The Associations Between Mental Disorders and Cascade of Care in Managing Hypertension, Diabetes, Dyslipidemia, Chronic Kidney Disease in China: A Pooled Cross-Sectional Analysis

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Abstract

Physical non-communicable diseases (NCDs) and mental disorder are a rapidly increasing health burden in low-and middle-income countries. This study aims to examine the relationships between mental disorder and cascade of care in managing four common physical NCDs (hypertension, diabetes, dyslipidemia, chronic kidney disease) in China. We utilized two waves of nationally-representative China Health and Retirement Longitudinal Study (CHARLS 2011, 2015) of older adult population aged 45 and above. A series of multivariate mixed-effect logistic regression was applied to evaluate the association between presence of mental disorder and physical chronic disease awareness, treatment, and control. We found that the odds of dyslipidemia (AOR=2.88, 95% CI=2.21-3.74) and kidney disease awareness (AOR=4.14, 95% CI=2.95-5.81) were higher for individuals with mental chronic conditions, compared to those without mental chronic conditions. The odds of having hypertension treatment was higher for subjects with mental disorder, compared to those without (AOR=1.57, 95% CI=1.23-2.01). The odds of having physical chronic conditions controlled was not significantly associated with having mental chronic conditions. These results indicated that adults with mental disorder have a greater likelihood of awareness of having dyslipidemia and kidney disease, and receiving treatment for hypertension. Strategies to address growing burden of physical-mental NCDs in China should include efforts to improve management of patients with comorbid health condition and improve access to continual high-quality treatment after the first diagnosis.

Introduction

The co-occurrence of physical and mental non-communicable diseases (NCDs) is increasing rapidly in low-and middle-income countries[1]. China, the most populous country and the second-largest economy in the world, has seen rapid demographic and epidemiological transition over the last few decades. By 2050, the projected proportion of the older population, aged 60 years and over, will dramatically increase to 35.1% from 16.2% in 2017.[2] Findings from the China Mental Health Survey suggested that the prevalence of mental disorders was 9.3% in 2013 among Chinese adults, and most mental disorders have become more common over the last 30 years[3]. The rising prevalence of physical and mental chronic conditions is expected to post significant challenges to the health system in China.

The potential impact of mental disorder on the cascade of care in managing physical NCDS is an emerging area of research interest. The UK National Institute from Health and Care Excellence (NICE) guidelines on multimorbidity have emphasized the challenge of poor management of chronic conditions in adults, which could subsequently be associated with higher treatment burden and poorer QoL.[4,5] The literature on the impact of having multimorbidity on the management and control of each of the chronic conditions is scarce, with current studies largely from HICs that use qualitative methods.[6–10] There is also some quantitative research in the literature that have investigated how having more comorbid NCDs influences management and control of specific conditions, primarily hypertension.[11,12] Furthermore, a limited number of studies, mostly from HICs as well, have focused on the differential impact of

concordant versus discordant conditions on the quality of chronic disease management.[5,13–17] While it may be hypothesised that concordant conditions would facilitate the management of a NCD due to the similar pathophysiology and treatment regiments, and discordant NCDs would have opposite effects, existing studies demonstrate inconsistencies on how concordant and discordant NCDs influence the management of chronic diseases.[5,14,17]

To illustrate, a retrospective cohort study in the United States on hypertensive primary care patients examined the impact of concordant versus discordant NCDs of hypertension, on hyperlipidemia management.[13] This study showed that additional discordant conditions were associated with lower odds of hyperlipidemia management compared with no discordant NCDs, and additional concordant conditions were associated with increased odds of hyperlipidemia management.[13] Another study analysed 15,000 patients from primary care practices in the United States who have multimorbidity and uncontrolled hypertension, and found that patients with more discordant NCDs to hypertension (28 conditions including arthritis and emphysema) were less likely to have their uncontrolled hypertension solved, compared to those with concordant conditions.[15] Our recent paper which also analysed WHO SAGE found that having more NCDs was associated with better odds of diagnosis but not better management and control of co-occurring NCDs.[18]Importantly, generating more research from MICs is crucial as the findings from HICs may not able applicable, due to different health systems and access to healthcare for diagnostic testing and treatment.[6,10,14,19] In addition, impact of a broader range of NCDs needs to be investigated.[5,11,12,14,16,17]

This study examines individuals in China with multimorbidity that consists of both physical and mental health chronic conditions. Specifically, we investigate how having mental health conditions is associated with cascade of care in managing four common physical NCDs (e.g. hypertension, diabetes, dyslipidemia, chronic kidney disease) of the elder adult population in China.

Methods

Participants and sample

This study is analysed pooled cross-sectional data of the first wave (2011) and third wave (2015) of China Health and Retirement Longitudinal Study (CHARLS). We have registered in CHARLS website and get the permission from Peking University of using this dataset. All participants of CHARLS have signed consent forms before face-to-face interview and all kinds of personal information, like ID, address, are coded as a string of numbers.

The CHARLS consists of nationally representative participants aged 45 or older from 450 randomly selected communities/villages in 28 provinces of China[20]. It collects information on demographics, family, health status and functioning, health care and insurance, income, work, and housing. Respondents of CHARLS are followed up every two years via face-to-face computer-assisted personal

interview (CAPI)[20]. Biomarkers for chronic diseases were used in each wave, while blood tests were conducted every two waves[21]. Additional information about CHARLS are available on http://charls.ccer.edu.cn/“http://charls.ccer.edu.cn/.

17,708 subjects participated the first wave (2011) and 20,967 participated the third wave (2015). For those participants, 14,574 participated both the first and third wave (2015). After excluding subjects with missing data on demographic characteristics, health status and functioning, insurance, biomarker and blood test result, the final sample size in our study is 17,141, which include 8,189 observations in the first wave and 8,952 observations in the third wave.

Variables

Chronic conditions

CHARLS collected information on 14 NCDs, including hypertension, dyslipidemia, diabetes, chronic lung disease (CLD), liver disease, heart disease, stroke, kidney disease, stomach disease, emotional problem, memory problem, arthritis and asthma.

Four of the 14 NCDs, hypertension, diabetes, dyslipidemia and kidney disease were assessed via biomarkers result or blood tests. Hence this study only included these 4 NCDs to examine the outcomes on awareness, treatment, and control.

For hypertension, subjects were aware of the chronic condition if they answered affirmatively to “have you been diagnosed with hypertension by a doctor?” or “do you know if you have hypertension?”,

For diabetes, dyslipidemia, and kidney disease, subjects were aware of the chronic condition if they answered affirmatively to “have you been diagnosed with [chronic condition] by a doctor?”

Respondents self-reported treatment if they answered affirmatively to “are you now taking any of the following treatment to treat […] or its complication?”.

Predictor variables

The predictor variable in this study is having a mental disorder. Having mental disorder was defined as the existence of any one of those following conditions (1) answer affirmatively to “have you been diagnosed with emotional, nervous, or psychiatric problem by a doctor?” (2) answered affirmatively to “have you been diagnosed with memory-related disease by a doctor?” (3) 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10) higher than 12[22]. This study only included respondents answered at least 9 items on CES-D-10, and used the average of the remaining 9 items to impute the missing item.

Outcome variables

Awareness

Having awareness of the chronic condition is defined as being diagnosed by doctors or being self-aware of their chronic conditions. For hypertension, blood pressure was measured three times for each participant and this study only included participants with at least two results on systolic blood pressure and diastolic blood pressure to minimize measurement error. This study revised WHO definition for hypertension to meet the questionnaire design[23]. Participants with hypertension are defined as the existence of one the following conditions: (1) average systolic blood pressure ≥ 140 mmHg; (2) average diastolic blood pressure ≥ 90 mmHg; (3) self-report hypertension diagnosed by a doctor or self-report aware of hypertension. Hypertension awareness is defined as respondents with hypertension and their hypertension is diagnosed by doctors or they aware their hypertension condition. Diabetes is defined as: (1) fasting blood glucose ≥ 126 mg/dl; (2) non-fasting blood glucose ≥ 200 mg/dl; (3) HbA1c concentration ≥ 6.5%; (4) self-report diabetes diagnosed by a doctor[24]. Dyslipidemia is defined as: (1) triglyceride ≥ 200 mg/ml; (2) HDL (high density lipoprotein cholesterol) < 40 mg/dl; (3) LDL (low density lipoprotein cholesterol) ≥ 160 mg/dl; (4) TC (total cholesterol) ≥ 240 mg/dl; (5) self-report dyslipidemia diagnosed by a doctor[25]. Kidney disease is defined as: (1) GFR (Glomerular Filtration Rate) < 90 ml/min/1.72 m^2; (2) with self-report kidney disease diagnosed by a doctor. GFR is calculated by using Levey's method[26]. Diabetes, dyslipidemia, kidney disease awareness was defined as respondents with diabetes, dyslipidemia, or kidney disease and these conditions are diagnosed by doctors.

Treatment

Being treated for a NCD is defined as respondents with self-report chronic conditions diagnosed by a doctor or aware of their chronic condition and take at least one treatment for this chronic condition. For hypertension, respondents answer affirmatively to "taking Chinese traditional medicine" or "taking western modern medicine" to the question "Are you taking any of the following treatments to treat hypertension or its complication?" are considered to be with hypertension treated. For diabetes and kidney disease, respondents choose any one of the following choices "taking Chinese traditional medicine", "taking western modern medicine" or "other treatments" to question "are you taking any of the following treatment to treat (…) or its complications?" are considered to be with hypertension/kidney disease treatment. For diabetes, respondents choose any one of those choices "taking Chinese traditional medicine" "taking western modern medicine" or "taking insulin injections" to the question "are you taking any of the following treatments to treat or control your diabetes" are considered to be with diabetes treated.

Controlled

Being controlled for a NCD is defined as respondents with self-report chronic condition, with self-report treatment and with normal biomarker or blood test result. The clinical criteria for hypertension, dyslipidemia, diabetes, and kidney disease are mentioned in the part of awareness.

Covariates

Covariates are age (45–54, 55–64, 65–74, 75+), sex (male, female), marital status (married, single), education level (primary school or below, middle or high school, college or above), consumption quantile,

residence type (rural, urban, migrates), health insurance status (no insurance, UEMI (urban employee medical insurance), URMI (urban resident health insurance), NCMI (new cooperative medical insurance), others), region (eastern, central, western, and north-east), number of outpatient visits, and number of physical chronic conditions (0, 1, 2, 3 ,4+)

Statistical analysis

Demographic characteristics of participants for year 2011 and 2015 were calculated separately. The demographic characteristics of participants with hypertension, diabetes, dyslipidemia, and or kidney disease were calculated separately for subjects with mental disorder and without mental disorder.

We estimated the prevalence of NCD awareness, treatment, and control for subjects with and without mental problem separately. Pearson chi-square test was used to test the significance in the difference between subjects with mental health disorder and those without mental health disorder for their awareness, treatment, and control of physical chronic conditions.

A serious of unadjusted and adjusted mixed-effects logistics regressions were used to evaluate the effect of mental health disorder on NCD awareness, treatment, and control. First, we conducted unadjusted mixed effect logistics regression with NCD awareness, treatment, or control as the outcome variable and mental problem as the predicting variable. Subsequently, we fitted multivariate mixed effect logistics regression with NCD awareness, treatment, or control as the outcome variable, mental problem as exposure variable, and adjusted for the covariates mentioned above.

All data analysis was performed by using Stata 14.0 and level of significance was set at 5%

Results

The number of observations in this study is 17,141, of which 8,189 observations are from year 2011, and 8,952 are from year 2015. The demographic characteristics of participants are presented in table 1 separately for year 2011, year 2015, and overall. Among those observations, 7,361 observations with hypertension, 2,342 observations with diabetes, 7,054 observations with dyslipidemia, and 9,265 observations with kidney disease. The demographic characteristics of observations with hypertension, with diabetes, with dyslipidemia, and with kidney disease are presented in appendix table 1a, 1b, 1c, and 1d.

Table 1 Demographic characteristic participants in year 2011, 2015 and overal

	2011 (N=8,189)		2015 (N=8,952)		All (N=17,141)	
	n	%	n	%	n	%
Gender						
Male	3,841	46.90	4,271	47.71	8,112	47.33
Female	4,348	53.10	4,681	52.29	9,029	52.67
Age						
45-54	2,843	34.72	2,564	28.64	5,407	31.54
55-64	3,218	39.30	3,467	38.73	6,685	39.00
65-74	1,589	19.40	2,242	25.04	3,831	22.35
75+	539	6.58	679	7.58	1,218	7.11
Education						
Middle school or low	5,736	70.05	5,947	66.43	11,683	68.16
High school/vocational school	2,205	26.93	2,672	29.85	4,877	28.45
College or above	248	3.03	333	3.72	581	3.39
Marital Status						
Married	7,254	88.58	7,886	88.09	15,140	88.33
Single	935	11.42	1,066	11.91	2,001	11.67
Consumption						
Q1 (most deprived)	2,134	26.06	1,880	21.00	4,014	23.42
Q2	1,997	24.39	1,944	21.72	3,941	22.99
Q3	1,683	20.55	1,835	20.50	3,518	20.52
Q4	1,374	16.78	1,757	19.63	3,131	18.27
Q5 (most affluent)	1,001	12.22	1,536	17.16	2,537	14.80
Insurance						
No	443	5.41	91	1.02	534	3.12
UEMI	632	7.72	1,087	12.14	1,719	10.03
URMI	305	3.72	488	5.45	793	4.63
NCMI	6,534	79.79	7,135	79.70	13,669	79.74
Others	275	3.36	151	1.69	426	2.49

Residence type						
Rural	5,188	63.35	5,329	59.53	10,517	61.36
Urban	1,202	14.68	1,507	16.83	2,709	15.80
Migrants	1,799	21.97	2,116	23.64	3,915	22.84
Region						
Eastern region	2,650	32.36	2,657	29.68	5,307	30.96
Central region	1,471	17.96	1,715	19.16	3,186	18.59
Western region	3,841	46.90	4,393	49.07	8,234	48.04
North-eastern region	227	2.77	187	2.09	414	2.42

The prevalence of NCD awareness, treatment, and control for subjects with and without mental disorder are presented in table 2. The prevalence of NCD awareness ranges from 74.47% for people with hypertension and with mental disorder to 2717% for people with kidney disease and without mental problem. For all of the four NCDs, the prevalence of NCD awareness is significantly higher for people with mental disorder than people without mental disorder (p-value <0.05).

For hypertension, dyslipidemia, and kidney disease, the prevalence of those physical conditions being treated is higher for people with mental problem than without mental disorder, while this difference is not significant for diabetes (P-value=0.510). Although the prevalence of physical conditions being controlled is lower for people without mental disorder than people with mental disorder, the difference is not significant at 5% level.

Table 2 prevalence of NCD aware, treated, and controlled for people with and without mental disorder

	With mental disorder			Without mental disorder			P-value
	n	N	%	n	N	%	
Hypertension							
aware	1,435	1,927	74.47	3,644	5,434	67.06	<0.001
treated	1,145	1,435	79.79	2,762	3,644	75.80	0.002
controlled	512	1,145	44.72	1,221	2,762	44.25	0.771
Diabetes							
aware	399	669	59.64	898	1,673	53.68	0.009
treated	274	399	68.67	633	898	70.49	0.510
controlled	123	274	44.89	232	633	36.65	0.020
Dyslipidemia							
aware	686	1,800	38.11	1,456	5,254	27.71	<0.001
treated	437	686	63.70	782	1,456	53.71	<0.001
controlled	215	437	49.20	368	782	47.06	0.473
Kidney disease							
aware	469	2,363	19.85	715	6,902	10.36	<0.001
treated	263	469	56.08	348	715	48.67	0.013
controlled	124	263	47.15	148	348	42.53	0.255

Table 3 presents the univariate and multivariate mixed effect logistic regression result. The reference group is people without mental problem. Having mental disorder was associated with increased odds of NCD awareness for dyslipidemia (AOR=2.88,95% CI=2.21-3.74) and kidney disease (AOR=4.14, 95% CI=2.95-5.81), while not significant increase the odds of hypertension and diabetes awareness (P>0.05). Having mental disorder associated with an increased odds of receiving hypertension treatment (AOR=1.57, 95% CI=1.23-2.01), but not diabetes treatment, dyslipidemia treatment, and kidney disease treatment (P>0.05). Having mental disorder is not associated with increased or decreased odds of being controlled for all four NCDs (P>0.05). All regression results are listed in the appendix table.

Table 3 effect of mental problem on NCD awareness, treatment, and control

	Without mental disorder	P-value	With mental disorder	P-value
Hypertension				
Aware (N=9,542)				
Unadjusted-OR	1 (Ref)	-	1.94 (1.53-2.46)	<0.001
Adjusted-OR	1 (Ref)	-	1.18 (0.92-1.52)	0.188
Treated (N=6,624)				
Unadjusted-OR	1 (Ref)	-	1.57 (1.23-2.01)	<0.001
Adjusted-OR	1 (Ref)	-	1.32 (1.02-1.70)	0.033
Controlled (N=4,203)				
Unadjusted-OR	1 (Ref)	-	1.03 (0.85-1.25)	0.750
Adjusted-OR	1 (Ref)	-	1.05 (0.86-1.28)	0.638
Diabetes				
Aware (N=2,702)				
Unadjusted-OR	1 (Ref)	-	2.00 (1.36-2.94)	<0.001
Adjusted-OR	1 (Ref)	-	1.18 (076-1.83)	0.452
Treated (N=1,675)				
Unadjusted-OR	1 (Ref)	-	0.97 (0.60-1.455)	0.888
Adjusted-OR	1 (Ref)	-	0.92 (0.55-1.54)	0.762
Controlled (N=886)				
Unadjusted-OR	1 (Ref)	-	1.69 (1.03-2.76)	0.037
Adjusted-OR	1 (Ref)	-	1.23 (0.75-2.00)	0.412
Dyslipidemia				
Aware (N=7,519)				
Unadjusted-OR	1 (Ref)	-	2.88 (2.21-3.74)	<0.001
Adjusted-OR	1 (Ref)	-	1.81 (1.36-2.39)	<0.001
Treated (N=2,756)				
Unadjusted-OR	1 (Ref)	-	1.74 (1.33-2.26)	<0.001
Adjusted-OR	1 (Ref)	-	1.29 (0.99-1.68)	0.059

Controlled (N=1,168)				
Unadjusted-OR	1 (Ref)	-	1.07 (0.72-1.60)	0.729
Adjusted-OR	1 (Ref)	-	0.93 (0.59-1.45)	0.745
Kidney disease				
Aware (N=9,218)				
Unadjusted-OR	1 (Ref)	-	4.14 (2.95-5.81)	<0.001
Adjusted-OR	1 (Ref)	-	2.88 (2.12-3.92)	<0.001
Treated (N=1,528)				
Unadjusted-OR	1 (Ref)	-	1.50 (1.09-2.05)	0.012
Adjusted-OR	1 (Ref)	-	1.35 (0.97-1.88)	0.073
Controlled (N=575)				
Unadjusted-OR	1 (Ref)	-	1.21 (0.67-2.18)	0.523
Adjusted-OR	1 (Ref)	-	1.04 (0.56-1.91)	0.907

Discussion

Principle findings

We presented the first study that investigate the associations between having mental disorder and cascade of care in managing four common physical NCDs in China among older adult population in China. Our study revealed that having mental disorder was associated with increased odds of being aware of having dyslipidemia, and kidney disease, after adjusting for covariates including frequency of outpatient visit. Additionally, having mental disorder was associated with increased odds of receiving treatment of hypertension, but not for diabetes, dyslipidemia, and kidney disease. However, having mental disorder was not associated with increased or decreased odds of being controlled for hypertension, diabetes, dyslipidemia and kidney disease.

Comparison with literature

The finding on the positive effect of having mental health conditions on better diagnosis of previously undiagnosed dyslipidemia and kidney disease is consistent with the small number of existing articles. Subjects with more comorbidities likely resulted in having more frequent visits to and interactions with multiple health providers,[5,17,27-29] such as dyslipidemia, and kidney disease in this particular study. Having more comorbidities and increased frequency of healthcare visits were likely associated with a greater tendency for patients to self-report kidney pain and test blood liquid [30,31].

Studies examined the relationship between comorbid health condition and NCD treatment have shown conflicting results which may reflect complexity of the issue[5,17,32-35] It is worth noting that our study considered only whether subjects were taking treatment or not, and did not if treatment was adequate, in terms of adherence to medication.[5,17,36] While our study showed that subjects with mental disorder have higher odds of taking treatment, but in reality, with more co-occurring physical conditions, the odds of treatment adherence and having adequate treatment would decline.[5,17]

The finding on having mental health conditions not associated with increased or decreased odds of being controlled for hypertension, diabetes, dyslipidemia and kidney disease is not consistent with the little amount of existing literature. The difficulty in controlling NCDs tend to be exacerbated with having more co-occurring physical chronic conditions.[9,11,15]

There has been debate in the recent literature on how co-occurring conditions influence the management and control of NCDs.[5,17] Magnan et al (2014) analysed electronic health data records of 24,430 adults aged 18 to 75 years from the United States, and revealed that even though having more concordant NCDs were correlated with a higher likelihood of achieving diabetes control goals, this relationship was not present for the outcome on achieving blood pressure control.[16] Ricci-Cabello et al (2015) investigated the prevalence of concordant and discordant NCDs of diabetes, and their impact on diabetes care in England.[5,14] The study revealed that only 2 of 8 discordant NCDs to diabetes were correlated with worse quality of diabetes care, and only 4 of 7 concordant NCDs with diabetes were correlated with better quality of diabetes care.[14]

Hence, this study along with our previous work and other papers, provide further evidence on the complexity of how co-occurring mental health conditions impact the management and control of NCDs, and the hypothesis that concordant comorbidities with mental illness facilitate the management of NCDs and discordant comorbidities with mental illness impede the management of NCDs may be over-simplified.[5,17]

Strengths and limitations

This is the first study that used a large population of adults from China with multimorbidity, to investigate the association between having mental health conditions with the odds of being undiagnosed, untreated and uncontrolled for co-occurring physical chronic condition.

Self-reported diagnosis of chronic conditions may be under-reported especially among the lower socioeconomic groups in China.[37-39] Additionally, stigma could be a reason for under-reporting of depression in MICs.[40,41] However, our study utilized clinical measurement for all physical NCDs as well as mental disorder which can mitigate under-reporting of NCDs. [42]

Additionally, this survey only asked if subjects were taking treatment (medicines, lifestyle changes), but did not measure self-reported treatment adherence (i.e. dosage, frequency, duration, etc).[17,36] Biomarkers

used to assess whether chronic conditions were controlled may not be sufficiently comprehensive, and supplemental assessment criteria may have been needed for better accuracy. However, this survey is one of the few existing surveys that utilised biomarkers, rather than only symptom-based assessment via questions.[5,17]

Future studies could expand on this study by examining more NCDs, especially conditions with high prevalence and morbidity.[5,17,43] The study's cross-sectional design means that causality could not be determined, and studies that use cohort study designs could examine how mental health conditions lead to worse treatment and control of physical chronic diseases in subjects that are followed-up over a decade.[5,17,33]

Clinical, policy, and research implications

Clinical guidelines must be updated to include improved screening and treatment of physical chronic conditions that may occur in patients with mental health conditions.[5,17] Regarding poorer treatment and control of mental health conditions and physical chronic diseases associated with having more NCDs, clinical guidelines could incorporate more intentional monitoring of patients' adherence to medication and treatments by clinicians.[5,17] Also proposed in our previous work, current clinical guidelines are based on evidence from controlled trials for treating single NCDs,[5,17,44-46] and treatments may no longer be effective and even have adverse effects when applying single-disease guidelines to patients with multimorbidity.[5,17,47] Hence, clinical guidelines should be tailored towards an approach to multimorbidity of co-occurring mental illness and physical chronic conditions, whereby clinicians review the effectiveness and risks of combining the medications and different treatments for mental illness and physical chronic diseases.[4,5,17,44]

Healthcare systems in LMICs like China may need to implement policies that improve access to care from the primary care system for continual treatment after first diagnosis.[48-51] Policies that prioritise NCD combinations that include mental health conditions that are more prevalent or associated with poorer management and control need be considered, such as reducing costs of medicines and clinic visits.[35,52] It is worth noting that health-care delivery in China is hospital-centered and fragmented, with little coordination among health-care providers across different tiers of the system[53]. Strong primary health care, underpinned by multidisciplinary teams lead by general practitioner, is also crucial for the improved prevention and treatment of patients with multiple NCDs. Health care delivery need to shift away from the current vertical approach of treating single-disease models to the one that emphasize on horizontal integration that aims to provide more effectively management for patients with multiple NCDs, including co-existing physical and mental NCDs. Overall, our study provides evidence on the impact of comorbid mental health condition on the management of physical NCDs in China. Further research is required to better understand the epidemiology of co-existing mental-physical NCDs and associated impacts on management of the conditions and associated costs and health outcomes in LMIC settings.

Declarations

Author contributions

ZZ: data analysis and drafted the manuscript; GS: draft writing and editing; VMQ: check result and provide assistance in data analysis; YZ: provide assistance for data analysis; TNH: provide suggestions on writing manuscript; BO: edit draft; FTL: design, coordinate the study and edit the draft.

Competing interests

The authors declare no competing interests.

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