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Meta-Analysis of the Disease Spectrum of Hospitalized Aircrews

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Abstract

Background: Aircrews are groups of people working in tough environment. Having diseases would stop them from working. The disease spectrum of hospitalized aircrews could give good service to the support of health management. However, the disease spectrum of Chinese aircrews is still obscure.

Methods: Four different database were searched with keywords. A total of 26983 subjects involved in the meta-analysis. Papers were included and excluded using given rules. Data such as publishing year, investigation period, subject resources, total number of subjects, name of diagnosis, proportion of diseases were extracted for investigation. Then the investigation year (before 2010 or after 2011) was applied for sub-analysis in further research.

Results: 24 results of disease spectrum of aircrews from numbers of hospitals were meta-analyzed. The first common disease was cervical and lumbar spine disorder which occupied 10% of diseases for hospitalization. The spectrum of diseases was sub-analyzed by investigation year for further exploration. The proportion of cervical and lumbar spine disorder increased dramatically in the group of after 2011.

Conclusion: Our work gave evidenced-based support for disease spectrum of aircrews, pointed research directions for treatment and prevention of aircrews' common diseases, supported health strategy constitution of aircrews and guided well allocation of medical resources.

Keywords: disease spectrum; aircrews; hospitalization; cervical and lumbar spine disorder; health management;

Introduction

Aircrews are groups of people working in the sky. They work in especially tough environment, frequently exposed to low pressure, chemicals, acceleration and so on [1-3]. This makes aircrews at great risk for diseases. In one word, aircrews in the air are taking high risks at work.

Getting hold by diseases and being detained in hospital would stop them from working in the air. Once there is a problem with the health of aircrews, the aeronautical training and duty will be seriously interrupted [4]. Therefore, the support for health management of aircrews is profoundly crucial.

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The disease spectrum of hospitalized aircrews could support well to health management of aircrews [5]. The disease spectrum is the summarized results of common diseases of aircrews. It could recognize the frequently happened diseases that stop them from normal work and training [6]. It gives a brief descriptions of diseases causing aircrews' hospitalization [7]. It could also be sub-analyzed with different factors, such as time, age for further investigation [7]. It also draws attention for aviation doctor and scholars on typical diseases, especially those at the top of the spectrum. In this way, the specialists could focus on the reason of variation of disease spectrum, also could come up with effective strategy of treatment and prevention. Therefore, the disease spectrum of aircrews could achieve better health services for aircrews.

However, the disease spectrum of Chinese aircrews is still obscure. Zhang et al concluded that cervical/lumbar spinal disease and hypertension are top 2 categories for hospitalized aircrews, up to 9.30% and 7.97% respectively [8]. But Yang et al, through collection of diseases causing hospitalization of pilots, realized the top two ranking diseases are cervical/lumbar spinal disease and hyperlipidemia, up to 8.03% and 7.05% respectively. And the percentage accounted for hypertension in their disease spectrum only take 1.86% [7]. These results lacking consensus in proportion of diseases of hospitalized aircrews.

The reason for getting hard to draw consensus of disease spectrum may as follow. First, the overall number of aircrews is small, let alone the small numbers of aircrews enrolled in the investigation of disease spectrum. Second, the reports of disease spectrum come from one hospital. This lacks integrated analysis with numbers of centers which might be another reason for differences of spectrum.

Therefore, our paper collected the published articles from multi-center that related to Chinese aircrews' spectrum, extracted and synthesized the data from these articles which involved huge number of subjects, in order to give a robust evidence of the spectrum of Chinese inpatient aircrews. We came a conclusion for disease spectrum of Chinese aircrews. The frequently happened diseases were presenting in our disease spectrum of Chinese aircrews. We further sub-analyzed the spectrum of diseases by investigation year for advanced exploration. Our work gave evidenced-based support for disease spectrum of Chinese aircrews, pointed research directions for treatment and prevention of aircrews' common diseases, supported health management of Chinese aircrews and guided well for allocation of medical resources.

Materials and Methods

Data sources and search strategy

Two investigators (Zhouheng Ye and Tianyi Zhang) conducted systematic literature review using dataset. The database included China national knowledge infrastructure (CNKI) (Published from 1990 to 2020), Wangfang Data (Published from 1990 to 2020), VIP Database for Chinese Technical Periodicals (VIP) (Published from 1990 to 2020) and PubMed (Published from 1990 to 2020). Papers related with description of disease spectrum of Chinese aircrews were searched. While the search formula is varied according to different database, the search keywords is same in each database, named as "aircrew" and "inpatient or hospitalization" and "disease spectrum". The Chinese version of search keywords was used in Chinese Database. The same paper was merged after reading essential information, such as title, author and publication year, of each paper. Then the full copy of the filtered paper was downloaded for further review.

Inclusion and exclusion criteria

The inclusion and exclusion criteria are as follows. Inclusion criteria: ①Subjects are aircrews from mainland of China; ②The research style is cross-sectional study; ③ The subjects' hospitalization is caused by diseases; ④ The diagnosis of disease is clear, specified as organ + disease; ⑤ Data resources is well-defined. Also clear are the spectrum period, total number of subjects and percentage for typical disease. ⑥The diseases with over 6 reports of proportion were qualified for inclusion. Exclusion criteria: ① The paper is reported by sanatorium and lack specific diseases; ② Diagnosis is defined in the way of systematic diagnosis, such as digestive disease or in the way of department + disease, such as orthopedic disease, endocrinology disease and so on; ③ The total number of subjects is missing or the proportion of disease is missing; ④ Research focus only on specialized fields and results of disease spectrum showed only on specialized fields. Study selection and application of inclusion criteria were carried out independently by the two investigators who conducted the literature search (Zhouheng Ye and Tianyi Zhang).

Data extraction

Data extraction was independently performed by two investigators (Zhouheng Ye and Tianyi Zhang). The following information was extracted from each eligible study: author, year, study period, subject resources, total number of subjects, name of diagnosis, proportion of diseases.

Search results and study characteristics

The complete selection process is as follows (Figure 1). 206 records were retrieved by our search strategy. We excluded 165 articles after reading the titles and abstracts, and retained 41 articles for further evaluation by reading the full articles. Finally, we selected 24 full-text articles about hospitalization disease spectrum of Chinese aircrews. The sample sizes reached up to 26983 within the analysis.

Sub-analysis

We divided included papers by investigation year. The sub-analysis of investigation year applied to 14 kinds diseases out of all common diseases. The proportion of disease in sub-group was meta-analyzed using same way above.

Statistical analysis

We calculated the proportion of disease spectrum of hospitalized aircrews based on the proportion and 95% confidence intervals published in each study. Meta-analyses were conducted in R version 4.0.3, using the MetaProp

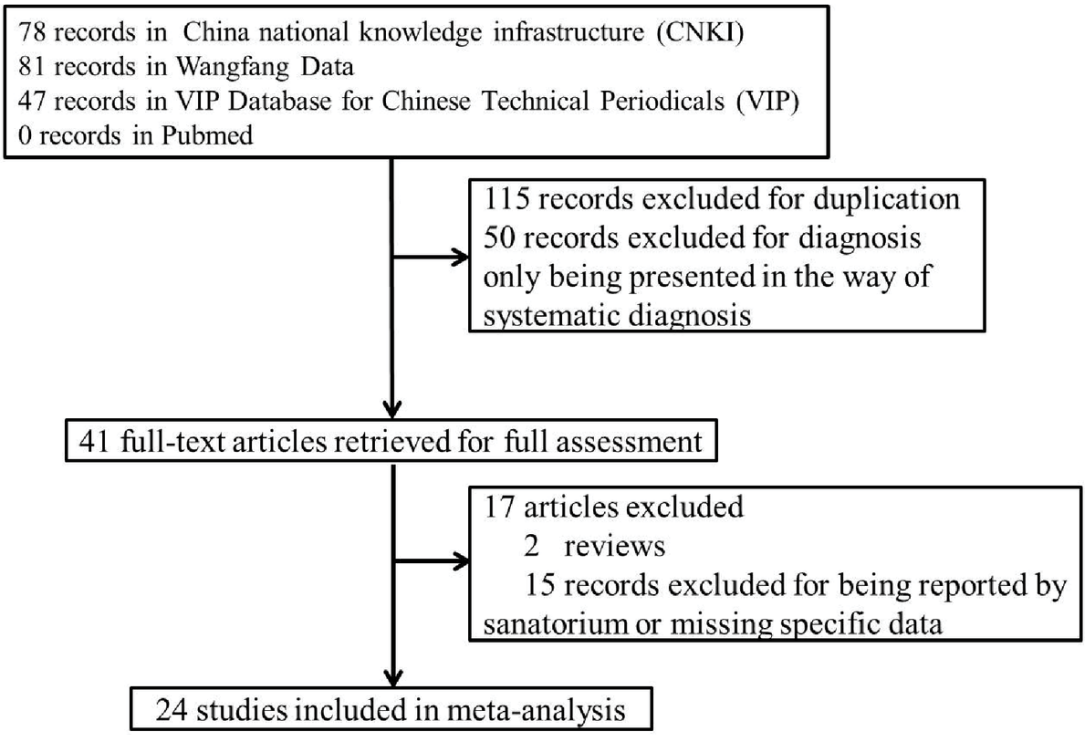

Figure 1: Selection process of studies for inclusion.

command in the "meta" package [9]. Pooled proportions were estimated using random effects models. Heterogeneity between studies was evaluated using the I2 statistic (p-values for heterogeneity). All statistical tests were 2-sided, and a P-value < 0.05 was considered to be statistically significant.

Results

Table 1 showed general characteristics of the 24 studies included in the analysis. The year of publication ranged from 1996 to 2019. The investigation duration was from 1958 to 2018. There are total 26983 subjects involved in meta-analysis. Fifteen kinds of diseases were involved in the investigation. Cervical and lumbar spine disorder included 23 research papers for investigation which was the most within all diseases. Neurasthenia included the least for investigation, only 6 papers.

Table 2 showed the proportion of diseases that is commonly happened in the hospitalized population of Chinese aircrews using meta-analysis. The first disease was cervical and lumbar spine disorder which occupied 10% of disease for hospitalization. And the other disease followed it was hyperlipidemia (8%), cervical spine disease (7%), neurasthenia (6%), hypertension (6%), gastritis and duodenitis (6%), headache (6%), vegetative nerve functional disturbance (6%), upper respiratory infection (6%), fatty liver (5%), gastric and duodenal ulcers (4%), arrhythmia (4%), ground syncope (3%), urinary calculus (3%) and poor acceleration tolerance (2%) respectively. The cervical and lumbar spine disorder was the leading disease with pooled proportion of 10%, 95%CI 8% to 13%. There were 2026 subjects out of 23 research records involved in the investigation. The p value of heterogeneity was <0.05 while the p value of egger's test was over 0.05. Hyperlipidemia ranged second place of the results with pooled proportion of 8% (95%CI 5% to 11%). The third disease was cervical spine disease with pooled proportion of 7% (95%CI 4% to 12%). Neurasthenia was the fourth common disease with pooled proportion of 6% (95%CI 3% to 9%). This proportion was same with hypertension, gastric and duodenitis, headaches, vegetable nerve functional disturbance and infection of the upper respiratory tract. The p value of the disease above was all < 0.05 while the p value of egger's test was over 0.05. The poor acceleration was the last disease in table 2 with pooled proportion of 2% (95%CI 2% to 3%). The other included disease, such as fatty liver, gastric and duodenal ulcers, arrhythmia, ground syncope and urinary calculus, was below 6%, ranging from 3% to 5% (Table 2). Figure 2 representatively showed the forest plots of cervical and lumbar spine disorder. The blue marker demonstrated the proportion extracted from each included records while the red diamond showed the pooled proportion meta-analyzed by metaprop function.

Sub-group analysis was applied according to different investigation year (Table 3). The 2010 was set as the dividing line for sub-analysis of each disease. Cervical and lumbar spine disorder showed proportion of 10% in group of before 2010 while a remarkable increase to 15% (95%CI 9% to 26%) was found in group of after 2011. The cervical spine disease reported proportion of 5% (95%CI 3% to 8%) in group of before 2010 while in group of after 2011 the pooled proportion increased to 12% (95%CI 4% to 38%). The egger's test for both disease was over 0.05 while p value

ID	Author	Publish Year	Investigation Duration	Number of Subjects	Cervical and lumbar spine disorder	Urinary calculus	Hypertension	Gastritis and duodenitis	Headaches	arrhythmia	Cervical spine disease	Infection of the upper respiratory tract	Fatty liver	Vegetative nerve functional disturbance	Ground syncope	Gastric and duodenal ulcers	Hyperlipidemia	Poor acceleration tolerance	Neurasthenia
1	Shizhen Qin	1996	1958-1996	6723	—	—	437	793	—	316	—	—	—	645	—	370	—	—	551
2	Xianrong Xu	2005	1965-2004	1200	84	32	17	49	—	20	23	—	17	—	41	—	—	43	25
3	Xuejun Zhong	2012	1986-2010	2974	87	68	—	290	—	—	—	110	—	—	—	76	—	—	—
4	Dongdong He	2007	2000-2005	2223	423	57	42	46	103	70	182	—	—	—	—	64	—	—	—
5	Yongping Liu	2007	2000-2006	130	38	11	14	8	—	—	10	7	4	16	4	—	10	—	—
6	Yan Dong	2013	2001-2010	1260	105	40	—	83	—	—	—	43	—	—	—	—	—	—	44
7	Haiyan Wang	2012	2001-2010	1175	83	28	—	59	—	—	42	—	—	—	31	—	—	—	—
8	Keliang Zhou	2012	2001-2010	96	8	13	—	—	—	—	—	—	—	—	—	—	—	—	9
9	Keliang Zhou	2012	2001-2010	575	45	14	—	—	—	—	—	—	—	—	—	—	—	—	23
10	Binbin Shi	2012	2002-2011	346	52	18	19	14	—	—	—	15	13	17	—	25	16	—	—
11	Huixian Wang	2010	2003-2008	1378	143	—	81	—	110	—	—	—	—	90	—	—	—	22	—
12	Dan Zhang	2014	2003-2012	1228	143	82	109	107	71	—	—	85	107	—	—	—	73	—	—
13	Leiming Lin	2007	2006-2007	75	4	4	4	3	—	—	—	11	—	—	—	—	—	—	8
14	Xianrong Xu	2011	2006-2011	129	20	5	11	6	11	6	—	—	—	—	9	—	—	—	—
15	Leiming Lin	2014	2006-2013	326	14	—	14	23	—	—	16	37	—	21	—	—	—	—	—
16	Xiuming Wang	2017	2006-2015	2035	286	—	119	91	68	—	182	76	—	—	—	—	—	—	—
17	Yuhua Liu	2012	2007-2010	2061	136	46	163	—	79	80	109	—	—	—	55	—	—	42	—
18	Yuhua Liu	2013	2007-2012	124	11	—	—	—	4	12	—	—	—	—	5	5	—	3	—
19	Yuhua Liu	2014	2007-2012	311	33	11	—	—	15	24	—	—	—	—	9	—	—	13	—
20	Binbin Shi	2013	2008-2012	1011	148	27	45	36	—	—	—	—	53	21	—	42	46	—	—
21	Ying Wang	2013	2008-2012	270	38	—	21	26	36	—	19	—	—	—	—	—	—	—	—
22	Jiaxing Zhou	2018	2011-2015	31	15	—	—	—	—	—	20	—	1	—	—	—	10	—	—
23	Lvpu Zhang	2018	2014-2016	281	28	—	24	8	—	10	—	—	17	11	—	7	—	—	—
24	Jishun Yang	2019	2015-2018	1021	82	12	19	—	56	13	—	—	60	—	—	—	72	24	—

Table 1: The general characteristics of the 24 studies included in the analysis.

Name of Disease	Number of paper included	Number of cases	Proportion (%)	95%CI		Heterogeneity Test		Egger's test	
						I^2(%)	P	T Value	P
Cervical and lumbar spine disorder	23	2026	10	8	13	96	<0.01	-1.4283	0.1679
Hyperlipidemia	6	227	8	5	11	89	<0.01	0.89046	0.4235
Cervical spine disease	9	603	7	4	12	98	<0.01	-0.37078	0.7218
Neurasthenia	6	660	6	3	9	97	<0.01	-0.11452	0.9143
Hypertension	16	1139	6	4	7	95	<0.01	1.7374	0.1043
Gastritis and duodenitis	16	1642	6	4	8	97	<0.01	0.37273	0.7149
Headaches	10	553	6	4	7	89	<0.01	0.14253	0.8902
Vegetative nerve functional disturbance	7	821	6	3	9	97	<0.01	-0.31652	0.7644
Infection of the upper respiratory tract	8	384	6	4	8	91	<0.01	0.90149	0.4021
Fatty liver	8	272	5	3	7	93	<0.01	1.6054	0.1595
Gastric and duodenal ulcers	7	589	4	3	5	92	<0.01	0.11269	0.9147
Arrhythmia	9	551	4	4	5	92	<0.01	0.53309	0.6105
Ground syncope	7	154	3	3	4	35	0.16	1.236	0.2713
Urinary calculus	16	468	3	3	5	88	<0.01	0.20197	0.8428
Poor acceleration tolerance	6	147	2	2	3	62	0.02	1.6147	0.1817

Table 2: Disease spectrum of military aircrews reported in 24 articles.

Name of Disease	Before 2010 or after 2011	Number of paper included	Number of cases	Proportion (%)	95%CI		Heterogeneity Test		Egger's test	
							I^2(%)	P	T Value	P
Cervical and lumbar spine disorder	Before 2010	19	1615	10	7	12	96	<0.01	-1.6652	0.1142
	After 2011	4	411	15	9	26	96	<0.01	0.2521	0.8245
Hyperlipidemia	Before 2010	3	99	6	5	7	0	0.41	0.2234	0.8601
	After 2011	3	128	7	3	11	87	<0.01	1.8408	0.3168
Cervical spine disease	Before 2010	5	366	5	3	8	95	<0.01	0.859	0.4535
	After 2011	4	237	12	4	38	98	<0.01	0.1465	0.897
Hypertension	Before 2010	7	758	5	3	8	97	<0.01	0.7812	0.47
	After 2011	9	381	6	4	8	91	<0.01	1.9418	0.0933
Gastritis and duodenitis	Before 2010	8	1331	6	3	9	98	<0.01	0.3430	0.7433
	After 2011	8	311	5	4	7	84	<0.01	0.9704	0.3693
Headaches	Before 2010	3	292	5	3	7	92	<0.01	5.9098	0.1067
	After 2011	7	261	6	4	7	83	<0.01	2.1183	0.0877
Vegetative nerve functional disturbance	Before 2010	3	751	9	6	11	89	<0.01	-0.1657	0.8955
	After 2011	3	49	3	2	5	70	0.04	4.175	0.1497
Infection of the upper respiratory tract	Before 2010	4	171	5	3	9	88	<0.01	1.367	0.305
	After 2011	4	213	6	4	9	90	<0.01	1.7304	0.2257
Fatty liver	Before 2010	3	34	2	1	4	64	0.06	2.097	0.2833
	After 2011	5	238	6	5	8	68	0.01	-0.3023	0.7821
Gastric and duodenal ulcers	Before 2010	3	510	4	2	6	97	<0.01	-0.6034	0.6544
	After 2011	4	79	4	3	6	63	0.05	0.4810	0.678
Arrhythmia	Before 2010	4	486	3	2	5	94	<0.01	-1.1986	0.3534
	After 2011	4	52	6	3	9	62	0.05	1.5488	0.2615
Ground syncope	Before 2010	4	131	3	2	3	0	0.65	0.5901	0.6149
	After 2011	3	23	4	2	6	30	0.24	2.5081	0.2415
Urinary calculus	Before 2010	9	302	3	2	4	83	<0.01	1.778	0.1187
	After 2011	6	155	4	2	6	91	<0.01	1.8197	0.1429
Poor acceleration tolerance	Before 2010	3	107	2	1	3	80	<0.01	1.9859	0.297
	After 2011	3	40	3	2	4	10	0.33	0.7963	0.5719

Table 3: Disease spectrum of military aircrews in different investigation duration.

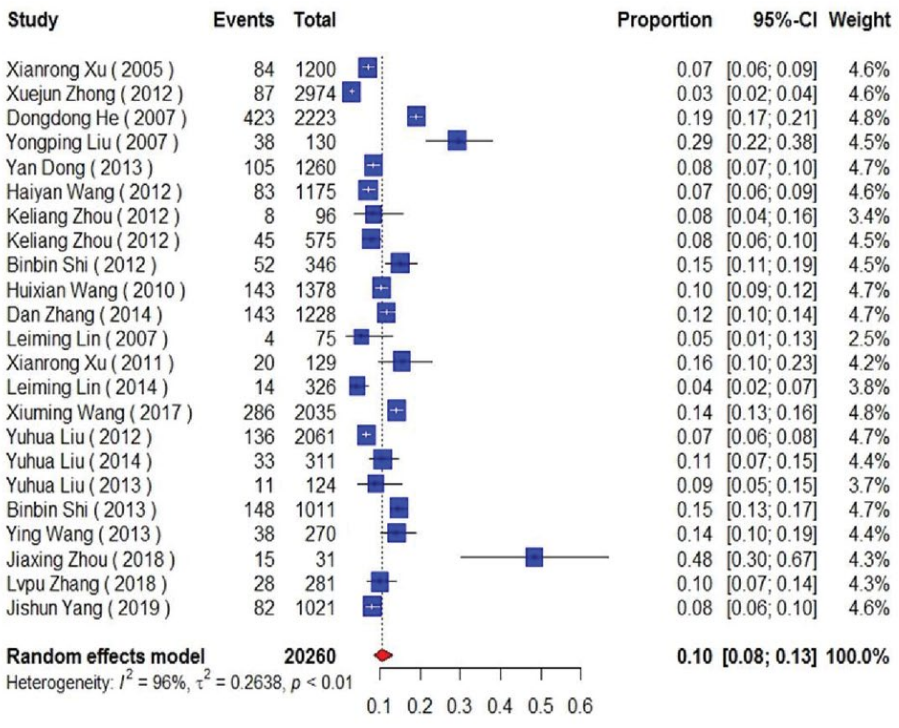

Figure 2: Forest plots with meta-analysis data for cervical and lumbar spine disorder.

of heterogeneity was <0.01. The vegetative nerve functional disturbance had higher proportion in the group of before 2010 (9%, 95%CI 6% to 11%) compared with the group of after 2011 (3%, 95%CI 2% to 5%). The fatty liver showed pooled proportion of 2% (95%CI 1% to 4%) which raised to 6% (95%CI 5% to 8%) in the group of after 2011. The arrhythmia showed pooled proportion of 3% (95%CI 2% to 5%) which grew to 6% (95%CI 3% to 9%) in the group of after 2011.

Discussion

The disease spectrum of the Chinese aircrews can describe the common disease of the aircrews that is crucial for health management of Chinese aircrews [10]. However, the disease spectrum is not well documented and lacks consistence between each research paper [11]. Thus, with poor health management causing by indefinite disease spectrum, the aircrews cannot fulfill the job working in the air [12]. And there is no way to guide properly for health support for aviation doctor. Therefore, the necessary to recognize the most common disease for the aircrews is deeply accepted.

Our results demonstrated that during investigation year from 1958 to 2018, there are 15 common diseases commonly happened in Chinese aircrews. These are cervical and lumbar spine disorder (10%), hyperlipidemia (8%), cervical spine disease (7%), neurasthenia (6%), hypertension (6%), gastritis and duodenitis (6%), headache (6%), vegetative nerve functional disturbance (6%), upper respiratory infection (6%), fatty liver (5%), gastric and duodenal ulcers (4%), arrhythmia (4%), ground syncope (3%), urinary calculus (3%) and poor acceleration tolerance (2%), respectively.

The first common disease was cervical and lumbar spine disorder. There is a consistency that cervical and lumbar was the first common disease in spectrum of Chinese aircrews. Yang et al supported this idea with their results [7]. The paper of Yang's presented that the first three common diseases in the investigation was cervical and lumbar spine disease, hyperlipidemia and fatty liver. The proportion of the disease was 8.03% which means 82 got the diseases out of 1021 subjects. This prevalence is same with our results, 10% (8%-13%). Our previous work had higher results that the two most frequently happened diseases were cervical spondylosis and lumbar disease [13]. The proportion of these two diseases were 29% and 22% respectfully. Xiuming Wang and colleagues reported the first common disease was lumbar and cervical disease [14]. Our results reported proportion with 10%. It is between the result of Jiaxing Zhou et al and Xiuming Wang.

There might be three reasons for aircrews getting a disc herniation. First, aircrews have to keep a sitting statue for long time, especially for transport plane [15]. Second, the helmet may burden the pressure hold by cervical spine, especially when there is high acceleration [16]. Third, the plus-minus acceleration may introduce more pressure on spine to fight against the acceleration [17].

Our sub-analyzed results of cervical and lumbar spine disorder of investigation year supported the third hypothesis. We did subgroup analysis for group of year before 2010 and group of year after 2011. There is an increase of acceleration for Chinese aircrews after 2011. In the group of before 2010 of disease of cervical and lumbar spine disorder, the proportion was 10%，almost same with the proportion in the whole objects. But the proportion in the group of after 2011 increase dramatically to 15%. This might support the third reason for the aircrews' spine disease. This might support the idea that with high acceleration [18], there is higher proportion of cervical and lumbar spine disorder happened in the aircrews.

The second common disease was hyperlipidemia with proportion of 8% (CI 5% to 11%). Hongjie Shen and colleagues reported that hyperlipidemia was among the first five diseases in aircrews [19]. Jishun Yang et al supported this by presenting the results that hyperlipidemia was the second-high proportion disease during investigation group [7]. The reason for this might related to the increase of food calories in aircrews' diets. Therefore, there is great need for aviation doctors focus on hyperlipidemia both on prevention and treatment.

There are other three kinds of trend we would like to discuss in the sub-analysis by investigation year. First, vegetative nerve functional disturbance decreased in the group of after 2011. This might have related to diagnosis accuracy. Disease used to be diagnosis with vegetative nerve functional disturbance now was grouped accurately to other diseases. Second, fatty liver increased dramatically in group of after 2011 compared with group of before 2010. This might have correlated to the increase of calories in the diet of aircrews with improvement of Chinese economy. Third, arrhythmia also showed high proportion of increase compared with group of before 2010. The proportion was only 2% in group of before 2010. And it increased to 6% in the group of after 2011. This might have related to the improvement of diagnostic capability of aviation doctors with the year passing by.

Our work demonstrated the most 15 common diseases for Chinese aircrews. With these results, aviation doctors could focus more on the frequently happened diseases. Also the proportion of other diseases was showed in the results. Our work makes a clear vision for future research and aviation work. The disease spectrum of aircrews is the classical way to get started for health management of aircrews. Our investigations also showed the variation of disease spectrum with different investigation year. This could guide research and improvement direction of the health service support in the future.

Limitations

Our results have limitation. Diseases happened for Chinese aircrews but not over 6 reports were not analyzed in our research. These diseases included depression, anxiety, knee joint disease, polyp of gallbladder, aviation disease, hyperuricemia and renal cysts and so on. These diseases also happened in inpatient aircrews and need further analyzed in near future.

Conclusion

Our paper presented all 15 common disease of Chinese aircrews. cervical and lumbar spine disorder was the first frequently happened disease in inpatient aircrews. The proportion of cervical and lumbar spine disorder in aircrews varied according to investigation year. Other diseases were also showed in meta-analysis work of inpatient aircrews. This disease spectrum could offer proper guide for health management of Chinese aircrews.

Auhors' Contribution

ZHY, TYZ and JCL contributed equally to this work. ZHY, TYZ and JCL conceived the idea and the designed the study. ZHY and TYZ collected the data. TYZ and JCL cleaned the data. ZHY and TYZ draft the manuscript. All authors critically revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

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Registration and Protocol

None

Competing Interest

The authors declare no competing interests.

Patient Consent for Publication

Not required.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

Reference

1. Ata N, Karaca E (2021) Investigation of a cluster of decompression sickness cases following a high-altitude chamber flight. Diving and hyperbaric medicine 51: 82-85.
2. Sweeney LM, Gearhart JM, Ott DK (2020) Considerations for Development of Exposure Limits for Chemicals Encountered During Aircraft Operation. Military medicine 185: 390-395.
3. Pollock RD, Gates SD, Storey JA (2021) Indices of acceleration atelectasis and the effect of hypergravity duration on its development. Experimental physiology 106: 18-27.
4. D'Arcy JL, Syburra T, Guettler N (2019) Contemporaneous management of valvular heart disease and aortopathy in aircrew. Heart (British Cardiac Society) 105: s57-s63.
5. Huang H, Liu J, Feng Y (2013) The distribution of apolipoprotein E gene polymorphism in Chinese civil aircrews, and a possible risk factor to their overweight and dyslipidemia is cumulative flight time. Clinica chimica acta; international journal of clinical chemistry 416: 36-40.
6. Huang YM, Xu D, Long J (2019) Spectrum of chronic kidney disease in China: A national study based on hospitalized patients from 2010 to 2015. Nephrology (Carlton, Vic) 24: 725-736.
7. Yang JS, Lan F, Cang J (2019) Disease spectrum of hospitalized Air Force pilots. Med J Air Force 35: 470-473.
8. Zhang LP, Cao XY, Zhang SL (2018) The comparison analysis of physical examination disease spectrum and inpatient disease spectrum for pilots. Chin J Aerospace Med 29: 238-239.
9. Tang BH, Chen Q, Chen X (2017) Earthquake-related injuries among survivors: A systematic review and quantitative synthesis of the literature. Int J Disast Risk Re 21: 159-167.
10. Lei Y, Meng H (2021) Disease spectrum analysis and health management strategy discuss of pilots. Chi Med 6: 477-480.
11. Wang GY, Kong DW, Wang J (2018) Meta-analysis of the main disease spectrum of flight personnel in China and the United States. Med J Air Force 34: 228-233.
12. Rumisha SF, Lyimo EP, Mremi IR (2020) Data quality of the routine health management information system at the primary healthcare facility and district levels in Tanzania. BMC medical informatics and decision making 20: 340.
13. Zhou JX, Han L, Zhou BY (2018) Analysis of hospitalized disease spectrum in a certain type of navy fighter pilots in 2011-2015. Chin J Health Care Med 20: 327-330.
14. Wang XM, Xie AG, Liu DB (2017) Disease distribution among hospitalized military pilots in Northeast of China from 2006 to 2015. Med J Air Force 33: 223-227.
15. Takahashi H, Aoki Y, Inoue M (2021) Characteristics of relief and residual low back pain after discectomy in patients with lumbar disc herniation: analysis using a detailed visual analog scale. BMC musculoskeletal disorders 22: 167.
16. Manen O, Clément J, Bisconte S (2014) Spine injuries related to high-performance aircraft ejections: a 9-year retrospective study. Aviation, space, and environmental medicine 85: 66-70.
17. Purushothaman Y, Humm J, Jebaseelan D (2021) Neck Vertebral Level-specific Forces and Moments Under G-x Accelerative Loading. Military medicine 186: 625-631.
18. Penchev R, Scheuring RA, Soto AT (2021) Back Pain in Outer Space. Anesthesiology 135: 384-395.
19. Shen HJ (2020) Analysis of the disease spectrum for high-performance fighter pilots who stayed in the sanatorium for refreshment from 2009 to 2019. J Navy Med 41: 401-410.