)	<0.001
	Single	1.96 (1.46 to 2.65)	<0.001	2.16 (1.50 to 2.73)	<0.001
	Widowed	1.92 (1.61 to 2.29)	<0.001	1.56 (1.32 to 1.95)	<0.001
Study wave	Time 1			1 (Reference)	
	Time 2			0.98 (0.83 to 1.16)	0.045
	Time 3			0.96 (0.81 to 1.15)	0.168
Insomnia symptoms	Married	1 (Reference)		1 (Reference)	
	Divorced	1.35 (0.91 to 2.01)	0.141	1.45 (0.97 to 2.17)	0.074
	Single	1.14 (0.78 to 1.67)	0.498	1.14 (0.77 to 1.69)	0.511
	Widowed	1.41 (1.14 to 1.74)	<0.001	1.17 (0.92 to 1.48)	0.148
Study wave	Time 1			1 (Reference)	
	Time 2			0.85 (0.79 to 1.03)	
	Time 3			0.74 (0.59 to 0.92)	
Emotional/psychiatric disorder	Married	1 (Reference)		1 (Reference)	
	Divorced	1.20 (0.16 to 9.19)	0.861	1.30 (0.18 to 9.62)	0.796
	Single	4.09 (1.10 to 15.22)	0.036	4.11 (1.06 to 15.93)	0.041
	Widowed	1.06 (0.35 to 3.24)	0.913	0.94 (0.27 to 3.26)	0.925
Study wave	Time 1			1 (Reference)	
	Time 2			0.81 (0.26 to 2.51)	0.808
	Time 3			2.45 (1.01 to 5.93)	0.047
Brain diseases, dementia	Married	1 (Reference)		—	
	Divorced	0.85 (0.21 to 3.50)	0.819		
	Single	0.71 (0.17 to 2.93)	0.639		
	Widowed	0.94 (0.47 to 1.89)	0.864		

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

with current alcohol use among women. Being single or widowed was positively associated with underweight among women, but not among men. Widowed was negatively associated with obesity among men and being single or widowed was negatively associated with obesity among women. In unadjusted analysis, single men and divorced women were positively associated with meal skipping. In both men and women, marital status was not significantly associated with physical inactivity and non-participation in annual health check-up (see Tables 3 and 4).

#### 4.2. Longitudinal associations between marital transitions and incident health risk behaviour

In the final logistic regression model, among men, remaining unmarried was marginally associated with incident underweight, and among women, transitioning to widowed or divorced was associated with incident current smoking and incident non-participation in annual health check-up, transitioning to became married was associated with incident alcohol use, and remaining unmarried was negatively associated with incident alcohol use (see Tables 5 and 6).

#### 4.3. Longitudinal associations between marital status and mental health

In the final adjusted GEE logistic regression model, divorced, single or widowed men but not women had higher odds of having depressive symptoms. Among both men and women, being divorced, single or widowed were positively associated with poor quality of life/happiness, and among men being divorced, single or widowed was positively associated with loneliness, and among women, being single or widowed was positively associated with loneliness. Among men, being single was positively associated with having an emotional or psychiatric disorder, and in unadjusted analysis, being widowed was positively associated with insomnia symptoms. Marital status was not significantly associated with brain diseases (see Tables 7 and 8).

#### 4.4. Longitudinal associations between marital transitions and mental health

In the final logistic regression model, among men, remaining unmarried was associated with incident depressive symptoms, incident poor quality of life/happiness and incident loneliness, and transitioning to being widowed or divorced or separated was associated with incident



**Table 8**  
Longitudinal associations between marital status and mental health, HART 2015–2020, among women.

Outcome variables	Marital status	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Mental health</b>					
Depressive symptoms	Married	1 (Reference)			
	Divorced	1.22 (0.85 to 1.76)	0.282	—	
	Single	0.99 (0.71 to 1.39)	0.961		
	Widowed	1.16 (0.98 to 1.38)	0.087		
Self-rated poor mental health	Married	1 (Reference)		1 (Reference)	
	Divorced	1.00 (0.77 to 1.30)	0.995	1.11 (0.82 to 1.51)	0.488
	Single	1.07 (0.84 to 1.36)	0.589	0.99 (0.76 to 1.29)	0.935
	Widowed	1.48 (1.31 to 1.66)	<0.001	1.16 (1.00 to 1.34)	0.052
Study wave	Time 1			1 (Reference)	
	Time 2			0.92 (0.80 to 1.06)	0.221
	Time 3			0.61 (0.52 to 0.72)	<0.001
Poor quality of life/happiness	Married	1 (Reference)		1 (Reference)	
	Divorced	1.23 (0.96 to 1.57)	0.101	1.42 (1.09 to 1.84)	0.009
	Single	1.51 (1.20 to 1.89)	<0.001	1.73 (1.35 to 2.23)	<0.001
	Widowed	1.58 (1.40 to 1.77)	<0.001	1.43 (1.24 to 1.64)	<0.001
Study wave	Time 1			1 (Reference)	
	Time 2			1.51 (1.32 to 1.71)	<0.001
	Time 3			1.02 (0.88 to 1.18)	0.825
Loneliness	Married	1 (Reference)		1 (Reference)	
	Divorced	1.29 (0.99 to 1.68)	0.063	1.27 (0.98 to 1.70)	0.093
	Single	1.37 (1.06 to 1.77)	0.015	1.32 (1.03 to 1.71)	0.041
	Widowed	1.45 (1.27 to 1.66)	<0.001	1.18 (1.02 to 1.37)	0.029
Study wave	Time 1			1 (Reference)	
	Time 2			1.15 (1.00 to 1.32)	0.055
	Time 3			0.97 (0.83 to 1.13)	0.669
Insomnia symptoms	Married	1 (Reference)			
	Divorced	1.00 (0.73 to 1.37)	0.997	—	
	Single	0.79 (0.57 to 1.10)	0.164		
	Widowed	1.10 (0.95 to 1.27)	0.194		
Emotional/psychiatric disorder	Married	1 (Reference)			
	Divorced	1.60 (0.34 to 7.53)	0.553	—	
	Single	0.44 (0.06 to 3.36)	0.444		
	Widowed	0.61 (0.27 to 1.36)	0.610		
Brain diseases, dementia	Married	1 (Reference)			
	Divorced	0.56 (0.14 to 2.37)	0.434	—	
	Single	1.68 (0.67 to 4.21)	0.273		
	Widowed	1.23 (0.73 to 2.10)	0.439		

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

poor mental health and incident loneliness. Among women, transitioning to being widowed or divorced or separated was associated with incident depressive symptoms and incident loneliness, and remaining unmarried increased the odds of incident poor quality of life/happiness (see Tables 9 and 10).

## 5. Discussion

This is the first longitudinal study on the associations between marital status, marital transitions and health risk behaviour and poor mental health indicators among middle- and older aged individuals in Thailand. In terms of health risk behaviours, we found that being single was positively associated with current smoking among men and women transitioning to widowhood or divorce had higher odds of incident current smoking. Divorced or separated was positively associated with current alcohol use among men and women who were single or remained unmarried had negative associations with current or incident alcohol use, while women that transitioned to become married had higher odds of incident alcohol use. Being single or widowed was positively associated with underweight among women, and among men, remaining unmarried was marginally associated with incident underweight. Widowed was negatively associated with overweight/obesity among men and being single or widowed was negatively associated with overweight/obesity among women. Furthermore, women transitioning to widowhood or divorce had higher odds of incident non-participation in annual health check-up. In terms of poor mental health outcomes, divorced, single or widowed men had higher odds of having depressive symptoms and women that transitioned to being widowed or divorced or

separated was associated with incident depressive symptoms. Among both men and women, being divorced, single or widowed were positively associated with poor quality of life/happiness, and among men being divorced, single or widowed was positively associated with loneliness, and among women, being single or widowed was positively associated with loneliness. Among men, being single was positively associated with having an emotional or psychiatric disorder, and in unadjusted analysis, being widowed was positively associated with insomnia symptoms. Marital status was not significantly associated with brain diseases.

The distribution of marital status in 2015 in this study ( $\geq 45$  years) was 62.6% married, 28.4% widowed, 4.8% never married and 4.2% divorced or separated, which is similar to 5.7% never married and 4.3% divorced or separated, higher in terms of widowed (19.1%) and lower in terms of married (70.9%) than in the cross-sectional 2017 Survey of Older Persons in Thailand aged 50 years and older (Teerawichitchainan et al., 2019). In comparison data from the US Health and Retirement Study (HRS) (50 years and older) show that the distribution of never married (5.1%) was similar, the proportion of widowed (18.7%) was similar to the 2017 Thailand survey but lower than in our study (28.4%), while the rates of divorced or separated (14.5%) was much higher than in Thailand. The proportion of being married (62.6%) in this survey was similar to the US HRS (61.7%, including remarried) (Yu, 2023). Considering the much higher rate of divorce or separation for example in the US compared to Thailand health associations with divorce may represent different processes.

Consistent with previous studies (Cho et al., 2008; Jee & Cho, 2019; Hilz & Wagner, 2018; Kim et al., 2018; Jung et al., 1995; Ramsey et al.,

**Table 9**  
Longitudinal associations between marital transition and incident mental health, HART 2015–2020, among men.

Outcome variables	Marital transitions	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Incident mental health</b>					
Incident depressive symptoms	Remained	1 (Reference)		1 (Reference)	
	Married		0.004		0.047
	Remained unmarried	2.00 (1.25 to 3.18)	0.152	1.66 (1.01 to 2.72)	0.248
	Became widowed/divorced	1.59 (0.84 to 3.02)	0.139	1.48 (0.76 to 2.86)	0.242
	Became married	1.99 (0.80 to 4.99)		1.75 (0.69 to 4.45)	
	Incident self-rated poor mental health	Remained	1 (Reference)		1 (Reference)
Married			0.576		0.194
Remained unmarried		0.89 (0.60 to 1.33)	0.003	0.76 (0.50 to 1.15)	0.028
Became widowed/divorced		2.01 (1.26 to 3.20)	0.291	1.73 (1.06 to 2.81)	0.680
Became married		1.48 (0.72 to 3.05)		1.17 (0.56 to 2.45)	
Incident poor quality of life/happiness		Remained	1 (Reference)		1 (Reference)
	Married		0.007		0.010
	Remained unmarried	1.72 (1.16 to 2.55)	0.117	1.74 (1.15 to 2.66)	0.354
	Became widowed/divorced	1.46 (0.91 to 2.36)	0.832	1.27 (0.77 to 2.09)	0.809
	Became married	0.91 (0.40 to 2.10)		0.90 (0.38 to 2.11)	
	Incident loneliness	Remained	1 (Reference)		1 (Reference)
Married			<0.001		<0.001
Remained unmarried		2.23 (1.55 to 3.21)	<0.001	2.05 (1.39 to 3.01)	0.009
Became widowed/divorced		2.11 (1.34 to 3.31)	0.192	1.89 (1.17 to 3.04)	0.330
Became married		1.64 (0.78 to 3.43)		1.46 (0.68 to 3.14)	
Incident insomnia symptoms		Remained	1 (Reference)		—
	Married		0.232		
	Remained unmarried	1.28 (0.85 to 1.92)	0.723		
	Became widowed/divorced	0.91 (0.52 to 1.57)	0.277		
	Became married	1.48 (0.73 to 3.01)			
	Incident emotional/psychiatric disorder	Remained	1 (Reference)		—
Married			0.660		
Remained unmarried		1.43 (0.29 to 7.16)	0.997		
Became widowed/divorced		0.00 (3.57 (0.42 to 30.33))	0.244		
Became married					
Incident brain diseases, dementia		Remained	1 (Reference)		—
	Married		0.134		
	Remained unmarried	2.01 (0.81 to 4.98)	0.680		
	Became widowed/divorced	1.37 (0.31 to 6.09)	0.998		
	Became married	0.00			

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

**Table 10**  
Longitudinal associations between marital transitions and incident mental health, HART 2015–2020, among women.

Outcome variables	Marital transitions	Model 1: unadjusted odds ratio (95% CI)	p-value	Model 2: adjusted odds ratio (95% CI) <sup>a</sup>	p-value
<b>Incident mental health</b>					
Incident depressive symptoms	Remained	1 (Reference)		1 (Reference)	
	Married		0.781		0.439
	Remained unmarried	0.95 (0.65 to 1.39)	0.007	0.85 (0.55 to 1.29)	0.020
	Became widowed/divorced	2.11 (1.22 to 3.65)	0.821	1.95 (1.10 to 3.42)	0.856
	Became married	1.10 (0.50 to 2.42)		1.08 (0.47 to 2.47)	
	Incident self-rated poor mental health	Remained	1 (Reference)		—
Married			0.419		
Remained unmarried		1.11 (0.86 to 1.45)	0.111		
Became widowed/divorced		1.44 (0.92 to 2.24)	0.669		
Became married		0.88 (0.49 to 1.58)			
Incident poor quality of life/happiness		Remained	1 (Reference)		1 (Reference)
	Married		0.004		0.006
	Remained unmarried	1.49 (1.14 to 1.95)	0.040	1.52 (1.13 to 2.05)	0.076
	Became widowed/divorced	1.61 (1.02 to 2.52)	0.770	1.53 (0.96 to 2.43)	0.465
	Became married	1.09 (0.61 to 1.94)		1.25 (0.69 to 2.26)	
	Incident loneliness	Remained	1 (Reference)		1 (Reference)
Married			0.136		0.942
Remained unmarried		1.22 (0.94 to 1.57)	0.007	1.01 (0.76 to 1.35)	0.048
Became widowed/divorced		1.80 (1.17 to 2.76)	0.820	1.56 (1.01 to 2.44)	0.717
Became married		1.07 (0.61 to 1.87)		0.90 (0.50 to 1.67)	
Incident insomnia symptoms		Remained	1 (Reference)		—
	Married		0.975		
	Remained unmarried	1.00 (0.75 to 1.32)	0.693		
	Became widowed/divorced	1.10 (0.68 to 1.80)	0.735		
	Became married	0.90 (0.48 to 1.68)			
	Incident emotional/psychiatric disorder	Remained	1 (Reference)		—
Married			0.936		
Remained unmarried		1.05 (0.32 to 3.46)	0.996		
Became widowed/divorced		0.00 (1.90 (0.22 to 16.52))	0.561		
Became married					
Incident brain diseases, dementia		Remained	1 (Reference)		—
	Married		0.748		
	Remained unmarried	0.88 (0.39 to 1.97)	0.365		
	Became widowed/divorced	0.39 (0.05 to 3.01)	0.804		
	Became married	0.77 (0.10 to 6.02)			

<sup>a</sup> Adjusted for age group, education, subjective economic status, area of residence, religion, self-rated physical health status, ADL disability; CI: Confidence Interval.

2019; Watt et al., 2014), we found that being unmarried (single) was associated with current smoking among men and transitioning to widowed or divorced was associated with incident current smoking among women. Never married Thai men and widowed or divorced women may smoke because of high levels of stress and low support (Kleinke et al., 1983; Watt et al., 2014). The prevalence of smoking among women was between 0.9% to 2.2%, and it is possible that due to the low proportion of smoking the positive associations between the unmarried categories and smoking did not reach significance. In agreement with some research (Keenan et al., 2017; Kim et al., 2018; Joung et al., 1995; Yim et al., 2012; Watt et al., 2014), we found that being divorced or separated was positively associated with current alcohol use among men, transitioning to become married was associated with incident alcohol use among women but being single and remaining unmarried was negatively associated with current and incident alcohol use among women. In line with previous studies (Besora-Moreno et al., 2020; Churak et al., 2018; Lee et al., 2020), we found that being single or widowed was positively associated with underweight among women, and remaining unmarried was marginally associated with incident underweight among men. Apart from non-marital status, various other factors, including teeth or gum diseases (Churak et al., 2018), no functional dentition (Gaewkhiew et al., 2019), inadequate energy and lipid consumption (Chanwikrai et al., 2020), and low income (Nawai et al., 2021), have been found associated with underweight among older adults in Thailand. Supporting never married Thai women and men and widowed Thai women may help to reduce underweight or malnutrition (Besora-Moreno et al., 2020). Furthermore, in agreement with a number of studies (Hilz & Wagner, 2018; Keenan et al., 2017; Lee et al., 2020) widowed was negatively associated with overweight/obesity among men and being single or widowed was negatively associated with overweight/obesity among women. More research is needed to explain why married women as opposed to married men in Thailand may be more likely obese (Lee et al., 2020).

Former studies found mixed results between marital status and physical inactivity (Hilz & Wagner, 2018; Jee & Cho, 2019; Joung et al., 1995; Keenan et al., 2017; Pettee et al., 2006), while we did not find a significant association between marital status and physical inactivity. Although some studies (Hilz & Wagner, 2018; Kim et al., 2018; Joung et al., 1995; Yim et al., 2012) identified associations between unmarried status and meal skipping and non-participation in health screening, we only found among women that transitioning to widowed or divorced was associated with incident non-participation in annual health check-up.

In consistence with previous research, (Gutiérrez-Rojas et al., 2020; Kim et al., 2018), we found that divorced, single, or widowed men had higher odds of having depressive symptoms, and women that transitioned to being widowed or divorced or separated had higher incident depressive symptoms. Marital break-up and never married may increase feelings of failure and lower self-esteem in men leading to depressive symptoms (Rehman et al., 2008). Widows in Thailand may undergo various stressful experiences, such as child care and education, occupation, and cost of family, which may lead to depressive symptoms (Buatchum et al., 2017).

Furthermore, in agreement with a study in Korea (Han et al., 2014) and Thailand (Jingmark et al., 2019), this survey showed that among both men and women, being divorced, single or widowed were positively associated with poor quality of life/happiness, and among both men and women that remained unmarried increased the odds of incident poor quality of life/happiness. It is important to develop counter measures for the unmarried Thai men and women to improve their quality of life/happiness. Consistent with a systematic review in older adults in China (Zuo et al., 2023), we found that being unmarried was a risk factor for loneliness.

Men who remained unmarried and men and women who transitioned to being widowed or divorced or separated had higher incident loneliness.

A study in Japan (Kawata et al., 2020) and Korea (Kim et al., 2018) showed a positive relationship between being unmarried and sleep problems, while we found this relationship only in unadjusted analysis with widowed men. The finding that among men, being single was positively associated with having an emotional or psychiatric disorder may be attributed to the selection theory (health influences marital status) (Joung, 1997). In contrast to a previous study (Nerobkova et al., 2022), we did not find a significant association between being unmarried and brain diseases, including dementia.

### 5.1. Study limitations

The limitations of the study include that variables were evaluated by self-reporting. A further limitation includes the high loss at follow-up. Due to a relatively small size, we did not analyze the data by age group, which could have provided some different results (see descriptive results in Supplementary Table 1). Social support could moderate effects on mental health and health behaviour (Watt et al., 2014), but we did not include it in this analysis, since it was not assessed in all three surveys. Furthermore, the marital status information was only available for the current survey, and not the marital history or overlapping groups. A further study limitation was that there are very low rates of smoking and alcohol use in women, which paired with those who are divorced/separated resulted in very small cell sizes.

## 6. Conclusion

We found among men and/or women that being unmarried was associated with several health risk behaviours and mental-ill health indicators. Enhanced screening, health education and treatment among unmarried middle-aged and older adults of mental-ill health and health risk behaviour may be warranted in Thailand.

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## CRedit authorship contribution statement

**Supa Pengpid:** Writing – original draft, Formal analysis, Conceptualization. **Karl Peltzer:** Writing – review & editing, Methodology, Formal analysis. **Dararatt Anantanasuwong:** Writing – review & editing, Project administration, Investigation, Funding acquisition, Data curation.

## Declaration of Competing Interest

None.

## Data availability

Data is publicly available at Health, Aging, and Retirement in Thailand (HART): <https://hart.nida.ac.th/download-center/>

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.archger.2023.105196](https://doi.org/10.1016/j.archger.2023.105196).

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