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Prevalence of anxiety, depression and associated risk factors in gastroenterology outpatients: a multicenter cross-sectional study

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Abstract

Background Anxiety and depression are closely related to digestive system diseases. However, anxiety and depression in gastroenterology outpatients are not consistently recognized or managed. This study aimed to investigate the prevalence of anxiety, depression and associated risk factors in gastroenterology outpatients.

Methods We conducted a cross-sectional study from June 2021 to June 2022 in the gastroenterology outpatients of three central hospitals. Professional researchers at each center collected data from patients through face-to-face interviews using a questionnaire. The Hamilton Anxiety Scale, Hamilton Depression Scale and Pittsburgh Sleep Quality Index were respectively used to assess anxiety, depression and sleep quality. Univariate and multivariate logistic regression were performed to identify associated risk factors.

Results A total of 931 patients were finally included for analysis. The overall detection rates of anxiety and depression were 26.5% and 12.2%, respectively. Gastroesophageal reflux (AOR:1.559, 95%CI:1.084–2.244), dyspepsia (AOR:2.194, 95%CI:1.302–3.696), bile reflux (AOR:3.509, 95%CI:2.413–5.103), atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia (AOR:3.814, 95%CI:1.399–10.402), biliary tract disease (AOR:1.584, 95%CI:1.042–2.410), liver disease (AOR:2.401, 95%CI:1.073–5.374), and poor sleep (AOR:5.578, 95%CI:3.859–8.063) were significantly associated with anxiety. Bile reflux (AOR:5.409, 95%CI:3.190–9.173), liver disease (AOR:3.177, 95%CI:1.183–8.531), and poor sleep (AOR:8.572, 95%CI:4.952–14.840) were significantly associated with depression. Physical exercise time ≥ 150 min/week (AOR:0.550, 95%CI:0.324–0.934) was inversely associated with depression.

Conclusion Anxiety and depression were prevalent among gastroenterology outpatients. Gastroenterologists should pay close attention to the psychological status of patients, especially those with gastroesophageal reflux, dyspepsia, bile reflux, atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia, biliary tract disease, liver disease, and poor sleep.

Keywords Anxiety, Depression, Prevalence, Risk factors, Gastroenterology outpatients

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Introduction

Anxiety and depression are prevalent psychological disorders with significant implications for individuals' physical and mental well-being. According to the Global Burden of Disease Study 2019 [1], they ranked the 6th and 4th leading causes of disability-adjusted life-years (DALYs) among adolescents aged 10–24 years, and the 15th and 6th leading causes of DALYs among those aged 25–49 years. These mental health conditions have been extensively linked to various digestive disorders, including irritable bowel syndrome [2], inflammatory bowel disease [3], and gastroesophageal reflux disease [4]. The brain-gut axis has been demonstrated to play a pivotal role in mediating these associations [5–7]. Consequently, evaluating the psychological state of patients with digestive system diseases is essential. Unfortunately, patients with psychological disorders are often not well recognized by gastroenterologists [8–11]. Moreover, most previous studies have focused on evaluating anxiety and depression in patients with specific gastrointestinal diseases using single-center samples. However, few multicenter studies have comprehensively assessed anxiety and depression, as well as their associated risk factors, in the broader population of gastroenterology outpatients. Therefore, we conducted a multicenter cross-sectional study to investigate the prevalence of anxiety and depression among overall gastroenterology outpatients of three central hospitals in Northwest China, and to identify their associated factors, aiming to provide evidence for targeted screening and management.

Methods

Study design and participants

We conducted a multicenter cross-sectional study. From June 2021 to June 2022, we consecutively recruited gastroenterology outpatients from three central hospitals in Shaanxi Province, China: Xijing Hospital (Xi'an), Honghui Hospital (Xi'an), and Xianyang Central Hospital (Xianyang). The inclusion criteria for this study were: (1) aged 18–75 years, regardless of gender; (2) had undergone gastroscopy and colonoscopy within one month (with available examination reports). The exclusion criteria were: (1) a history of gastrointestinal surgery; (2) a history of malignant tumor; (3) ongoing psychological intervention or use of psychotropic drugs; (4) incomplete clinical data or questionnaire responses; (5) failure to complete the study questionnaire.

Sample size estimation

The sample size was estimated using the formula for prevalence-based cross-sectional studies: $n = z^2 \times p \times (1 - p)/d^2$. Based on previous research, the prevalence rates of anxiety and depression were estimated to be 30% [12], so $p = 0.3$. The significance level (α) was set at 0.05,

corresponding to a z -value of 1.96. The allowable error $d = 0.1p = 0.03$. Using these parameters, the minimum estimated sample size was 897 participants. To account for a potential 10% non-response rate, we aimed to recruit at least 987 patients.

Assessment of sleep quality, anxiety, and depression

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Total PSQI scores ranged from 0 to 21, with higher scores indicating worse sleep quality. Poor sleep was defined as a PSQI total score ≥ 8 , while good sleep quality was defined as a PSQI total score < 8 [13]. Anxiety was assessed using the Hamilton Anxiety Scale (HAMA), which comprises 14 items. Higher total scores indicate more severe anxiety, and the anxiety disorder was defined as a HAMA total score > 14 [14, 15]. Depression was assessed using the Hamilton Depression Scale (HAMD), which includes 24 items. Higher total scores indicate more severe depression, and the depression disorder was defined as a HAMD total score > 20 [16, 17].

Assessment of possible confounding factors

Body mass index (BMI) was categorized according to Chinese criteria: underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal weight ($18.5 \leq \text{BMI} < 24 \text{ kg/m}^2$), and overweight/obesity ($\text{BMI} \geq 24 \text{ kg/m}^2$). Current smoking was defined as reporting smoking at least one cigarette per day over the past three months. Current alcohol consumption was defined as reporting alcohol intake at least once per week over the past three months. Clinical characteristics were assessed via a combination of self-report, clinician assessment, and review of relevant medical records. Biliary tract diseases included cholecystectomy, cholecystitis, gallstones, and gallbladder polyps. Liver diseases included viral hepatitis, alcoholic hepatitis, autoimmune liver disease, and cirrhosis.

Data collection and quality control

Each center collected patient data via face-to-face interviews using a standardized questionnaire by professional researchers. The data mainly included socio-demographic characteristics, living habits, and clinical characteristics. We developed a standardized questionnaire with the assistance of statistical experts and linguists. Researchers at each center underwent both online and offline training to fully understand the content of the questionnaire, interview procedures, and ethical requirements. We regularly reviewed the returned questionnaires to exclude incomplete or invalid responses, thus ensuring the integrity and reliability of the data.

Statistical analysis

Statistical analysis was performed using SPSS version 25.0 (IBM, Armonk, NY, USA). Categorical variables were expressed as proportions (n, %) and were compared using χ^2 tests. We performed univariate logistic regression analysis for all correlated variables separately to obtain crude odds ratios (COR). Subsequently, all variables with $P < 0.15$ in the univariate logistic regression analysis were included in the multivariate logistic regression analysis to identify independent factors. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) were reported to indicate the strength of associations. The variance inflation factor was used to test for multicollinearity between variables in the model. A P -value < 0.05 was considered statistically significant.

Results

Socio-demographic characteristics and living habits of the study participants

A total of 1224 gastroenterology outpatients participated in the survey. According to the inclusion and exclusion criteria, 931 outpatients were finally included in the analysis, including 571 from Xijing Hospital, 255 from Honghui Hospital, and 105 from Xianyang Central Hospital. Among all participants, 507 (54.5%) were female, with

a median age of 49 years (interquartile range, 38–58). A majority of the participants 537(57.7%) had an average weight and 820(88.1%) were married. Most participants, 642(69.0%) resided in urban areas and 440(47.3%) had a college education or above. Additionally, 551(59.2%) participants worked more than 8 h daily, while 656 (70.5%) had an average monthly income of no less than 3000 RMB. Regarding living habits, 547(58.8%) participants reported doing physical exercise for less than 150 min per week. The majority of participants did not smoke 776(83.4%) or consume alcohol 733(78.7%), as shown in Table 1.

Clinical characteristics of the study participants

Regarding gastrointestinal symptoms, approximately half of the patients 442 (47.5%) experienced gastroesophageal reflux, while more than three-quarters 711 (76.4%) had dyspepsia. Among the participants, 137 (14.7%) reported chronic diarrhea, and 224 (24.1%) reported chronic constipation. Findings from gastroscopy and colonoscopy revealed that more than one-third 332 (35.7%) had bile reflux, while 91 (9.8%) had peptic ulcer, and 89 (9.6%) had gastrointestinal polyps. Furthermore, 504(54.1%) participants had non-atrophic gastritis, 396 (42.5%) had atrophic gastritis, and 31 (3.3%) had atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia. Other relevant investigations showed that 188(20.2%) participants tested positive for *Helicobacter pylori* infection, 214 (23.0%) had biliary tract disease, 37 (4.0%) had liver disease, 129(13.9%) had hypertension, and 44(4.7%) had diabetes as shown in Table 2.

Table 1 Socio-demographic characteristics and living habits of the study participants (n = 931)

Variables	Categories	Frequency(n)	Percentage(%)
Gender	Male	424	45.5
	Female	507	54.5
Age in years	18–29	94	10.1
	30–44	255	27.4
	45–59	381	40.9
	60–75	201	21.6
BMI(kg/m ²)	< 18.5	90	9.7
	18.5–23.99	537	57.7
	≥ 24	304	32.7
Marital status	Unmarried	93	10.0
	Married	820	88.1
	Divorced/Widowed	18	1.9
Residence	Rural	289	31.0
	Urban	642	69.0
Educational level	≤ Middle school	116	12.5
	High school	375	40.3
	≥ College	440	47.3
Monthly income(RMB)	< 3000	275	29.5
	≥ 3000	656	70.5
Working hours per day(h)	< 8	380	40.8
	≥ 8	551	59.2
Physical exercise time(min/week)	< 150	547	58.8
	≥ 150	384	41.2
Current smoking	No	776	83.4
	Yes	155	16.6
Current alcohol intake	No	733	78.7
	Yes	198	21.3

Prevalence of poor sleep, anxiety, and depression of the study participants

Among the study participants, approximately one-third 312 (33.5%) reported poor sleep quality. The overall detection rates for anxiety, depression, anxiety or depression, and anxiety and depression were 26.5%, 12.2%, 27.2%, and 11.6%, respectively. It was observed that the detection rates of poor sleep, anxiety, and depression were higher in females compared to males ($P < 0.001$). Additionally, the detection rates of poor sleep, depression, and anxiety and depression were higher in the 60–75 years age group compared to other age groups ($P < 0.05$) (Table 3).

Factors associated with anxiety

The univariate logistic regression analysis indicated that several socio-demographic characteristics and living habits, including gender, age, BMI, residence, educational level, monthly income, working hours per day, and current alcohol intake, were significantly associated with anxiety ($P < 0.15$). Clinical characteristics such as gastroesophageal reflux, dyspepsia, chronic constipation, bile

Table 2 Clinical characteristics of the study participants (n = 931)

Variables	Categories	Frequency(n)	Percentage(%)
Gastroesophageal reflux	No	489	52.5
	Yes	442	47.5
Dyspepsia	No	220	23.6
	Yes	711	76.4
Chronic diarrhea	No	794	85.3
	Yes	137	14.7
Chronic constipation	No	707	75.9
	Yes	224	24.1
Peptic ulcer	No	840	90.2
	Yes	91	9.8
Gastrointestinal polyp	No	842	90.4
	Yes	89	9.6
Bile reflux	No	599	64.3
	Yes	332	35.7
Gastroscopy findings	Non-atrophic gastritis	504	54.1
	Atrophic gastritis	396	42.5
	Atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia	31	3.3
<i>Helicobacter pylori</i> infection status	No	743	79.8
	Yes	188	20.2
Biliary tract disease	No	717	77.0
	Yes	214	23.0
Liver disease	No	894	96.0
	Yes	37	4.0
Hypertension	No	802	86.1
	Yes	129	13.9
Diabetes	No	887	95.3
	Yes	44	4.7

reflux, biliary tract disease, peptic ulcer, liver disease, gastrointestinal polyps, gastroscopy findings, and sleep quality were also significantly associated with anxiety. The variance inflation factors for these variables were all less than 5, excluding multicollinearity among the variables. Subsequently, a multivariate regression analysis

was performed to identify the independent associations between anxiety and the significant variables. The results revealed that gastroesophageal reflux, dyspepsia, bile reflux, biliary tract disease, liver disease, atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia, and poor sleep were independently associated with anxiety ($P < 0.05$).

Patients with gastroesophageal reflux symptoms were 1.559 times more likely to develop anxiety than those without gastroesophageal reflux symptoms (AOR:1.559, 95%CI: 1.084–2.244). The risk of anxiety in patients with dyspepsia was 2.194 times higher than those without (AOR:2.194, 95%CI: 1.302–3.696). Patients with bile reflux had a 3.509-fold increased risk of anxiety (AOR:3.509, 95%CI:2.413–5.103) compared to patients without bile reflux. Patients with biliary tract disease had 1.584 times the odds of developing anxiety as patients without biliary tract disease (AOR: 1.584, 95%CI:1.042–2.410). The odds of having anxiety among participants with liver disease was 2.401 times higher than those without liver disease (AOR: 2.401, 95%CI:1.073–5.374). The model also showed that patients who had atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia were 3.814times more likely to have potential anxiety as compared to those with non-atrophic gastritis (AOR:3.814, 95%CI:1.399–10.402). The results of this study showed that the odds of having anxiety among participants who had poor sleep was about 5.578 times higher compared to participants who had good sleep (AOR:5.578, 95%CI:3.859–8.063) (Table 4).

Factors associated with depression

Our univariate logistic regression analysis revealed that several socio-demographic characteristics and living habits such as gender, age, BMI, marital status, residence, educational level, monthly income, working hours per day, physical exercise time, and current alcohol intake were significantly associated with depression ($P < 0.15$).

Table 3 Prevalence of poor sleep, anxiety, and depression among outpatients in the department of gastroenterology

Patients	Poor sleep	Anxiety	Depression	Anxiety or depression	Anxiety and depression
Total(n = 931)	312(33.5)	247(26.5)	114(12.2)	253(27.2)	108(11.6)
Gender					
Male(n = 424)	112(26.4)	83(19.6)	33(7.8)	84(19.8)	32(7.5)
Female(n = 507)	200(39.4)	164(32.3)	81(16.0)	169(33.3)	76(15.0)
Statistic	$\chi^2 = 17.601$	$\chi^2 = 19.323$	$\chi^2 = 14.425$	$\chi^2 = 21.333$	$\chi^2 = 12.474$
P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Age in years					
18–29(n = 94)	20(21.3)	24(25.5)	10(10.6)	25(26.6)	9(9.6)
30–44(n = 255)	63(24.7)	52(20.4)	19(7.5)	54(21.2)	17(6.7)
45–59(n = 381)	138(36.2)	111(29.1)	55(14.4)	114(29.9)	52(13.6)
60–75(n = 201)	91(45.3)	60(29.9)	30(14.9)	60(29.9)	30(14.9)
Statistic	$\chi^2 = 28.924$	$\chi^2 = 7.439$	$\chi^2 = 8.725$	$\chi^2 = 6.831$	$\chi^2 = 10.154$
P	< 0.001	0.059	0.033	0.077	0.017

Table 4 Univariate and multivariate logistic regression analysis on factors associated with anxiety among outpatients in the department of gastroenterology($n = 931$)

Variables	Categories	Anxiety		COR(95%CI)	AOR(95%CI)
		No	Yes		
Gender	Male	341	83	1	1
	Female	343	164	1.964(1.450–2.661)	1.149(0.748–1.766)
Age in years	18–29	70	24	1	1
	30–44	203	52	0.747(0.429–1.301)	0.722(0.369–1.411)
	45–59	270	111	1.199(0.717–2.004)	0.970(0.479–1.965)
	60–75	141	60	1.241(0.714–2.158)	0.649(0.286–1.474)
BMI(kg/m ²)	< 18.5	56	34	1.566(0.983–2.496)	0.985(0.541–1.792)
	18.5–23.99	387	150	1	1
	≥ 24	241	63	0.674	0.704(0.465–1.067)
Residence	Rural	199	90	1.397(1.028–1.900)	1.329(0.843–2.096)
	Urban	485	157	1	1
Educational level	≤Middle school	69	47	2.229(1.448–3.431)	1.348(0.678–2.683)
	High school	278	97	1.142(0.829–1.571)	0.802(0.506–1.271)
	≥College	337	103	1	1
Monthly income(RMB)	< 3000	181	94	1.707(1.255–2.323)	0.905(0.576–1.423)
	≥ 3000	503	153	1	1
Working hours per day(h)	< 8	256	124	1.685(1.257–2.261)	1.284(0.856–1.927)
	≥ 8	428	123	1	1
Current alcohol intake	No	518	215	2.153(1.428–3.246)	1.372(0.799–2.354)
	Yes	166	32	1	1
Gastroesophageal reflux	No	393	96	1	1
	Yes	291	151	2.124(1.578–2.860)	1.559(1.084–2.244)*
Dyspepsia	No	196	24	1	1
	Yes	488	223	3.732(2.374–5.867)	2.194(1.302–3.696)*
Chronic constipation	No	543	164	1	1
	Yes	141	83	1.949(1.412–2.691)	1.393(0.926–2.097)
Peptic ulcer	No	609	231	1	1
	Yes	75	16	0.594(0.332–1.075)	0.865(0.456–1.653)
Gastrointestinal polyp	No	612	230	1	1
	Yes	72	17	0.628(0.363–1.089)	0.922(0.478–1.779)
Bile reflux	No	507	92	1	1
	Yes	177	155	4.826(3.541–6.577)	3.509(2.413–5.103)**
Gastroscopy findings	Non-atrophic gastritis	379	125	1	1
	Atrophic gastritis	292	104	1.080(0.799–1.460)	0.904(0.608–1.345)
	Atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia	13	18	4.198(2.000–8.812)	3.814(1.399–10.402)*
Biliary tract disease	No	553	164	1	1
	Yes	131	83	2.136(1.543–2.958)	1.584(1.042–2.410)*
Liver disease	No	665	229	1	1
	Yes	19	18	2.751(1.419–5.333)	2.401(1.073–5.374)*
Sleep quality	Good sleep	532	87	1	1
	Poor sleep	152	160	6.437(4.687–8.840)	5.578(3.859–8.063)**

1: reference category, AOR: Adjusted odds ratio, CI confidence interval, COR Crude odds ratio, *: statistically significant at $P < 0.05$, **: statistically significant at $P < 0.001$

Clinical characteristics, including gastroesophageal reflux, dyspepsia, chronic constipation, bile reflux, biliary tract disease, peptic ulcer, liver disease, gastrointestinal polyps, gastroscopy findings, and sleep quality, were also significantly associated with depression. The variance inflation factors for these variables were all less than 5, excluding multicollinearity among the variables. Further multivariate regression analysis revealed that physical exercise time, bile reflux, liver disease, and poor sleep were independently associated with depression ($P < 0.05$).

In this study, the odds of having depression among participants with bile reflux were about 5.409 times higher as compared to those without bile reflux (AOR:5.409, 95%CI: 3.190–9.173). Patients with liver disease were 3.177 times more likely to develop depression than those without liver disease (AOR:3.177, 95%CI: 1.183–8.531). The odds of developing depression were 8.572 times higher among respondents with poor sleep than good sleep (AOR:8.572, 95%CI: 4.952–14.840). The results of the study found that patients with physical exercise

Table 5 Univariate and multivariate logistic regression analysis on factors associated with depression among outpatients in the department of gastroenterology($n = 931$)

Variables	Categories	Depression		COR(95%CI)	AOR(95%CI)
		No	Yes		
Gender	Male	391	33	1	1
	Female	426	81	2.253(1.469–3.454)	1.227(0.656–2.296)
Age in years	18–29	84	10	1	1
	30–44	236	19	0.676(0.302–1.513)	0.541(0.106–2.763)
	45–59	326	55	1.417(0.693–2.898)	0.965(0.184–5.048)
	60–75	171	30	1.474(0.688–3.157)	0.676(0.121–3.772)
BMI(kg/m ²)	< 18.5	68	22	2.349(1.361–4.057)	1.769(0.862–3.630)
	18.5–23.99	472	65	1	1
	≥ 24	277	27	0.708(0.441–1.135)	0.753(0.422–1.342)
Marital status	Unmarried	85	8	1	1
	Married	719	101	1.493(0.702–3.173)	1.455(0.281–7.537)
	Divorced/Widowed	13	5	4.087(1.158–14.416)	5.002(0.594–42.153)
Residence	Rural	242	47	1.667(1.115–2.492)	1.567(0.868–2.830)
	Urban	575	67	1	1
Educational level	≤Middle school	90	26	2.667(1.557–4.568)	0.893(0.370–2.153)
	High school	330	45	1.259(0.809–1.960)	0.672(0.358–1.261)
	≥College	397	43	1	1
Monthly income(RMB)	< 3000	223	52	2.234(1.498–3.331)	1.455(0.809–2.617)
	≥ 3000	594	62	1	1
Working hours per day(h)	< 8	324	56	1.469(0.992–2.176)	0.811(0.454–1.449)
	≥ 8	493	58	1	1
Physical exercise time(min/week)	< 150	469	78	1	1
	≥ 150	348	36	0.622(0.409–0.945)	0.550(0.324–0.934)*
Current alcohol intake	No	634	99	1.905(1.080–3.360)	0.961(0.445–1.449)
	Yes	183	15	1	1
Gastroesophageal reflux	No	447	42	1	1
	Yes	370	72	2.071(1.382–3.104)	1.273(0.770–2.104)
Dyspepsia	No	212	8	1	1
	Yes	605	106	4.643(2.225–9.687)	2.257(0.982–5.191)
Chronic constipation	No	633	74	1	1
	Yes	184	40	1.860(1.224–2.825)	0.990(0.578–1.693)
Peptic ulcer	No	731	109	1	1
	Yes	86	5	0.390(0.155–0.982)	0.640(0.207–1.986)
Gastrointestinal polyp	No	732	110	1	1
	Yes	85	4	0.313(0.113–0.871)	0.530(0.169–1.666)
Bile reflux	No	570	29	1	1
	Yes	247	85	6.764(4.325–10.578)	5.409(3.190–9.173)**
Gastroscopy findings	Non-atrophic gastritis	475	47	1	1
	Atrophic gastritis	337	59	1.702(1.132–2.561)	1.565(0.911–2.690)
	Atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia	23	8	3.382(1.433–7.982)	2.268(0.707–7.272)
Biliary tract disease	No	642	75	1	1
	Yes	175	39	1.908(1.252–2.908)	1.166(0.672–2.022)
Liver disease	No	790	104	1	1
	Yes	27	10	2.813(1.324–5.979)	3.177(1.183–8.531)*
Sleep quality	Good sleep	597	22	1	1
	Poor sleep	220	92	11.348(6.951–18.526)	8.572(4.952–14.840)**

1: reference category, AOR: Adjusted odds ratio, CI confidence interval, COR Crude odds ratio, *: statistically significant at $P < 0.05$, **: statistically significant at $P < 0.001$

time ≥ 150 min/week may have a reduced risk of depression compared with patients with physical exercise time < 150 min/week (AOR:0.550, 95%CI:0.324–0.934). (Table 5).

Discussion

This multicenter cross-sectional study aimed to investigate the prevalence of anxiety and depression, as well as their associated risk factors, among gastroenterology

outpatients of three central hospitals in Northwest China. The results showed that the overall detection rates of anxiety and depression were 26.5% and 12.2%, respectively. Gastroesophageal reflux, dyspepsia, bile reflux, atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia, biliary tract disease, liver disease, and poor sleep were significantly associated with anxiety. Bile reflux, liver disease, and poor sleep were significantly associated with depression. Physical exercise time ≥ 150 min/week was inversely associated with depression.

Prevalence of anxiety and depression among outpatients in the department of gastroenterology

Previous studies indicated that mental and psychological problems were quite common in the northwest region of China, especially in rural areas [18, 19], among the elderly population [20] and student groups [21].

The anxiety detection rate (26.5%) in our study was almost consistent with those reported in previous studies, including 27.0% among gastroenterology inpatients and outpatients from eight general hospitals in Shandong Province, China [12], and 27.5% among gastroenterology outpatients from four general hospitals in Riyadh, Saudi Arabia [22]. However, our results were higher than those reported in studies by Lijuan Feng (20.7%) [23], Monika Mussell (19.4%) [24], Xiaojing Li (9.4%) [25], and Chunyan Zhu (6.9%) [26]. These differences in results could be attributed to variations in study design, geographical differences, and the use of different assessment scales. For instance, Lijuan Feng's study focused on inpatients in a single Chinese general hospital, while Monika Mussell studied subjects in primary care centers in the United States. Additionally, the anxiety assessment scales in their study differed from our HAMA, with Xiaojing Li and Chunyan Zhu using the Hospital Anxiety and Depression Scale (HADS), Lijuan Feng using the Self-Rating Anxiety Scale (SAS), and Monika Mussell using the seven-item Generalized Anxiety Disorder Scale (GAD-7).

The depression detection rate (12.2%) in our study was comparable to those reported in studies by Xiaoxia Qin (11.0%) [27], Chunyan Zhu (15.2%) [26], and Xiaojing Li (9.4%) [25]. However, our results were lower compared to studies conducted in the United States (19.1%) [24] and Saudi Arabia (35.9%) [22]. Different results may be attributed to the differences in economic culture and the different assessment scales in the United States (the eight-item depression module of the Patient Health Questionnaire, PHQ-8) and Saudi Arabia (PHQ-9). Furthermore, our results were lower than the other two studies from China, Anzhong Zhang (31.1%) [12], and Lijuan Feng (31.8%) [23]. One possible explanation for this difference was that the subjects in those studies were selected from inpatients who generally had more severe

conditions and thus a higher likelihood of developing severe depression.

Factors associated with anxiety and depression

Gastroesophageal reflux was significantly associated with anxiety in our study. Several studies have shown a strong association between anxiety and gastroesophageal reflux disease (GERD) [28, 29]. Moreover, a bidirectional Mendelian randomization study confirmed that GERD was associated with an increased likelihood of anxiety [30]. Patients with dyspepsia were 2.194 times more likely to suffer from anxiety than those without dyspepsia. A cross-sectional survey from a Chinese community found that dyspepsia was associated with an increased likelihood of anxiety by 2.03 times (OR = 2.03, 95% CI: 1.06–3.89) [31]. Furthermore, a 5–15 year prospective study from the United States found that dyspepsia in childhood was associated with an increased likelihood of anxiety disorders and reduced quality of life in adolescence and young adulthood [32], and a 10-year follow-up study in Sweden also confirmed a strong association between dyspepsia and anxiety [33]. Compared with patients with non-atrophic gastritis, those with atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia were more likely to suffer from anxiety. Gastric intestinal metaplasia or intraepithelial neoplasia was associated with an increased likelihood of progression to gastric cancer [34, 35], which may be correlated with anxiety due to patient concern. A multicenter population-based cohort study also showed that patients with high-grade intraepithelial neoplasia and esophageal cancer were more likely to have anxiety (RR: 2.20, 95% CI: 1.10–4.30) and a longer duration of anxiety [36]. Furthermore, our study revealed that biliary tract disease was associated with an increased likelihood of anxiety. Previous studies have shown that biliary tract diseases can lead to gastrointestinal dysfunction [37, 38], which can decrease quality of life and subsequently induces anxiety. Notably, we found an inverse association between moderate physical exercise and depression, consistent with a population-based study from Korea that reported a similar association between moderate physical exercise and depressive symptoms [39]. Additionally, several randomized controlled trials have also demonstrated that moderate physical exercise can reduce the risk of depression in various populations, including adolescents [40], older adults [41], and pregnant women during the perinatal period [42]. Multiple studies have confirmed that exercise may alleviate depression by regulating the release of neurotransmitters and neurotrophic factors, as well as modulating the immune inflammatory response [43, 44].

Furthermore, our results demonstrated that bile reflux was an independent risk factor for anxiety and depression. This may be due to the recurrent symptoms of bile

reflux, which negatively impact overall quality of life. Additionally, bile reflux is associated with an increased likelihood of gastric cancer [45] and esophageal cancer [46], which can further exacerbate anxiety and depression in affected patients. Liver disease was also identified as an independent risk factor for both anxiety and depression in our study. A multicenter epidemiological study of patients with chronic digestive system diseases found that the detection rates of anxiety and depression were the highest in patients with digestive system tumors, followed by patients with liver cirrhosis (48.1% and 41.4%, respectively) [12]. A multicenter study from the United States also confirmed that anxiety and depression are common in patients with cirrhosis, with nearly half experiencing moderate to severe anxiety and nearly one in six experiencing moderate to severe depression [47]. Additionally, our findings indicated that poor sleep quality was associated with an increased likelihood of both anxiety and depression. This was consistent with previous research that had consistently shown a link between poor sleep and an increased risk of anxiety and depression in various populations, including children [48], college students [49], the elderly [50], and postpartum women [51].

Limitations of the study

Indeed, several limitations of our study should be acknowledged. Firstly, the study subjects were recruited exclusively from three general hospitals in northwest China, which may limit the generalizability of our findings to other populations or regions. The lack of random sampling in hospital selection may have introduced selection bias and compromised the representativeness of the study sample. In addition, the cross-sectional design of our study prevented us from establishing causal relationships between the outcome variables and the predictor variables. In the future, longitudinal or prospective studies would be needed to provide more robust evidence on the causal relationships between anxiety, depression, and the risk factors identified in our study.

Conclusions

Anxiety and depression were prevalent among gastroenterology outpatients. Gastroesophageal reflux, dyspepsia, biliary tract disease, and atrophic gastritis with intestinal metaplasia or intraepithelial neoplasia were significantly associated with anxiety. Bile reflux, liver disease, and poor sleep were significantly associated with anxiety and depression. Gastroenterologists should enhance screening for anxiety and depression in gastroenterology outpatients, especially in those with the aforementioned risk factors.

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Authors' contributions

DQ analyzed and interpreted the data, and was a major contributor in writing the manuscript. SYQ made substantial contributions to conception and design; DQ, LSB, ZXJ, LKX, LYN, WSS contributions to acquisition of data. DQ was involved in revising it critically for important intellectual content. All authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Xijing Hospital, Air Force Medical University (No. KY20202100-F-1). Each enrolled patient signed a written informed consent form.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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