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## Effects of length of residency on the development of physical and mental illnesses in immigrant women in Taiwan: Verification of the negative acculturation theory by a prospective cohort study using nationwide data

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Effects of length of residency on the development of physical and mental illnesses in immigrant women in Taiwan: Verification of the negative acculturation theory by a prospective cohort study using nationwide data

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## Abstract

**Objectives:** Few studies have validated the impact of length of residency on physical and mental health using large-scale data. This study combined five nationwide databases and explored the impact of length of residency in Taiwan on the physical and mental health of female marriage immigrants.

**Methods:** We used a retrospective cohort study design and analyzed data on 168,202 eligible female immigrants for 2001–2017. The length of residency was taken as the period from their first appearance in the national health insurance database to the end of 2017. Hypertension and diabetes were chosen as indices of physical health and depression as an index of mental health. Diagnosis standards were based on the International Classification of Disease, 9th or 10th Revision. Data were analyzed using time-dependent Cox regressions. Nationality of origin, age upon arrival, region of residence, and socioeconomic status were controlled for when estimating the adjusted hazard ratio of developing hypertension, diabetes, and depression in response to increasing duration of residency.

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**Results:** The physical and mental health of the immigrants deteriorated with increasing time of residence in Taiwan. Immigrants who had resided in Taiwan for 5–10 years or  $\geq 10$  years respectively had a 5.8-fold (95% confidence interval [CI]: 3.46–9.74) or 6.29-fold (95% CI: 4.61–8.59) higher adjusted risk of developing hypertension; a 3.97-fold (95% CI: 2.54–6.21) or 9.18-fold (95% CI: 5.48–15.38) higher adjusted risk of developing diabetes; and a 5.01-fold (95% CI: 3.14–8.01) or 12.19-fold (95% CI: 8.65–17.18) higher adjusted risk of developing depression than their counterparts who had lived in Taiwan for  $\leq 5$  years.

**Conclusion:** These findings support the application of negative acculturation theory to both physical and mental health among female marriage immigrants in Taiwan.

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**Keywords:** new immigrants, immigration, the negative acculturation theory, hypertension, diabetes, depression

## Strengths and limitations of this study

- This is a pioneering study that uses representative nationwide data to explore the impact of acculturation on female immigrants' health development.
- Both mental-health conditions (depression) and common physiological illnesses (hypertension and diabetes) are introduced as useful health indices in the present study.
- A part of immigrant women may be lost to follow-up due to maladjustment or health issues, which results in underestimating of the hazard ratios.

## Background

The population of new immigrants in Taiwan comprises mostly women who come to the country through marriage and as individuals <sup>1</sup>. This differs from the predominant pattern of family immigration that is seen in many other countries around the world. Hence, the theory that was established based on family immigration and related phenomena observed in previous studies should be further validated based on the new immigrant population of Taiwan. Knowledge concerning the physiological and psychological development of marriage immigrants overcoming multiple acculturation challenges is still limited.

In general, immigrants are a strongly selected population: their average physical condition tends to be better than that of the citizens of the host country. The "healthy immigrant effect" theory pertains not only to physiological aspects<sup>2</sup>, but can also be extended to the psychological aspects of the female immigrants of Taiwan<sup>3</sup>. It predicts that with increasing length of residency, female immigrants will acclimatize to living in Taiwan, and their physical and mental state will accordingly be increasingly healthy. However, this traditional "acculturation theory" <sup>4</sup> has recently been challenged. A study conducted in Central Taiwan showed that in female immigrants, with increasing time of residence in the host country, symptoms of depression increased significantly <sup>5</sup>. A study conducted in the USA indicated that with increasing time of residence in the host country, immigrants' depression and mental disturbance became worse than those of local Americans<sup>6</sup>. With respect to cardiovascular health, the advantage conferred by the healthy immigrant effect appears to be short-lived <sup>7</sup>. These studies exemplify the implications of the "negative acculturation theory" <sup>89</sup>. However, the sample sizes were small and the studies were conducted in specific regions. This calls the representativeness of the data into question. Additionally, the paucity of studies on health issues related to immigration hinders our understanding of the full impact of Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies

acculturation.

 To overcome this problem, using representative nationwide data, we explored the impact of acculturation (using time spent living in Taiwan as an index) on female immigrants' health development. A useful health index should include both mental-health conditions, such as depression, and common physiological illnesses, such as hypertension and diabetes. We sought to validate the negative acculturation theory based on the mental and physical health of the new immigrant population in Taiwan.

## Methods

## Research design and data selection

We adopted a retrospective cohort study design. Using five databases, we extracted eligible samples and their corresponding variables. First, we selected non-Taiwanese mothers documented in the "Birth Reporting Database" from 2001 to 2016 and eliminated duplicate data for mothers who had given birth more than once. This resulted in 184,833 female immigrants. Next, we matched the mothers' ID with the 2001–2017 data in the "Registry of Beneficiaries" and used the first date on which each woman had appeared in the database as the starting point of her residency in Taiwan. The end of the study was the end of 2017. Immigrants without health insurance or who had held their insurance for less than one year, or who did not have a birth date in the database, were excluded. This process yielded 169,519 female immigrants with health insurance. Disease data for the observation period was obtained from the "Ambulatory Care Expenditure by Visits" and the "Inpatient Expenditure by Admissions" databases. We selected hypertension, diabetes, and depression as the outcomes of this study. All diseases were diagnosed according to the diagnosis standard in the International Classification of Diseases, 9th or 10th Revision, and were only regarded as a confirmed diagnosis when there were at least three outpatient visits or one inpatient admission.

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Further, to prevent reverse causality (i.e., when the woman may have already had the disease in her country of origin), we excluded all women who were diagnosed within one year of arriving in Taiwan. The final sample size was 168,202 (Figure 1).

(Insert Figure 1 about here)

## **Research variables**

#### Dependent variable

The dependent variables of this study were the diagnoses of hypertension, diabetes, and depression. We aimed to explore the impact of the process of acculturation on disease. To avoid any possible interference from hereditary or genetic disorders, we excluded diseases that are mainly caused by hereditary or genetic factors. We therefore included the following hypertension-related diseases (ICD-9 codes 402-405 and ICD-10 codes I11-I15): hypertensive heart disease, hypertensive chronic kidney disease, hypertensive heart and chronic kidney disease, and secondary hypertension. We included the following diabetes diagnoses (ICD-9 code 250 and ICD-10 codes E11-E14): non-insulin-dependent diabetes mellitus, malnutrition-related diabetes mellitus, other specified diabetes mellitus, and unspecified diabetes mellitus. Finally, we included the following depression diagnoses (ICD-9 codes 296.2 296.3 300.4 and ICD-10 codes F32-F34): depressive episode, recurrent depressive disorder, and persistent depressive disorder.

## Independent variable

As the independent variable, we used length of residency (in years) in Taiwan as an index of acculturation. This was defined as 2017 (the endpoint of the study period) minus the year that the woman was first documented in the Registry of Beneficiaries,

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rounded off to the nearest integer. To prevent prevalent cases, women who were diagnosed with the disease within their first year of arriving were excluded. When estimating the risk of disease, the length of residency was divided to three categories:  $\leq 5$  years, 5–10 years, and  $\geq 10$  years.

#### Sociodemographic variables

 To prevent confounding, we adjusted for sociodemographic variables using regression analysis. These variables included (1) nationality of origin; (2) age upon arrival (defined as the first year of registration in the insurance database minus the year of birth, rounded off to the nearest integer; for convenience, based on analysis, this was categorized into 18-25 years, 26-30 years, 31-35 years, and  $\geq 35$  years); (3) region of residence (northern, central, southern, eastern, and outlying islands); and (4) socioeconomic status (obtained from the "Low-income and Middle-income Households" database and categorized into high [upper-middle-income households] and low [lower-middle- and low-income households]).

#### Statistical analysis

Data were analyzed using the SAS 9.4 software (SAS Institute, Cary, NC, USA). The observed variables were summarized using frequency, percentage, mean, standard deviation, and their distributions. We used time-dependent Cox regression analysis to estimate the risk of developing hypertension, diabetes, and depression during the follow-up period. Because we used the incidence cases, the first year became immortal time. We followed up our participants from the second year of arriving to the outcomes of interest or the end of study (December 31, 2017). Upon controlling for confounding variables, we used hazard ratios (HRs) to describe the risk of developing each disease and 95% confidence intervals (CIs) to assess whether the HRs were statistically

significant.

## Results

#### Characteristics and distribution of sociodemographic variables

For the 17-year observation period, we obtained data for 168,202 female immigrants who were eligible and included in the study. In terms of nationality of origin, the majority were from either Southeast Asia (50.84%) or Mainland China, Hong Kong, and Macau (46.68%) in similar proportions (Table 1). Approximately two-thirds (62.66%) of the women had lived in Taiwan for more than 10 years, and the largest proportion (46.83%) arrived when they were in the youngest age category (18–25 years). More than half of them lived in Northern Taiwan (51.52%). Only 1.85% of the women lived in low-income households. é lie

(Insert Table 1 about here)

## Incidence rate and age of onset of physical and mental illnesses

In the 17-year study period, the most common of the three diseases we were considering was depression: 2,829 of the immigrants developed depression (Table 2). The cumulative incidence rate was 1.68%, the average annual incidence rate was 0.11%, and the mean age of onset was  $33.40 \pm 5.43$  years. This was followed by hypertension (1,636 cases), which had a cumulative incidence rate of 0.97%, an average annual incidence rate of 0.06%, and a mean age of onset of  $36.07 \pm 5.85$  years. Finally, 1.224 of the women were diagnosed with diabetes, which had a cumulative incidence rate of 0.73%, an average annual incidence rate of 0.05%, and a mean age of onset of  $33.90 \pm$ 5.78 years.

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(Insert Table 2 about here)

### Cumulative numbers of cases vs length of residency

Figure 2 shows that the cumulative cases of hypertension, diabetes, and depression increased rapidly in the women's first five years of living in Taiwan. The rate of increase in these cases gradually declined when the women had been in the country for 5–10 years. When the length of residency exceeded 10 years, the cumulative cases of all three diseases gradually plateaued. These patterns appear to reflect the predictions of the theory of acculturation.

(Insert Figure 2 about here)

## Physical and mental disease risk in female immigrants

Controlling for nationality, age upon arrival, region of residence, and socioeconomic status, time-dependent Cox regression models revealed a pattern of increasing risk of physical and mental diseases with increasing length of residency in this group of female immigrants (Table 3). Compared to women who had lived in Taiwan for  $\leq$  5 years, the risk of developing hypertension in those who had lived there for 5–10 years was 5.8-fold higher (95% CI: 3.46–9.74), and in those with  $\geq$  10 years' residency it was 6.29-fold higher (95% CI: 4.61–8.59). Similarly, the risk of developing diabetes was 3.97-fold higher in residents of 5–10 years (95% CI: 2.54–6.21) and 9.18-fold higher in residents of  $\geq$  10 years (95% CI: 5.48–15.38) than in those of  $\leq$  5 years' residency. Finally, the risk of developing depression that was 5.01-fold higher in residents of 5–10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.65–17.18) than in those of  $\leq$  5 years' residency. These reflect the pattern of the theory of acculturation.

 (Insert Table 3 about here)

## Discussion

We used data from representative nationwide databases to explore the impact of length of residency on female immigrants' physical and mental health to validate the negative acculturation theory, which is applicable to marriage immigrants who came to their new country as individuals. Main findings of the present study were: (1) The longer the women resided in Taiwan, the higher was their risk of developing physical illness (hypertension and diabetes), and their risk of developing mental illness (depression) was even higher. This suggests that the initial healthy immigrant effect was reduced or completely abolished with increasing time of residency in Taiwan, and that the risk of developing physical and mental health problems increased with time. (2) The predictions of the negative acculturation theory applied to the development in both physical and mental health.

Length of residency in the immigration country is often used as an index of acculturation, and it is often assumed that a longer residency time equates to better acculturation and thus better health <sup>10</sup>. However, our findings suggest that this acculturation theory does not apply to or explain the physical and mental health of female immigrants in Taiwan. On the contrary, our findings support the negative acculturation theory, which predicts that with increasing residency time, new immigrants' health status declines. Similar findings have been reported in previous studies <sup>6</sup> <sup>11-13</sup>. For example, a recent study in Central Italy <sup>13</sup> showed that the risk of developing hypertension and type 2 diabetes in first-generation Chinese immigrants, especially women, who had lived in Italy for  $\geq$  20 years was double that of their  $\leq$  10 years counterparts (the odds ratios were 1.90 and 1.93, respectively). In contrast to

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previous studies, which only recruited participants regionally and had small sample sizes <sup>5</sup>, we included the entire population of Taiwan in our analysis to prevent sampling and selection bias and allow for more compelling data inference. We also included both physical and mental health indices as outcomes and used the International Classification of Disease as our standard for disease diagnosis, which provides a more multimodal and objective assessment than the diagnosis standards applied in these previous studies.

The reason for the decline in the physical health of immigrants over time is generally believed to be related to the environment of the immigration country, especially changes in lifestyle and diet. This suggests that immigrants' health status should become more consistent with that of locals with increasing residency time <sup>8</sup> <sup>14</sup> <sup>15</sup>. It has been shown in the USA that the prevalence rate of hypertension in the immigrant population increases with increasing length of residency <sup>11</sup>. Compared to local Caucasians, Southeast Asian immigrants were more likely to develop hypertension problems<sup>16</sup>. The reason for this may be insufficient intake of fresh vegetables, consuming excessive quantities of processed food, and increasing amounts of time spent sedentary <sup>17</sup>.

Life in Taiwan is fast-paced, and Taiwanese society attaches great importance to good food. The prevalence rate of hypertension and diabetes in the general population aged over 19 years is increasing annually. A large-scale survey indicated that the prevalence rate of diabetes in males increased from 3.2% in the 1990s to 12.0% in the 2000s. In females, it increased from 5.5% to 8.0%. This change is likely due to unhealthy changes in diet and lifestyle, including the increased availability and variety of sweets and sugary drinks, increased calorie intake, and long hours spent sedentary <sup>18</sup>. Our finding that diabetes and hypertension in new immigrants in Taiwan also increased with time of residency suggests that the immigrants are adapting to the diet and lifestyle in Taiwan, thereby increasing their risk of diabetes and hypertension.

It is noteworthy that the risk of depression also increased significantly with increasing length of residency. This implies that negative acculturation exerts a stronger impact on mental health. A nationwide survey <sup>19</sup> showed that the prevalence rate of depression requiring treatment in hospitals and clinics in females in Taiwan rose from 2.02% in 2007 to 2.42% in 2016, which was a 20% increase in 10 years. Our findings are consistent with this study and indicate that female immigrants encounter similar levels of stress to local Taiwanese women. Further, female immigrants are subject to stigmatization and discrimination <sup>1</sup> because they have come to the country as part of the system of commodified marriage <sup>20</sup>. More importantly, a lack of emotional support in such marriages and the patriarchal culture of traditional Chinese society makes acculturation more challenging <sup>5</sup>. The continuous challenges of adapting can result in mental health problems.

In conclusion, we found that the acculturation process of female marriage immigrants affected their physical and mental health negatively and that their health deteriorated with increasing time of residency in Taiwan. A longer period of residency does not equate to better acculturation, but may instead become a risk factor for their physical and mental health. Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies

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**Contributors:** PCL generated the concept of this research paper, wrote the research proposal, analysed the data, was involved in the presentation and interpretation process of results and discussions., YLC was involved in data analysis, participated in the presentation and interpretation process of results and discussions, and reviewed the draft manuscript. HJY participated in the concept generation and presentation and interpretation of results and discussions, and reviewed and finalised the manuscript, and is the corresponding author. All the authors read and approved the final manuscript.

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Competing interests: None declared.

**Data sharing statement:** The data that support the findings of this study are available from Ministry of Health and Welfare, Taiwan, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.



Figure 1. The sampling process of this study

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Figure 2. Cumulative cases of hypertension, diabetes, and depression among female immigrants by the length of residency

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Nationality of origin		
Mainland China, Hong Kong, Macau	78,523	46
Southeast Asia	85,515	50
Others	4,164	2
Length of residency		
$\leq$ 5 years	16,243	ç
5–10 years	46,561	27
$\geq$ 10 years	105,398	62
Age upon arrival		
18–25 years	78,763	46
26–30 years	57,067	33
31–35 years	25,267	15
$\geq$ 35 years	7,105	Ζ
<b>Region of residence in Taiwan</b>		
Northern	87,167	51
Central	35,414	21
Southern	41,392	24
Eastern	3,103	1
Outlying islands	1,126	(
Low-income household		
Yes	3,113	1
No	165,089	98

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Table 2.	Incidence	rate and	age of	onset	of physical	and	mental	illnesses	in	female
immigra	nts									

	Number	Cumulative	Annual average	A go of ongot
	of cases	incidence rate	incidence rate	Age of onset
Physical illness				
Hypertension	1,636	0.97%	0.06%	$36.07 \pm 5.85$
Diabetes	1,224	0.73%	0.05%	$33.90 \pm 5.78$
Mental illness				
Depression	2,829	1.68%	0.11%	$33.40 \pm 5.43$

duration of reside	ency		
Length of	Hypertension	Diabetes	Depression
residency	aHR (CI)	aHR (CI)	aHR (CI)
< 5 years	Reference	Reference	Reference
5–10 years	5.80 (3.46–9.74)	3.97 (2.54-6.21)	5.01 (3.14-8.01)
$\geq 10$ years	6.29 (4.61-8.59)	9.18 (5.48–15.38)	12.19 (8.65–17.18)
Note: All models	adjusted for nationality	v of origin, age upon ar	rival, region of

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Table 3 Changes in hazard ratios for physical and mental illnesses with increasing (

residence, and socioeconomic status.

aHR, adjusted hazard ratio; CI, confidence interval

## STROBE Statement—Checklist of items that should be included in reports of cohort studies

	Item No	Recommendation	Page No
Title and abstract	1	( <i>a</i> ) Indicate the study's design with a commonly used term in the title or the	2
		abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was	
		done and what was found	
Introduction			4
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of	5
C		recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of	5-6
1		participants. Describe methods of follow-up	
		(b) For matched studies, give matching criteria and number of exposed and	
		unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and	6-7
		effect modifiers. Give diagnostic criteria, if applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	6-7
measurement	-	assessment (measurement). Describe comparability of assessment methods if	
		there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,	7-8
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for	7-8
		confounding	
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable explain how loss to follow-up was addressed	
		(e) Describe any sensitivity analyses	
Dogulto			
Results Dortioinanta	12*	(a) Papart numbers of individuals at each stage of study – as numbers notantially	5-6
1 articipalits	13.	a) report numbers of multiduals at each stage of study—eg numbers potentially aligible, avamined for aligibility, confirmed aligible, included in the study	
		completing follow up and analysed	
		(b) Give reasons for non-participation at each stage	5
		(a) Consider use of a flow diagram	17
Description 1-1-	144	(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social)	
		and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8
		(c) Summarise tollow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	0

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Main results	16	( <i>a</i> ) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	3
		Discuss both direction and magnitude of any potential bias	1.0
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,	12
		multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other informati	on		
Funding	22	Give the source of funding and the role of the funders for the present study and, if	15
		applicable, for the original study on which the present article is based	

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

## **BMJ Open**

# Effects of length of residency on the development of physical and mental illnesses in immigrant women in Taiwan: a retrospective cohort study using nationwide data

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## Effects of length of residency on the development of physical and mental illnesses in immigrant women in Taiwan: a retrospective cohort study using nationwide data

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## Abstract

**Objectives:** The majority of female immigrants who are married in Taiwan often face a variety of stresses, which may lead to physical or mental illness. Yet few studies have validated the impact of length of residency on physical and mental health using large-scale data. This study combined five nationwide databases and explored the impact of length of residency in Taiwan on the physical and mental health of female marriage immigrants.

**Design:** This is a retrospective cohort study.

Setting: Taiwan.

**Participants:** A total of 168,202 female immigrants, who were registered in the national health insurance database from 2001 to 2017, were enrolled for analysis. **Measure:** The length of residency was taken as the period from their first appearance in the national health insurance database to the end of 2017. Hypertension and diabetes were chosen as indices of physical health and depression as an index of mental health. Diagnosis standards were based on the International Classification of Disease, 9th or 10th Revision.

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**Results:** The physical and mental health of the immigrants deteriorated with increasing time of residence in Taiwan. Immigrants who had resided in Taiwan for 5–10 years or  $\geq 10$  years respectively had a 5.8-fold (95% confidence interval [CI]: 3.46–9.74) or 6.29-fold (95% CI: 4.61–8.59) higher adjusted risk of developing hypertension; a 3.97-fold (95% CI: 2.54–6.21) or 9.18-fold (95% CI: 5.48–15.38) higher adjusted risk of developing diabetes; and a 5.01-fold (95% CI: 3.14–8.01) or 12.19-fold (95% CI: 8.65–17.18) higher adjusted risk of developing depression than their counterparts who had lived in Taiwan for  $\leq 5$  years.

Conclusion: These findings suggest the time elapsed since migration can be a factor

in the deterioration of both physical and mental health among female marriage immigrants in Taiwan.

**Keywords:** new immigrants, immigration, acculturation, hypertension, diabetes, depression

## Strengths and limitations of this study

- This study included the entire population of Taiwan in the analyses to prevent sampling and selection bias.
- Through the retrospective cohort design, the causal relationships among the variables in this study become clearer.
- Since length of residency correlates with age, the impact of residency duration on physical and mental illnesses observed in this 17-year longitudinal study could be influenced by the confounding factor of aging.
- A part of immigrant women may be lost to follow-up due to maladjustment or health issues, which results in underestimating of the hazard ratios.

## Background

The population of new immigrants in Taiwan comprises mostly women (90%) who come to the country through marriage and as individuals [1]. This differs from the predominant pattern of family immigration that is seen in many other countries around the world [2]. Knowledge concerning the physical and psychological development of marriage immigrants overcoming multiple acculturation challenges is still limited.

In general, immigrants are a strongly selected population: their average physical condition tends to be better than that of the citizens of the host country. The "healthy immigrant effect" theory pertains not only to physical aspects [3], but can also be extended to the psychological aspects of the female immigrants of Taiwan [4]. However, adaptation is a process that changes over time. For example, Berry [5] proposed four distinct patterns of acculturation in terms of separation, integration, assimilation and marginalization or individualism, which can change over time from one pattern to another. Ward and Geeraert [6] further emphasized that cultural adaptation is not only a dynamic process but also highlighted that both acculturative stress and acculturative change occur within an ecological context. Therefore, the trajectories and outcomes of the adaptation process need to be understood through different levels of factors. Additionally, immigrants often encounter multiple and long-term stressors in their new environment. Taking a stress perspective, Cervantes and Castro [7] explained how Mexican American immigrants evaluate potential sources of stress and regulate the impact of these stressors on their physical and mental health through a "multivariate stress-mediation-outcome model." Subsequently, Castro and Murray [8], based on resilience theory and research, proposed a "resilience-based stress-appraisal-coping model" that conceptualizes coping and cultural adjustment as processes within a longterm, time-oriented, and developmental framework. The process of cultural adaptation is further defined as a resilience trajectory, which represents the path of development

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 over time for immigrants in the host society. These perspectives suggest that a longterm observation from a process-oriented perspective is necessary when exploring immigrant health issues.

A study conducted in Central Taiwan showed that in female immigrants, with increasing time of residence in the host country, symptoms of depression increased significantly [9]. A study conducted in the USA indicated that with increasing time of residence in the host country, immigrants' depression and mental disturbance became worse than those of local Americans [10]. With respect to cardiovascular health, the advantage conferred by the healthy immigrant effect appears to be short-lived [11]. All these results indicate that the longer immigrants stay in the host country, the worse their physical and mental well-being becomes [12, 13]. However, the sample sizes were small and the studies were conducted in specific regions. This calls the representativeness of the data into question. Additionally, the paucity of studies on health issues related to immigration hinders our understanding of the full impact of acculturation.

To overcome this problem, using representative nationwide data, we explored the impact of acculturation (using time spent living in Taiwan as an index) on female immigrants' health development. A useful health index should include both mental-health conditions, such as depression, and common physical illnesses, such as hypertension and diabetes. Using the 17-year retrospective follow-up study, we sought to examine whether immigrant women who were in good health when they first arrived in Taiwan see their physical and mental health deteriorate during the years of residence.

## Methods

## Research design and data selection

We adopted a retrospective cohort study design. Using five databases, we extracted

eligible participants and their corresponding variables. First, we selected non-Taiwanese mothers documented in the "Birth Reporting Database", which was maintained by the Ministry of Interior in Taiwan, from 2001 to 2016 and eliminated duplicate data for mothers who had given birth more than once. This resulted in 184,833 female immigrants. Next, we matched the mothers' ID with the 2001–2017 data in the "Registry of Beneficiaries", which was maintained by the Ministry of Health and Welfare in Taiwan, and used the first date on which each woman had appeared in the database as the starting point of her residency in Taiwan. The end of the study was the end of 2017. Immigrants without health insurance or who had held their insurance for less than one year, or who did not have a birth date in the database, were excluded. This process yielded 169,519 female immigrants with health insurance. Disease data for the observation period was obtained from the "Ambulatory Care Expenditure by Visits" and the "Inpatient Expenditure by Admissions" databases, which was maintained by the Ministry of Health and Welfare in Taiwan. We selected hypertension, diabetes, and depression as the outcomes of this study. All diseases were diagnosed according to the diagnosis standard in the International Classification of Diseases, 9th or 10th Revision, and were only regarded as a confirmed diagnosis when there were at least three outpatient visits or one inpatient admission. Further, to prevent reverse causality (i.e., when the woman may have already had the disease in her country of origin), we excluded all women who were diagnosed within one year of arriving in Taiwan. The final number of participants was 168,202 (Figure 1). This study was approved by the Research Ethics Committee of the China Medical University & Hospital (approval number: CMUH108-REC1-142), and informed consent is not required as this study used existing data of the NHIRD in Taiwan which are de-identified.

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(Insert Figure 1 about here)

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## Patient and Public Involvement

Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this study.

## **Research variables**

#### Dependent variable

The dependent variables of this study were the diagnoses of hypertension, diabetes, and depression. We aimed to explore the impact of the process of acculturation on disease. To avoid any possible interference from hereditary or genetic disorders, we excluded diseases that are mainly caused by hereditary or genetic factors. We therefore included the following hypertension-related diseases (ICD-9 codes 402-405 and ICD-10 codes 111-I15): hypertensive heart disease, hypertensive chronic kidney disease, hypertensive heart and chronic kidney disease, and secondary hypertension. We included the following diabetes diagnoses (ICD-9 code 250 and ICD-10 codes E11-E14): non-insulin-dependent diabetes mellitus, malnutrition-related diabetes mellitus, other specified diabetes mellitus, and unspecified diabetes mellitus. Finally, we included the following depression diagnoses (ICD-9 codes 296.2 296.3 300.4 and ICD-10 codes F32-F34): depressive episode, recurrent depressive disorder, and persistent depressive disorder.

## Independent variable

As the independent variable, we used length of residency (in years) in Taiwan as an index of acculturation. This was defined as 2017 (the endpoint of the study period) minus the year that the woman was first documented in the Registry of Beneficiaries, rounded off to the nearest integer. To prevent prevalent cases, women who were diagnosed with the disease within their first year of arriving were excluded. When

estimating the risk of disease, the length of residency was divided to three categories:  $\leq$  5 years, 5–10 years, and  $\geq$  10 years.

## Sociodemographic variables

To prevent confounding, we adjusted for sociodemographic variables using regression analysis. These variables included (1) nationality of origin; (2) age upon arrival (defined as the first year of registration in the insurance database minus the year of birth, rounded off to the nearest integer; for convenience, based on analysis, this was categorized into 18–25 years, 26–30 years, 31–35 years, and  $\geq$  35 years); (3) region of residence (northern, central, southern, eastern, and outlying islands); and (4) socioeconomic status (obtained from the "Low-income and Middle-income Households", which was maintained by the Ministry of Health and Welfare in Taiwan, database and categorized into high [upper-middle-income households] and low [lower-middle- and low-income households]). ere

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## Statistical analysis

Data were analyzed using the SAS 9.4 software (SAS Institute, Cary, NC, USA). The observed variables were summarized using frequency, percentage, mean, standard deviation, and their distributions. We used time-dependent Cox regression analysis to estimate the risk of developing hypertension, diabetes, and depression during the follow-up period. Because we used the incidence cases, the first year became immortal time. We followed up our participants from the second year of arriving to the outcomes of interest or the end of study (December 31, 2017). Upon controlling for confounding variables, we used hazard ratios (HRs) to describe the risk of developing each disease and 95% confidence intervals (CIs) to assess whether the HRs were statistically significant.

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## Results

#### Characteristics and distribution of sociodemographic variables

For the 17-year observation period, we obtained data for 168,202 female immigrants who were eligible and included in the study. In terms of nationality of origin, the majority were from either Southeast Asia (50.84%) or Mainland China, Hong Kong, and Macau (46.68%) in similar proportions (Table 1). Approximately two-thirds (62.66%) of the women had lived in Taiwan for more than 10 years, and the largest proportion (46.83%) arrived when they were in the youngest age category (18–25 years). More than half of them lived in Northern Taiwan (51.52%). Only 1.85% of the women lived in low-income households.

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(Insert Table 1 about here)

## Incidence rate and age of onset of physical and mental illnesses

In the 17-year study period, the most common of the three diseases we were considering was depression: 2,829 of the immigrants developed depression (Table 2). The cumulative incidence rate was 1.68%, the average annual incidence rate was 0.11%, and the mean age of onset was  $33.40 \pm 5.43$  years. This was followed by hypertension (1,636 cases), which had a cumulative incidence rate of 0.97%, an average annual incidence rate of 0.06%, and a mean age of onset of  $36.07 \pm 5.85$  years. Finally, 1,224 of the women were diagnosed with diabetes, which had a cumulative incidence rate of 0.73%, an average annual incidence rate of 0.05%, and a mean age of onset of  $33.90 \pm 5.78$  years.

 (Insert Table 2 about here)

### Cumulative numbers of cases vs length of residency

Figure 2 shows that the cumulative cases of hypertension, diabetes, and depression increased rapidly in the women's first five years of living in Taiwan. The rate of increase in these cases gradually declined when the women had been in the country for 5–10 years. When the length of residency exceeded 10 years, the cumulative cases of all three diseases gradually plateaued. These patterns appear to reflect the predictions of the theory of acculturation.

(Insert Figure 2 about here)

## Physical and mental disease risk in female immigrants

Controlling for nationality, age upon arrival, region of residence, and socioeconomic status, time-dependent Cox regression models revealed a pattern of increasing risk of physical and mental diseases with increasing length of residency in this group of female immigrants (Table 3). Compared to women who had lived in Taiwan for  $\leq$  5 years, the risk of developing hypertension in those who had lived there for 5–10 years was 5.8-fold higher (95% CI: 3.46–9.74), and in those with  $\geq$  10 years' residency it was 6.29-fold higher (95% CI: 4.61–8.59). Similarly, the risk of developing diabetes was 3.97-fold higher in residents of 5–10 years (95% CI: 2.54–6.21) and 9.18-fold higher in residents of 5–10 years (95% CI: 5.48–15.38) than in those of  $\leq$  5 years' residency. Finally, the risk of developing depression that was 5.01-fold higher in residents of 5–10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher in residents of  $\geq$  10 years (95% CI: 3.14–8.01) and 12.19-fold higher

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immigrants in Taiwan.

(Insert Table 3 about here)

## Discussion

We used data from representative nationwide databases to explore the impact of length of residency on female immigrants' physical and mental health to validate the negative acculturation theory, which is applicable to marriage immigrants who came to their new country as individuals. Main findings of the present study were: (1) The longer the women resided in Taiwan, the higher was their risk of developing physical illness (hypertension and diabetes), and their risk of developing mental illness (depression) was even higher. This suggests that the initial healthy immigrant effect was reduced or completely abolished with increasing time of residency in Taiwan, and that the risk of developing physical and mental health problems increased with time. (2) Acculturation is not a linear process that goes from the time of arrival to that of integration or assimilation. In addition, it is a process of adaptation which can change over time that must be understood as a set of strategies deployed by immigrants to adapt to a new environment.

Although length of residency in the immigration country is often used as an index of acculturation, our findings suggest that with increasing residency time, new immigrants' health status declines. Similar findings have been reported in previous studies [10, 14-16]. For example, a recent study in Central Italy [16] showed that the risk of developing hypertension and type 2 diabetes in first-generation Chinese immigrants, especially women, who had lived in Italy for  $\geq 20$  years was double that of their  $\leq 10$  years counterparts (the odds ratios were 1.90 and 1.93, respectively). In contrast to previous studies, which only recruited participants regionally and had small sample sizes [9], we included the entire population of Taiwan in our analysis to prevent sampling and selection bias and allow for more compelling data inference. We also 

included both physical and mental health indices as outcomes and used the International Classification of Disease as our standard for disease diagnosis, which provides a more multimodal and objective assessment than the diagnosis standards applied in these previous studies.

The reason for the decline in the physical health of immigrants over time is generally believed to be related to the environment of the immigration country, especially changes in lifestyle and diet. This suggests that immigrants' health status should become more consistent with that of locals with increasing residency time [12, 17-18]. It has been shown in the USA that the prevalence rate of hypertension in the immigrant population increases with increasing length of residency [14]. Compared to local Caucasians, Southeast Asian immigrants were more likely to develop hypertension problems [19]. The reason for this may be insufficient intake of fresh vegetables, consuming excessive quantities of processed food, and increasing amounts of time spent sedentary [20].

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Life in Taiwan is fast-paced, and Taiwanese society attaches great importance to gourmet food which often contains high levels of sugar, fat, and salt. The prevalence rate of hypertension and diabetes in the general population aged over 19 years is increasing annually. A large-scale survey indicated that the prevalence rate of diabetes in males increased from 3.2% in the 1990s to 12.0% in the 2000s. In females, it increased from 5.5% to 8.0%. This change is likely due to unhealthy changes in diet and lifestyle, including the increased availability and variety of sweets and sugary drinks, increased calorie intake, and long hours spent sedentary [21]. Our finding that diabetes and hypertension in new immigrants in Taiwan also increased with time of residency suggests that the immigrants are adapting to the diet and lifestyle in Taiwan, thereby increasing their risk of diabetes and hypertension.

Apart from lifestyle and diet, the process of immigration and subsequent 12

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adaptation contribute to increasing risk factors for hypertension and diabetes. Recent research [22] has compiled study results of migrants in Europe and North America, revealing that acculturation, psychological stress, and various environmental factors contribute to the development of cardiovascular and metabolic conditions. This indicates that the experience of being an immigrant, along with associated stresses, could be significant contributing factors to diabetes and hypertension.

It is noteworthy that the risk of depression also increased significantly with increasing length of residency. This implies that negative acculturation exerts a stronger impact on mental health. A nationwide survey [23] showed that the prevalence rate of depression requiring treatment in hospitals and clinics in females in Taiwan rose from 2.02% in 2007 to 2.42% in 2016, which was a 20% increase in 10 years. Our findings are consistent with this study and indicate that female immigrants encounter similar levels of stress to local Taiwanese women. Further, female immigrants are subject to stigmatization and discrimination [1] because they have come to the country as part of the system of commodified marriage [24]. More importantly, a lack of emotional support in such marriages and the patriarchal culture of traditional Chinese society makes acculturation more challenging [9]. The continuous challenges of adapting can result in mental health problems.

Female immigrants in Taiwan through marriage are a highly selective group with considerable physical and mental resilience [4]. The "healthy immigrant theory" refers to their physical and mental state upon first arriving and it does not presuppose that immigrants will remain so for the rest of their lives. It is conceivable that there is a process whereby, for some, this state of health deteriorates from the very first years to reach the national average, and that changes in lifestyle habits are significantly involved.

There are some limitations to the current study, which may reduce the generalizability of the findings. First, since length of residency correlates with age, the

impact of residency duration on physical and mental illnesses observed in this 17-year longitudinal study could be influenced by the confounding factor of aging. Although age upon arrival is controlled for in the Cox proportional hazards model, it is still challenging to avoid the impact of aging on physical and mental health during longterm follow-up of participants. Second, a part of immigrant women may be lost to follow-up due to maladjustment or health issues, which results in underestimating of the hazard ratios. Nevertheless, since this study analyzed national data, the number of people lost to follow-up was relatively small, so the extent of the impact should be minimal.

In conclusion, we found that among the female marriage immigrants who account for 90% of immigrants in Taiwan, the time elapsed since migration can be a factor in the deterioration of their physical and mental health. Findings of this study suggest that providing health-promoting information and programs during the early stages of immigration, along with continuous screening in later periods, is of significant importance for the physical and mental health of immigrant populations. Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies

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**Contributors:** PCL generated the concept of this research paper, wrote the research proposal, analysed the data, was involved in the presentation and interpretation process of results and discussions., YLC was involved in data analysis, participated in the presentation and interpretation process of results and discussions, and reviewed the draft manuscript. HJY participated in the concept generation and presentation and interpretation of results and discussions, and reviewed and finalised the manuscript, and is the corresponding author. All the authors read and approved the final manuscript.

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Competing interests: None declared.

**Patient and public involvement:** Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this study.

**Data sharing statement:** The data that support the findings of this study are available from Ministry of Health and Welfare, Taiwan, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

	n	
Nationality of origin		
Mainland China, Hong Kong, Macau	78,523	
Southeast Asia	85,515	:
Others	4,164	
Length of residency		
$\leq$ 5 years	16,243	
5–10 years	46,561	
$\geq$ 10 years	105,398	
Age upon arrival		
18–25 years	78,763	
26–30 years	57,067	
31–35 years	25,267	
$\geq$ 35 years	7,105	
<b>Region of residence in Taiwan</b>		
Northern	87,167	:
Central	35,414	
Southern	41,392	
Eastern	3,103	
Outlying islands	1,126	
Low-income household		
Yes	3,113	
No	165,089	

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Table 2.	Incidence	rate and	age of	onset	of physical	and	mental	illnesses	in	female
immigra	nts									

of cases         incidence rate         incidence rate           Physical illness         1,636         0.97%         0.06%         36.07 ± 5.85           Diabetes         1,224         0.73%         0.05%         33.90 ± 5.78           Mental illness	Age of cases         incidence rate         incidence rate           Physical illness         1,636         0.97%         0.06%         36.07 ± 5.85           Diabetes         1,224         0.73%         0.05%         33.90 ± 5.78           Mental illness		Number	Cumulative	Annual average	Ago of open
Physical illness         Hypertension       1,636       0.97%       0.06%       36.07 ± 5.85         Diabetes       1,224       0.73%       0.05%       33.90 ± 5.78         Mental illness	Physical illness           Hypertension         1,636         0.97%         0.06%         36.07 ± 5.85           Diabetes         1,224         0.73%         0.05%         33.90 ± 5.78           Mental illness         Depression         2,829         1.68%         0.11%         33.40 ± 5.43		of cases	incidence rate	incidence rate	
Hypertension       1,636 $0.97\%$ $0.06\%$ $36.07 \pm 5.85$ Diabetes       1,224 $0.73\%$ $0.05\%$ $33.90 \pm 5.78$ Mental illness $0.11\%$ $33.40 \pm 5.43$	Hypertension         1,636         0.97%         0.06%         36.07 ± 5.85           Diabetes         1,224         0.73%         0.05%         33.90 ± 5.78           Mental illness	Physical illness				
Diabetes       1,224       0.73%       0.05%       33.90 ± 5.78         Mental illness       Depression       2,829       1.68%       0.11%       33.40 ± 5.43	Diabetes       1,224       0.73%       0.05%       33.90 ± 5.78         Mental illness	Hypertension	1,636	0.97%	0.06%	$36.07 \pm 5.85$
Mental illness Depression 2,829 1.68% 0.11% 33.40 ± 5.43	Mental illness         0.11%         33.40 ± 5.43	Diabetes	1,224	0.73%	0.05%	$33.90 \pm 5.78$
Depression 2,829 1.68% 0.11% 33.40 ± 5.43	Depression 2,829 1.68% 0.11% 33.40±5.43	Mental illness				
	Peer terier only	Depression	2,829	1.68%	0.11%	$33.40\pm5.43$

duration of reside	ency		
Length of	Hypertension	Diabetes	Depression
residency	aHR (CI)	aHR (CI)	aHR (CI)
< 5 years	Reference	Reference	Reference
5–10 years	5.80 (3.46–9.74)	3.97 (2.54-6.21)	5.01 (3.14-8.01)
$\geq$ 10 years	6.29 (4.61-8.59)	9.18 (5.48–15.38)	12.19 (8.65–17.18)
Note: All models	adjusted for nationality	v of origin age upon ar	rival ragion of

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Table 3 Changes in hazard ratios for physical and mental illnesses with increasing

Note: All models adjusted for nationality of origin, age upon arrival, region of

residence, and socioeconomic status.

aHR, adjusted hazard ratio; CI, confidence interval 

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Figure legend:

Figure 1. The sampling process of this study

Figure 2. Cumulative cases of hypertension, diabetes, and depression among female immigrants by the length of residency

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## STROBE Statement—Checklist of items that should be included in reports of cohort studies

	Item No	Recommendation	Page No
Title and abstract	1	( <i>a</i> ) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was	2
		done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of	5
		recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of	5-6
		participants. Describe methods of follow-up	
		(b) For matched studies, give matching criteria and number of exposed and	
		unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and	6-7
		effect modifiers. Give diagnostic criteria, if applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	6-7
measurement		assessment (measurement). Describe comparability of assessment methods if	
		there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,	7-8
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for	7-8
		confounding	
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, explain how loss to follow-up was addressed	
		( <u>e</u> ) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially	5-6
		eligible, examined for eligibility, confirmed eligible, included in the study,	
		completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	17
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social)	8
		and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	8
		(c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	8

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Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their	9
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for	
		and why they were included	
		(b) Report category boundaries when continuous variables were categorized	9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a	9
		meaningful time period	
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity	
		analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	3
		Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,	12
		multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other informati	on		
Funding	22	Give the source of funding and the role of the funders for the present study and, if	15
		applicable, for the original study on which the present article is based	

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.