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Prevalence of the Activities of Daily Living Disability among Seniors in China: A Meta-Analysis

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Abstract: *This meta-analysis aimed to systematically assess the prevalence of Activities of Daily Living (ADL) disability among elderly in China. Two reviewers conducted a meta-analysis using articles available in nine databases. Methods: The Newcastle–Ottawa Scale (NOS) was used to assess the quality of the studies. The random-effects model was used to estimate the prevalence of ADL disability. The source of heterogeneity among subgroups was determined by subgroup analysis of different parameters. Publication bias was assessed using a funnel plot and Egger test. A total of 100 studies involving 291235 subjects were included. The aggregate prevalence of ADL disability was 31.7% (95% CI = 28.2%–35.2%). The prevalence rate of IADL disability was 43.3% (95% CI: 30.5%–56.1%), and that of PADL disability was 14.4% (95% CI: 7.8%–20.7%). The prevalence of male was 17.9% (95%CI: 17.6%–18.1%), and that of female was 21.4% (95%CI: 21.1%–21.6%). For subgroup analysis by age, the prevalence of disability was 10.8% (95% CI: 10.5%–11.0%) in 60–69 year-old participants, 21.2% (95% CI: (20.8%–21.6%) in 70–79 year-old participants, and 47.0% (95% CI: (46.2%–47.8%) in participants aged ≥80 years. The prevalence of ADL disability in married elderly was 13.4% (95% CI: 13.1%–13.6%), and that in single elderly was 29.7% (95% CI: 29.2%–30.2%). The prevalence rate of chronic ADL disability was 29.6% (95%CI: 29.2%–30.0%), and that of non-chronic ADL disability was (15.9% CI: 15.5%–16.4%). The prevalence of living alone ADL disability was 19.6% (95% CI: 19.0%–20.2%), and that of living with their families or living in institutions was 18.5% (95% CI: 18.2%–18.7%). The prevalence rates were 28.6% (95% CI: 28.1%–29.1%), 19.1% (95% CI: 18.5 %–19.8%), and 18.8% (95% CI: 17.4%–20.2%) among primary school graduates to university graduates. Given the high prevalence of ADL disability and its negative health outcomes, preventive measures need to be implemented for the high-risk group. Our study may help the development of strategies for ADL disability management.*

Keywords: *China; Meta-analysis; Activities of Daily Living; Prevalence; Old adult*

1. Introduction

With the long-term trend of the extension of average life expectancy and the decline of fertility rate, the global population is aging rapidly[1]. Since 1999, when societal aging began in China, the country has experienced a dramatic increase in its aging population. National Bureau of Statistics reported that the number of people aged 60 and above in China increased from 90 million in 2001 to 267 million in 2021, accounting for 18.9% of the total population[2]. Given that the physical function of elderly people gradually declines, their morbidity is higher than that of younger people, which can significantly increase the burden on families and bring a heavy financial pressure to the whole society[3]. For example, hypertension, hyperlipidemia, diabetes, coronary heart disease, and chronic obstructive pulmonary disease can limit the daily activities of the elderly in later stages of development. Thus, ensuring and maintaining the health of elderly is crucial for China to cope with aging[4].

Activities of Daily Living (ADL) is a convenient way to assess a person's functional level; it refers to the ability to perform his or her daily activities that are basic for an independent life[5]. The ADL scale consists of physical activities of daily living (PADL) and instrumental activities of daily living (IADL)[6]. The PADL indicators include eating, dressing, grooming, walking, getting in and out of bed, and bathing; the IADL indicators include making phone calls, using transportation, shopping, doing housework, taking medication, cooking, and managing money[7]. For elderly, ADL is a fundamental indicator of health status and a major determinant of quality of life[8]. Based on these arguments and that older adults who develop ADL disability are hardly to recover function, the risk and protective factors for ADL in the elderly population should be identified.

The prevalence of ADL disability in Chinese population varies widely. Scholars should develop strategies that can prevent or delay the onset of ADL disability and address the challenges of a rapidly aging society in the coming decades[9]. In this regard, we conducted this meta-analysis using published population-based studies (among Chinese elderly population) to establish the relationship among different variables, namely, ADL disability, immutable risk factors (such as age and gender), and modifiable risk factors (e.g., illness, lifestyle, education background, and marital status)[10]. To extract a more accurate and general influencing factors of ADL disability by avoiding differences in individual studies caused by biased samples and moderating factors[11].

2. Materials and Methods

2.1. Search strategy

Two investigators performed a comprehensive search on the following electronic databases for relevant eligible studies published before December 2021: China Biomedical Literature Database (CBM), China National Knowledge Infrastructure (CNKI), WanFang Data, VIP database, PubMed, Embase, Web of Science, Cochrane Library, and Google Scholar. Additional relevant articles were identified by manual search of the references of retrieved literature. Relevant keywords used as search strategy were as follows: ('ADL' OR 'Activity of Daily Living' OR 'Chronic Limitation of Activity') AND ('elder' OR 'old population' OR 'aged' OR 'senile') AND ('influence factors' OR 'risk factors' OR 'associated factors'). Ethical approval was not required for this study as it was based entirely on literature.

2.2. Inclusion criteria and exclusion criteria

The inclusion criteria were as follows: (1) sample size of ≥100 elderly Chinese participants (age ≥60 years); (2) identified assessment data and definition for ADL impaired; (3) cross-sectional data; and (4) date of normal and damage of ADL in participants for comparison in primary analysis.

The exclusion criteria were as follows: (1) republished paper; (2) review, meeting, case, or unpublished paper; (3) incomplete, unclear, or unextractable data for research; (4) non-Chinese or English literature; and (5) unscientific or poor quality design scheme.

2.3. Data extraction

Data were extracted from the included studies by two independent investigators and included the following: (1) name of the first author; (2) year of publication; (3) sample size; (4) age range of the participants; (5) name of journal; and (6) research regions. Any discrepancy was solved by discussion with a third investigator. Two reviewers extracted the information from each eligible study and encoded into Excel. Data are summarized in Table 1, when necessary, the original authors were contacted for additional information.

2.4. Quality appraisal

The Newcastle–Ottawa Scale (NOS) was used for quality assessment of cross-sectional studies for this meta-analysis[12]. The scale assesses the aspects of study quality, assigns a maximum of 9 points based on three categories: selection (four items, one point for each), comparability (one item, up to two points), and outcome (three items, one point for each). Each item was scored 1 point if the criterion was met (except for the comparability of the 2 points). Overall quality score was calculated by summing the items. We considered studies with quality scores >6 to be high-quality studies.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

2.5. Statistical analysis

All analyses were conducted using Stata version 11.0 (Stata Corporation, College Station, TX). A random-effects model was used for this meta-analysis due to heterogeneity between studies. Statistical heterogeneity was assessed through I2 statistic[13]. The I2 values of 25%–50% indicated low heterogeneity; values of 50%–75% indicated moderate heterogeneity, and values > 75% indicated high heterogeneity[14]. Begg's and Egger's tests were used to assess potential publication bias[15][16]. Subgroup analyses were conducted to explore the differences among the effects of various types of characteristics (gender, age, education level, and so on) on ADL performance.

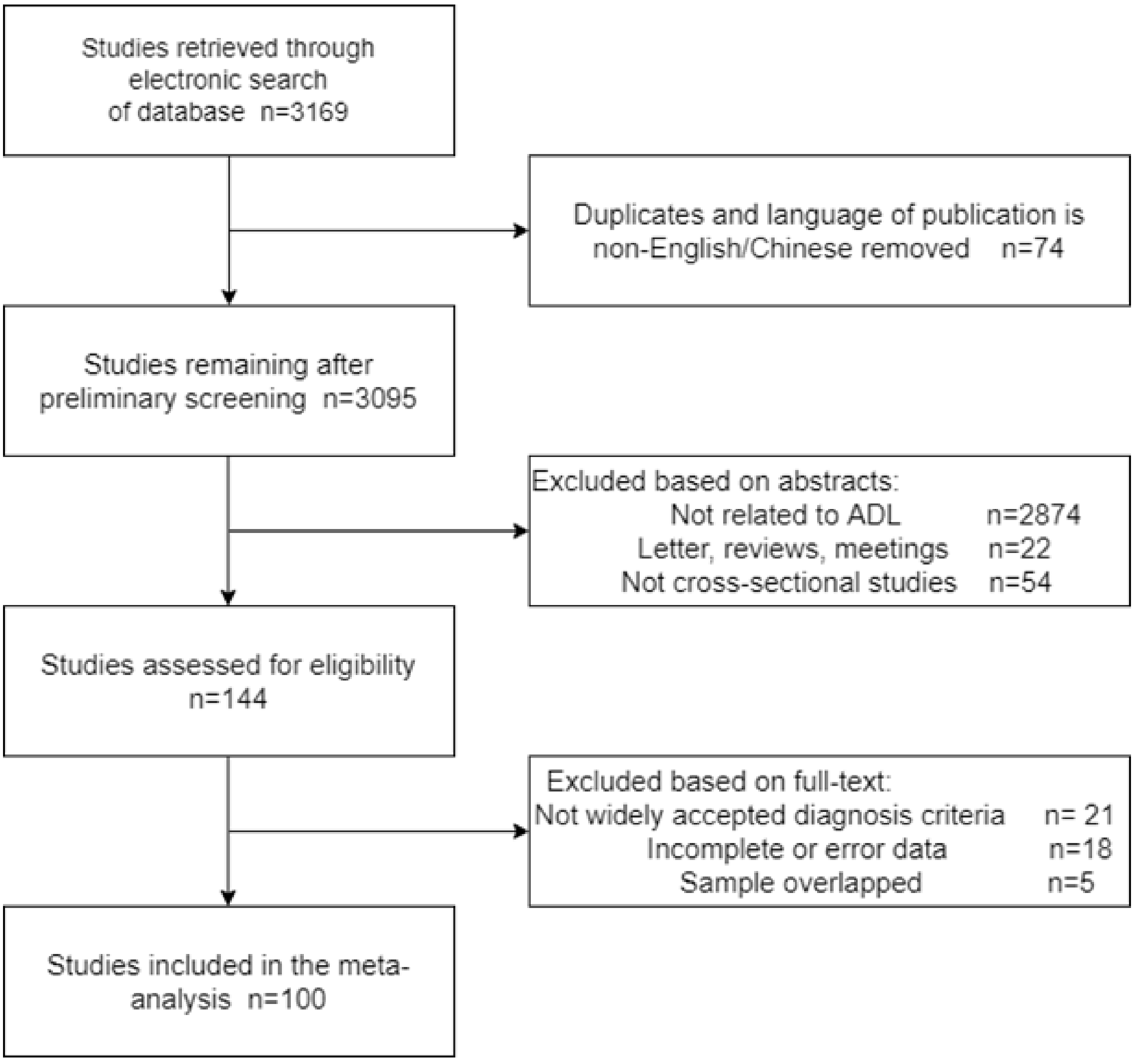


Figure 1: Flow chart of study selection

Table 1: Basic characteristics of the studies in this meta-analysis

Study	City	Age	Events	Total	Prevalence	Score
ZR Shi(2009)[17]	Shandong	≥60	152	152	0.3684	6
YZ Sun(2004)[18]	Henan	≥60	812	812	0.3608	6
W He(2018)[19]	Xinjiang	≥60	948	948	0.4768	6
YX Chen(2021)[20]	Hubei	≥60	2927	2927	0.0547	6
F Feng(2016)[21]	Anhui	≥60	3182	3182	0.6109	6
C Li(2016)[22]	Anhui	≥60	746	746	0.2828	6
Y Han(2016)[23]	Beijing	≥60	1845	1845	0.2531	6
M Liu(2018)[24]	Beijing	≥60	4499	4499	0.1209	6

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

XF XU(2018)[25]	Chengdu	≥60	890	890	0.1337	6
W Huang(2012)[26]	Anhui	≥60	1117	1117	0.7314	6
HF Zhao(2009)[27]	Fujian	≥60	4237	4237	0.1730	6
B Xue(2011)[28]	Shanghai	≥80	1027	1027	0.6563	6
ZX Yin(2012)[29]	Henan	≥80	1014	1014	0.2485	6
ZY Li(2019)[30]	China	≥65	10563	10563	0.2017	7
XF XU(2021)[31]	Guangxi	≥60	1037	1037	0.2266	6
S Xu(2020)[32]	Hainan	≥60	365	365	0.0795	6
Y Yao(2017)[33]	Hainan	≥100	804	804	0.7251	6
SG Gen(2022)[34]	Henan	≥60	8441	8441	0.2906	7
C Zhang(2019)[35]	Henan	≥60	200	200	0.1800	6
DY Wang(2019)[36]	Shandong	≥60	1381	1381	0.6054	6
W Yan(2021)[37]	China	≥65	15771	15771	0.2661	7
Y Qiao(2018)[38]	Shandong	≥60	1864	1864	0.2023	6
XY Gu(2020)[39]	Jiangsu	≥60	3259	3259	0.1056	6
LB Gu(2018)[40]	Jiangsu	≥60	184	184	0.5489	6
XL Wang(2015)[41]	Jiangxi	≥60	304	304	0.4408	6
H Jiang(2015)[42]	Jiangxi	≥60	218	218	0.1972	6
XM Lin(2020)[43]	Liaoning	≥60	769	769	0.1417	6
XM Lin(2012)[44]	Liaoning	≥60	779	779	0.0513	6
JK S(2012)[45]	Shanghai	≥60	830	830	0.7145	6
X Gao(2017)[46]	Jiangsu	≥60	1139	1139	0.1554	6
WP Yuan(2021)[47]	Shanxi	≥60	3250	3250	0.0757	6
N Chen(2021)[48]	China	≥60	7168	7168	0.3602	7
JQ Xu(2019)[49]	Jiangsu	≥60	1048	1048	0.1985	6
JH Ji(2017)[50]	Guangdong	≥60	422	422	0.2180	6
H Lin(2002)[51]	Beijing	≥60	895	895	0.1944	6
ZJ Qiu(2021)[52]	Hunan	≥60	2095	2095	0.8210	6
MH Wang(2002)[53]	Guangdong	≥60	1161	1161	0.0810	6
JF Liang(2010)[54]	Guangdong	≥60	1000	1000	0.0890	6
AQ Song(2012)[55]	Shandong	≥65	504	504	0.1905	6
YY Zhou(2020)[56]	Guangdong	≥60	275	275	0.9091	6
ZY Liu(2015)[57]	Sichuan	≥60	267	267	0.4345	6
L Zhao(2016)[58]	Zhejiang	≥60	1053	1053	0.3951	6
X Zhang(2020)[59]	Sichuan	≥60	783	783	0.2299	6
QR Qing(2018)[60]	Anhui	≥60	3476	3476	0.1827	6
JH Qian(2016)[61]	China	≥60	7970	7970	0.2381	6
LY Dai(2018)[62]	China	≥65	5296	5296	0.2213	6
JF Chen(2019)[63]	Zhejiang	≥60	571	571	0.3555	6
T Xiao(2021)[64]	Shanxi	≥60	3307	3307	0.3420	6
HL Zhai(2018)[65]	Anhui	≥60	995	995	0.3236	6
XQ Xu(2011)[66]	Zhejiang	≥60	753	753	0.1248	6
RM Tan(2010)[67]	Zhejiang	≥60	814	814	0.3538	6
AQ Song(2013)[68]	Shandong	≥65	504	504	0.1905	6
LP Yi(2016)[69]	Hubei	≥65	4002	4002	0.3441	6

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

J Chen(2016)[70]	Shanghai	≥60	3556	3556	0.2472	6
YY Song(2020)[71]	Shandong	≥65	559	559	0.2558	6
LP Gao(2010)[72]	Shandong	≥60	5400	5400	0.1737	6
R Jing(2009)[73]	Shandong	≥60	451	451	0.5565	6
YT Li(2012)[74]	Shanghai	≥60	11338	11338	0.1775	7
F Chen(2015)[75]	Liaoning	≥60	329	329	0.2492	6
QY Liu(2018)[76]	Anhui	≥60	302	302	0.2351	6
XJ Yang(2017)[77]	Shanghai	≥60	8389	8389	0.1560	6
MJ Zhang(2007)[78]	Jiangxi	≥60	258	258	0.0349	6
XM Zhang(2016)[79]	Shandong	≥60	1208	1208	0.4263	6
Y Qu(2021)[80]	Liaoning	≥60	279	279	0.4946	6
GX Yuan(2009)[81]	Hubei	≥65	148	148	0.4054	6
HL Tao(2020)[82]	Anhui	≥90	478	478	0.2699	6
L Huang(2021)[83]	Henan	≥60	720	720	0.2944	6
YB Xiao(2017)[84]	Anhui,Shanghai,Guangdong,Heilongjiang,Shanxi,Hubei	≥60	6980	6980	0.1195	6
YB Xiao(2017)[85]	Guangdong,Shanghai,Shanxi,Hubei,Heilongjiang	≥60	5282	5282	0.0795	6
XF XU(2018)[86]	Western China	≥60	7175	7175	0.2114	6
JJ Shu(2019)[87]	Xinjiang	≥60	761	761	0.7043	6
YT Ai(2021)[88]	Hubei	≥60	822	822	0.1058	6
MS Si(2018)[89]	Shandong	≥60	800	800	0.7613	6
Q Liao(2020)[90]	Sichuan	≥60	436	436	0.8188	6
JH Ma(2005)[91]	Ningxia	≥60	5399	5399	0.8652	6
YS Guo(2018)[92]	Ningxia	≥60	869	869	0.5305	6
Y Li(2015)[93]	Ningxia	≥60	817	817	0.1028	6
Y Liu(2003)[94]	Sichuan	≥60	110	110	0.3364	6
JC Zhou(2001)[95]	Chongqing	≥60	1242	1242	0.3398	6
YN Cai(2020)[96]	Yunnan	≥60	3978	3978	0.2559	6
SG Qi(2019)[97]	Beijing,Shanghai,Hubei,Sichuan,Guangxi,Yunnan	≥60	18785	18785	0.1043	7
Y Jiang(2020)[98]	China	≥80	4646	4646	0.3220	6
JH Qian(2016)[99]	China	≥60	7970	7970	0.2381	6
SM Jiang(2019)[100]	China	≥65	5087	5087	0.4970	6
SK Li(2017)[101]	Liaoning,Shanghai,Gansu,Henan,Guangdong	≥60	7631	7631	0.0891	6
XF Jing(2017)[102]	Shanghai,Beijing,Guangzhou,Chengdu,Chongqing	≥65	4929	4929	0.0769	6
JS Luo(2017)[103]	Longevity area in China	≥65	938	938	0.1066	6

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

L Zhang(2020)[104]	Chongqing	≥65	1341	1341	0.4444	6
XF Xu(2020)[105]	Ningxia	≥60	1040	1040	0.1702	6
YB Lv(2018)[106]	China	≥80	16022	16022	0.5064	7
M Liu(2019)[107]	China	≥80	4621	4621	0.3207	6
SY Chen(2018)[108]	Guangxi	≥60	2300	2300	0.4339	6
TT Wu(2017)[109]	Chongqing	≥100	564	564	0.6578	6
RD Xu(019)[110]	Jiangxi	≥60	1087	1087	0.6863	6
ZH Li(2020)[111]	China	≥80	12331	12331	0.1375	7
X Peng(2019)[112]	Southern China	≥60	1321	1321	0.1650	6
ZH Li(2019)[113]	China	≥65	12546	12446	0.2169	7
YR Wang(2021)[114]	China	≥65	127	127	0.1496	6
ZY Huang(2020)[115]	China	≥100	228	228	0.4298	6
W Jia(2020)[116]	China	≥100	822	822	0.2968	6

3. Results

3.1. Literature Search

A total of 3169 related articles were found during the literature search, and 3095 studies remained for further screening after duplicates were removed. After screening for titles and abstracts, 2951 papers were excluded because they did not meet the selection criteria. In the remaining 144 papers, 44 were excluded after the full-text review due to various reasons (e.g., overlapping, incomplete, or erroneous data). The selection process is illustrated in Fig. 1.

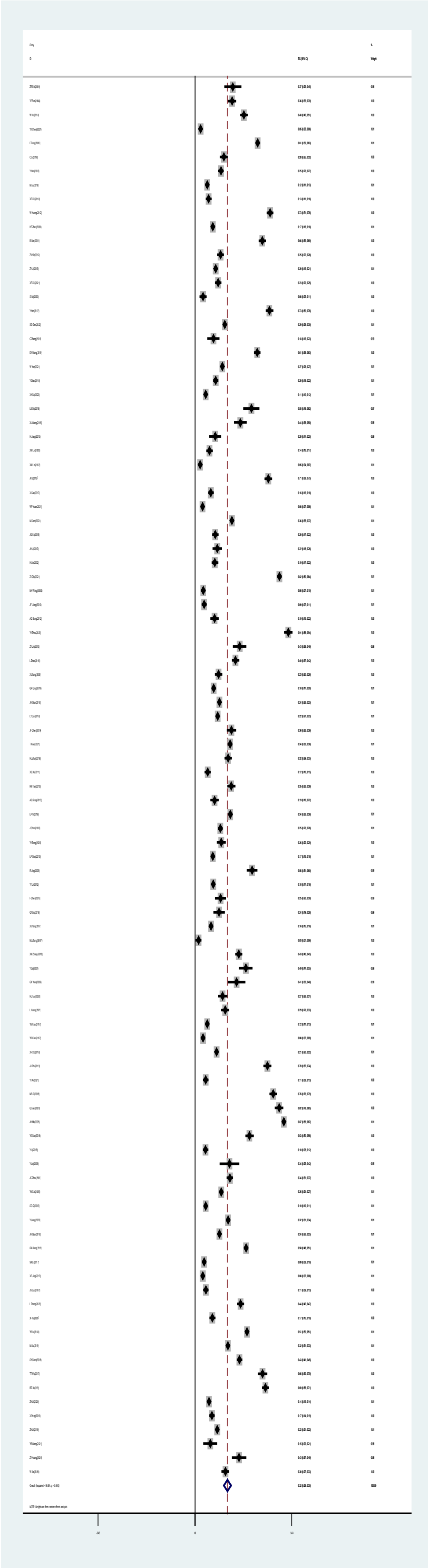
3.2. Characteristics of the included studies

A total of 100 studies from 2001 to 2021 were eventually included in this meta-analysis[17-116]. The total number of participants was 291235, with sample sizes ranging from 110 to 18785. Of these, 19 used nationally representative samples (19.0%), 50 studies were conducted in urban settings (50.0%), 17 were conducted in rural areas (17.0%), and the remaining 14 (14.0%) examined urban and rural locations. Seventy-five studies focused on people aged 60 years and older, 14 focused on people aged 65 years and older, 6 focused on people aged 80 years and older, 1 focused on people aged 90 years and older, and 4 focused on people aged 100 years and older. Twelve articles were published in English, while the remainder were in Chinese. Table 1 presents information on first author, year, age, region, and prevalence.

3.3. Aggregate prevalence of ADL disability

A heterogeneity test was carried out for 100 studies. The P value of <.10 and I2 of 99.8% indicated considerable heterogeneity. Therefore, the random-effects model was used for the meta-analysis. The aggregate prevalence of ADL disability was 31.7% (95% CI = 28.2%–35.2%), as shown in Figure 2.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801



Study	ES	[95% Conf.	Interval]	% Weight
ZR Shi(2009)	0.368	0.292	0.445	0.96
YZ Sun(2004)	0.361	0.328	0.394	1.00
W He(2018)	0.477	0.445	0.509	1.00
YX Chen(2021)	0.055	0.046	0.063	1.01
F Feng(2016)	0.611	0.594	0.628	1.01
C Li(2016)	0.283	0.250	0.315	1.00
Y Han(2016)	0.253	0.233	0.273	1.00
M Liu(2018)	0.121	0.111	0.130	1.01
XF XU(2018)	0.134	0.111	0.156	1.00
W Huang(2012)	0.731	0.705	0.757	1.00
HF Zhao(2009)	0.173	0.162	0.184	1.01
B Xue(2011)	0.656	0.627	0.685	1.00
ZX Yin(2012)	0.249	0.222	0.275	1.00
ZY Li(2019)	0.202	0.194	0.209	1.01
XF XU(2021)	0.227	0.201	0.252	1.00
S Xu(2020)	0.079	0.052	0.107	1.00
Y Yao(2017)	0.725	0.694	0.756	1.00
SG Gen(2022)	0.291	0.281	0.300	1.01
C Zhang(2019)	0.180	0.127	0.233	0.99
DY Wang(2019)	0.605	0.580	0.631	1.00
W Yan(2021)	0.266	0.259	0.273	1.01
Y Qiao(2018)	0.202	0.184	0.221	1.01
XY Gu(2020)	0.106	0.095	0.116	1.01
LB Gu(2018)	0.549	0.477	0.621	0.97
XL Wang(2015)	0.441	0.385	0.497	0.98
H Jiang(2015)	0.197	0.144	0.250	0.99
XM Lin(2020)	0.142	0.117	0.166	1.00
XM Lin(2012)	0.051	0.036	0.067	1.01
JK S(2012£©	0.715	0.684	0.745	1.00
X Gao(2017)	0.155	0.134	0.176	1.00
WP Yuan(2021)	0.076	0.067	0.085	1.01
N Chen(2021)	0.360	0.349	0.371	1.01
JQ Xu(2019)	0.199	0.174	0.223	1.00
JH Ji(2017)	0.218	0.179	0.257	1.00
H Lin(2002)	0.194	0.168	0.220	1.00
ZJ Qiu(2021)	0.821	0.805	0.837	1.01
MH Wang(2002)	0.081	0.065	0.097	1.01
JF Liang(2010)	0.089	0.071	0.107	1.01
AQ Song(2012)	0.191	0.156	0.225	1.00
YY Zhou(2020)	0.909	0.875	0.943	1.00
ZY Liu(2015)	0.435	0.375	0.494	0.98
L Zhao(2016)	0.395	0.366	0.425	1.00
X Zhang(2020)	0.230	0.200	0.259	1.00
QR Qing(2018)	0.183	0.170	0.196	1.01
JH Qian(2016)	0.238	0.229	0.247	1.01
LY Dai(2018)	0.221	0.210	0.232	1.01
JF Chen(2019)	0.356	0.316	0.395	1.00
T Xiao(2021)	0.342	0.326	0.358	1.01
HL Zhai(2018)	0.324	0.295	0.353	1.00
XQ Xu(2011)	0.125	0.101	0.148	1.00
RM Tan(2010)	0.354	0.321	0.387	1.00
AQ Song(2013)	0.191	0.156	0.225	1.00
LP Yi(2016)	0.344	0.329	0.359	1.01
J Chen(2016)	0.247	0.233	0.261	1.01
YY Song(2020)	0.256	0.220	0.292	1.00
LP Gao(2010)	0.174	0.164	0.184	1.01
R Jing(2009)	0.557	0.511	0.602	0.99
YT Li(2012)	0.177	0.170	0.185	1.01
F Chen(2015)	0.249	0.202	0.296	0.99
QY Liu(2018)	0.235	0.187	0.283	0.99
XJ Yang(2017)	0.156	0.148	0.164	1.01
MJ Zhang(2007)	0.035	0.013	0.057	1.00
XM Zhang(2016)	0.426	0.398	0.454	1.00
Y Qu(2021)	0.495	0.436	0.553	0.98
GX Yuan(2009)	0.405	0.326	0.484	0.96
HL Tao(2020)	0.270	0.230	0.310	1.00
L Huang(2021)	0.294	0.261	0.328	1.00
YB Xiao(2017)	0.119	0.112	0.127	1.01
YB Xiao(2017)	0.079	0.072	0.087	1.01
XF XU(2018)	0.211	0.202	0.221	1.01
JJ Shu(2019)	0.704	0.672	0.737	1.00
YT Ai(2021)	0.106	0.085	0.127	1.00
MS Si(2018)	0.761	0.732	0.791	1.00
Q Liao(2020)	0.819	0.783	0.855	1.00
JH Ma(2005)	0.865	0.856	0.874	1.01
YS Guo(2018)	0.530	0.497	0.564	1.00
Y Li(2015)	0.103	0.082	0.124	1.00
Y Liu(2003)	0.336	0.248	0.425	0.95
JC Zhou(2001)	0.340	0.313	0.366	1.00
YN Cai(2020)	0.256	0.242	0.269	1.01
SG Qi(2019)	0.104	0.100	0.109	1.01
Y Jiang(2020)	0.322	0.309	0.335	1.01
JH Qian(2016)	0.238	0.229	0.247	1.01
SM Jiang(2019)	0.497	0.483	0.511	1.01
SK Li(2017)	0.089	0.083	0.095	1.01
XF Jing(2017)	0.077	0.069	0.084	1.01
JS Luo(2017)	0.107	0.087	0.126	1.00
L Zhang(2020)	0.444	0.418	0.471	1.00
XF Xu(2020£©	0.170	0.147	0.193	1.00
YB Lv(2018)	0.506	0.499	0.514	1.01
M Liu(2019)	0.321	0.307	0.334	1.01
SY Chen(2018)	0.434	0.414	0.454	1.00
TT Wu(2017)	0.658	0.619	0.697	1.00
RD Xu(019)	0.686	0.659	0.714	1.00
ZH Li(2020)	0.138	0.131	0.144	1.01
X Peng(2019)	0.165	0.145	0.185	1.00
ZH Li(2019)	0.217	0.210	0.224	1.01
YR Wang(2021)	0.150	0.088	0.212	0.98
ZY Huang(2020)	0.430	0.366	0.494	0.98
W Jia(2020)	0.297	0.266	0.328	1.00
D+L pooled ES	0.317	0.282	0.352	100.00

Heterogeneity chi-squared = 63925.06 (d.f. = 99) p = 0.000
I-squared (variation in ES attributable to heterogeneity) = 99.8%
Estimate of between-study variance Tau-squared = 0.0319

Test of ES=0 : z= 17.67 p = 0.000

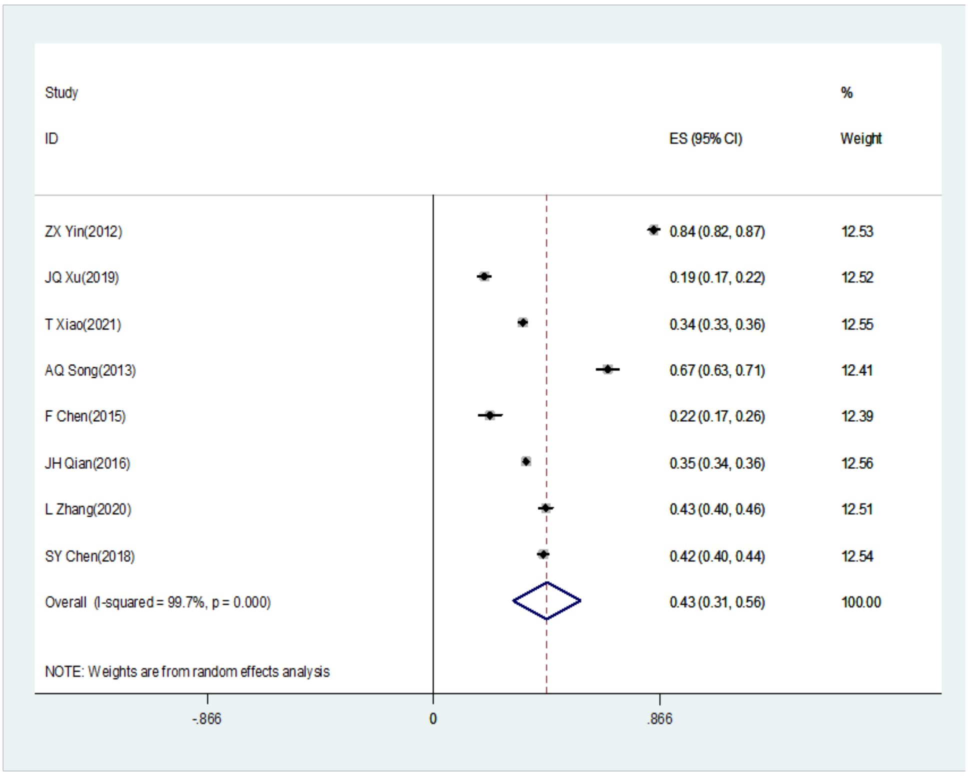
Figure 2: The prevalence of ADL disability.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

3.4. Analysis of 2 subitems of the incidence of ADL disability

3.4.1. IADL

The prevalence rate of IADL disability was 43.3% (95% CI: 30.5%–56.1%). The forest plot is shown in Figure 3.



Study	ES	[95% Conf.	Interval]	% Weight
ZX Yin(2012)	0.843	0.821	0.866	12.53
JQ Xu(2019)	0.195	0.171	0.219	12.52
T Xiao(2021)	0.342	0.326	0.358	12.55
AQ Song(2013)	0.667	0.626	0.708	12.41
F Chen(2015)	0.216	0.171	0.260	12.39
JH Qian(2016)	0.354	0.344	0.365	12.56
L Zhang(2020)	0.429	0.402	0.455	12.51
SY Chen(2018)	0.420	0.399	0.440	12.54
D+L pooled ES	0.433	0.305	0.561	100.00

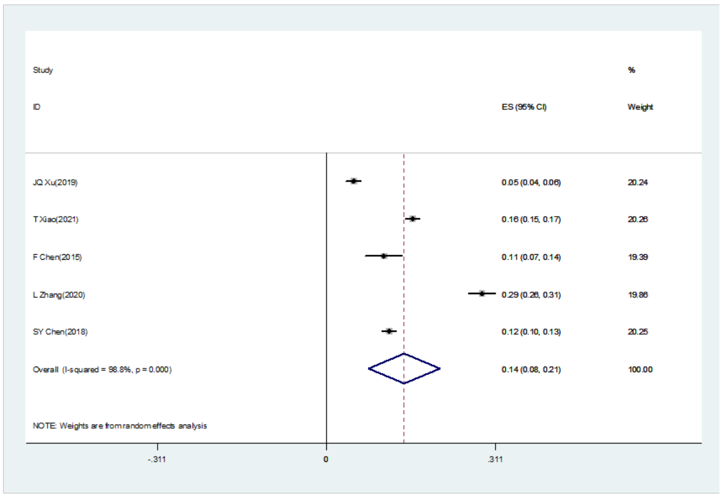
```
Heterogeneity chi-squared = 2146.18 (d.f. = 7) p = 0.000
I-squared (variation in ES attributable to heterogeneity) =  99.7%
Estimate of between-study variance Tau-squared =  0.0339

Test of ES=0 : z=   6.63 p = 0.000
```

Figure 3: The prevalence of IADL disability.

3.4.2. PADL

The prevalence rate of PADL disability was 14.4% (95% CI: 7.8%–20.7%). The forest plot is shown in Figure 4.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801



Study	ES	[95% Conf.	Interval]	% Weight
JQ Xu(2019)	0.051	0.037	0.064	20.24
T Xiao(2021)	0.159	0.147	0.172	20.26
F Chen(2015)	0.106	0.073	0.140	19.39
L Zhang(2020)	0.287	0.263	0.311	19.86
SY Chen(2018)	0.116	0.103	0.129	20.25
D+L pooled ES	0.144	0.078	0.209	100.00

```
Heterogeneity chi-squared = 324.63 (d.f. = 4) p = 0.000
I-squared (variation in ES attributable to heterogeneity) =  98.8%
Estimate of between-study variance Tau-squared =  0.0055

Test of ES=0 : z=    4.28 p = 0.000
```

Figure 4: The prevalence of PADL disability.

3.5. Publication Bias

Funnel plots and Egger's test were used to assess potential publication bias.

3.5.1. ADL

The results of Begg's test showed no statistically significant publication bias (p > 0.10). No significant asymmetry was found in the funnel plots of the 100 included studies. Therefore, we did not find significant publication bias (Figure 5).

```
Begg's Test

  adj. Kendall's Score (P-Q) =     -114
          Std. Dev. of Score =   335.78 (corrected for ties)
           Number of Studies =      100
                           z =    -0.34
                    Pr > |z| =    0.734
                           z =     0.34 (continuity corrected)
                    Pr > |z| =    0.736 (continuity corrected)
```

Egger's test

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	-.3915952	.0820424	-4.77	0.000	-.5544056	-.2287847
bias	-21.44064	3.326388	-6.45	0.000	-28.04175	-14.83953

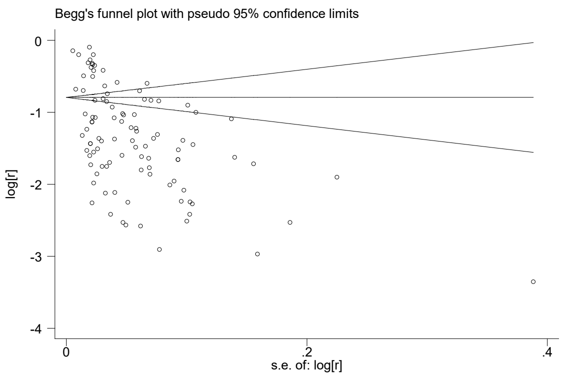


Figure 5: The funnel plot of publication bias of ADL.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

3.5.2. IADL and PADL

The results of Egger's test showed no statistically significant publication bias (p > 0.10). No significant asymmetry was detected in the funnel plot, and no significant publication bias was found (Figures 6 and 7).

```
Begg's Test

  adj. Kendall's Score (P-Q) =       2
          Std. Dev. of Score =    8.08
           Number of Studies =       8
                          z  =    0.25
                   Pr > |z|  =   0.805
                          z  =    0.12 (continuity corrected)
                   Pr > |z|  =   0.902 (continuity corrected)
```

Egger's test

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
slope	-.342178	.3239714	-1.06	0.332	-1.134907	.4505515
bias	-16.83776	14.27962	-1.18	0.283	-51.77873	18.10321

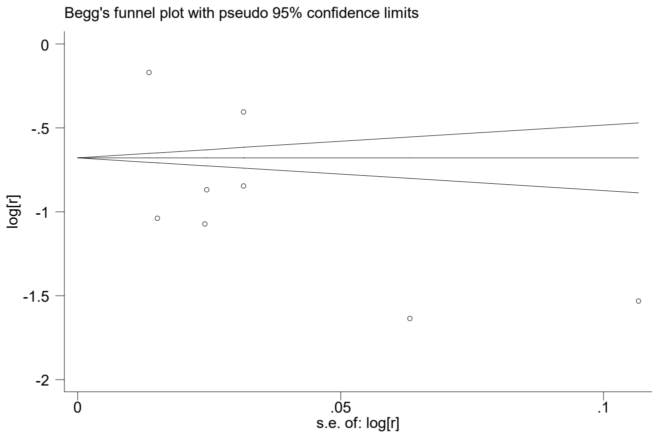


Figure 6: The funnel plot of publication bias of IADL.

```
Begg's Test

  adj. Kendall's Score (P-Q) =      -2
          Std. Dev. of Score =    4.08
           Number of Studies =       5
                          z  =   -0.49
                   Pr > |z|  =   0.624
                          z  =    0.24 (continuity corrected)
                   Pr > |z|  =   0.806 (continuity corrected)
```

Egger's test

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
slope	-1.229505	.4380926	-2.81	0.067	-2.623711	.1647018
bias	-10.10615	7.713459	-1.31	0.281	-34.65382	14.44153

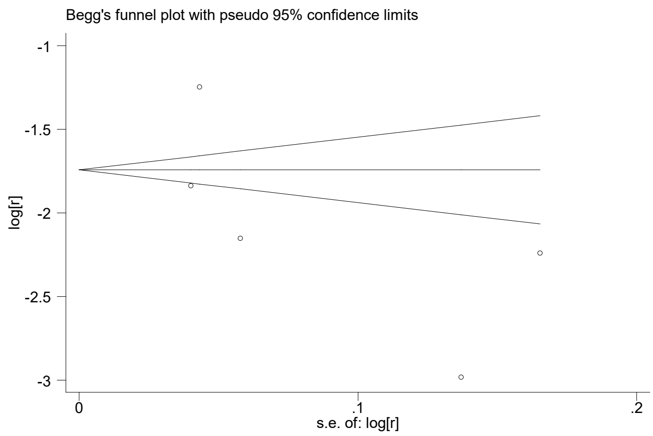


Figure 7: The funnel plot of publication bias of PADL.

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

3.6. Subgroup analyses

We analyzed the factors that may influence the prevalence of ADL disability, and the results were all highly heterogeneous. Therefore, we used the random-effects model to combine effect size. In the subgroup analysis by gender, the prevalence of male was 17.9% (95%CI: 17.6%–18.1%), and that of female was 21.4% (95%CI: 21.1%–21.6%). The difference between male and female was statistically significant (P=.000). Based on the subgroup analysis by age, the prevalence of disability was as follows: 10.8% (95% CI: 10.5%–11.0%) in the 60–69 year-old group, 21.2% (95% CI: 20.8%–21.6%) in the 70-79 year-old group, 47.0% (95% CI: 46.2%–47.8%) in the ≥80 year-old group. The difference in prevalence among the age groups was statistically significant (P= .000). Significant difference was found in the association of marital status and chronic disease with ADL disability. The prevalence of ADL disability in married elderly was 13.4% (95% CI: 13.1%–13.6%), which was significantly lower than that in single elderly (e.g,, divorced, widowed or unmarried; 29.7% with 95% CI: 29.2%–30.2%). The difference in morbidity between married and unmarried was statistically significant (P=.000). The rate of chronic ADL injury was 29.6% (95%CI: 29.2%–30.0%), which was almost twice as high as that of non-chronic ADL injury (15.9%; 95% CI: 15.5%–16.4%). Significant difference was found in the prevalence of chronic disease condition (P=.000). In the subgroup analysis by living alone, the percentage of elderly living alone (19.6%, 95% CI: 19.0%–20.2%) was higher than that of the elderly living with their families or living in institutions (18.5%, 95% CI: 18.2%–18.7%). The difference between the prevalence of living alone and non-living alone was significant (P=.000). The subgroup analysis by educational level showed that the prevalence of ADL disability appeared to decline as older adults became more educated. The prevalence of people who completed their university education and suffered from ADL disability was 18.8% (95% CI: 17.4%–20.2%). People without higher education were more likely to suffer from ADL disability (primary school graduates (28.6%, 95% CI: 28.1%–29.1%). The prevalence of ADL disability among middle and high school graduates was 19.1% (95% CI: 18.5%–19.8%). The difference in prevalence rate among people with different education levels was significant (P=.000, Table 2).

Table 2: The prevalence of ADL disability by subgroup analysis.

Parameter	Document number	Sample size (n)	Disability prevalence (%) and 95% CI	I2 (%)	P	Pz
Gender						
Male	46	62042	17.9% (17.6–18.1)	99.4	0.000	0.000
Female	46	67706	21.4% (21.1–21.6)	99.5	0.000	
Age						
60-69	38	54326	10.8% (10.5–11.0)	99.3	0.000	
70-79	38	36720	21.2% (20.8–21.6)	99.4	0.000	0.000
≥80	38	13198	47.0% (46.2–47.8)	98.7	0.000	
Degree of education						
Primary school	22	29336	28.6% (28.1–29.1)	99.3	0.000	
High school	22	13503	19.1% (18.5–19.8)	98.7	0.000	0.000
College	21	2749	18.8% (17.4–20.2)	93.3	0.000	
Marital status						
Have a spouse	29	62727	13.4% (13.1–13.6)	99.7	0.000	0.000
Have no spouse	29	29843	29.7% (29.2–30.2)	99.3	0.000	
Inhabiting information						
Live alone	25	13104	19.6% (19.0–20.2)	99.3	0.000	0.000
Not live alone	25	66835	18.5% (18.2–18.7)	99.7	0.000	
Prevalence situation						
Without chronic disease	25	23443	15.9% (15.5–16.4)	99.0	0.000	0.000
Have chronic disease	27	49963	29.6% (29.2–30.0)	99.7	0.000	

ISSN 2706-6819 Vol.5, Issue 8: 1-19, DOI: 10.25236/IJFM.2023.050801

4. Discussion

Based on 100 studies involving 291235 participants, the estimated prevalence rate of ADL disability in China was 31.7%. The pooled prevalence in this meta-analysis is similar to the findings in Chinese aged ＞60 years[98][107] but higher than that in some articles with data from CLHLS [61][62]. The prevalence is also similar to that in some countries, such as 30.1% in Brazil[117] and 37% in India[118]. However, the pooled prevalence is higher than those reported in other countries, such as 10.8% in Singapore[119] and 10.3% in the USA[120]. The variations in the pooled prevalence of ADL disability may be due to different social economic development levels, dietary habits, and lifestyle. Singapore and the USA had better socioeconomic development, which occurred much later in China. The timing and pace of economic development in combination with transitions in the orientation and coverage of the health care system as well as other societal changes may influence societal trends in health[121].

The results showed that IADL disability was more common than ADL disability, accounting for 43.3%. By contrast, PADL was only 14.4%. This finding is consistent with our knowledge that IADL deficits usually precede ADL deficits[122]. The prevalence and trends of IADL and PADL are similar to those in an Indian study[123]. In the present meta-analysis, the funnel plot and Egger's test results indicated no publication bias.

In the subgroup analysis, the result revealed women had a higher risk to report ADL disability. From the physiological perspective, most older women are postmenopausal, and they tend to have lower levels of estrogen and vitamin D than normal women, both of which have negative effects on muscle strength and neuro-muscular function[124]. From the perspective of social reality, in the past, women in China had fewer opportunities to receive education than men. According to our analysis, this phenomenon has an impact on the prevalence rate; women have a longer life expectancy and lower relative income, which may also lead to a lower quality of life and worse health in their later years [125].

The study found that the risk of ADL disability increased as people get older, and almost all research concord with this finding. The prevalence of ADL among 70–79 year-old individuals was 21.2%, which is twice as high as the prevalence among 60–69 year-old individuals (10.8%); the prevalence in the age range ≥80 reached 47.0%, which is four times higher than that in the 60–69 year-old group. From the data published by the National Bureau of Statistics, the health status of the elderly deteriorates with age [126]. This finding may be due to the degenerative changes in the structure and function of the organs and tissues in the body with age, which inevitably leads to a decrease in the reserve capacity and physiological functions of the individual and to the degeneration of organ functions and reduced mobility[127]. The degeneration of organ function will increase the susceptibility of the elderly to underlying diseases, which will also make the elderly less active[128].

A higher percentage of uneducated elderly had ADL disability than elderly who had higher education level. According to research, education optimizes individual health behavior; for example, educated older adults show more moderation in smoking behavior[129]. In addition, the level of education influences socioeconomic factors to some extent; that is, higher education level can prove the social status of older adults, providing a reliable and adequate source of livelihood, and can expand the budget for health inputs[130]. Education will improve the health evaluation standards of older adults, making them more likely to be aware of their health problems and facilitate timely access to medical care[131].

The prevalence of ADL disability among single older adults (e.g., divorced, widowed, or unmarried) was 29.7%, which was twice as high as the 13.4% among married (remarried) older adults. This may be due to the spouse's ability to provide daily care and psychological comfort to the elderly as well as to monitor their health status and prompt them to seek medical care when they fall ill, thereby improving their quality of life and health[132-133].

Compared with elderly living alone, those living with children or living in a nursing home had a lower risk of ADL disability. This is consistent with previous reports by ZR Shi [17],HL Zhai [65] et al. This finding may be due to the fact that emotional and caregiving support from a spouse or child influences the psychological and physical environment of non-solitary elderly, thereby facilitating a healthy lifestyle, increasing the likelihood of timely medical care, and reducing the prevalence of ADL disability[134].

Further, literature has established an association between chronic disease and ADL disability among the elderly. The prevalence of ADL disability is significantly higher in older adults with chronic diseases than in older adults without chronic diseases. This may be due to the low body function caused by chronic diseases, such as diabetes, hypertension, and so on[135]. In addition, the long treatment period, poor prognosis, and many complications may even lead to damage to important tissues and organs, resulting in the decline in the daily living activities of the elderly[136].

5. Limitation

This study has some limitations. First, the heterogeneity in the sub-group analysis of all influencing factors was statistically significant; nevertheless, heterogeneity is difficult to avoid in epidemiological reviews. To reduce this potential problem, we used the random effects model when the heterogeneity was significant. Second, different ADL disability diagnostic criteria were used in the included studies, and the grouping criteria of risk factors varied, which make it difficult to conduct meta-analysis and leads to limited statistical ability. Third, studies conducted in Hong Kong, Macau, and Taiwan were not included in this meta-analysis due to different socioeconomic and culture backgrounds. Most studies that we reviewed were conducted in eastern and central China, and certain area in this meta-analysis were underrepresented. Finally, other subgroup analyses (e.g., household income, dietary habit, religious faith) could not be conducted due to the lack of data.

6. Conclusions

This meta-analysis found a high prevalence of ADL disability among Chinese older adults. Significant differences in ADL prevalence were found between subgroups with respect to gender, marital status, age, chronic disease, and education level. These findings suggest that policies should focus on vulnerable groups as well as in selection of appropriate interventions and promotion of community management and self-management of patients with ADL based on the full utilization of primary medical resources to reduce the occurrence of various adverse outcomes, improve quality of life, and promote healthy aging.

Author Contributions

Conceptualization, Y. L; Collection, curation data: Y.-L.C and J.X; analyzed the data and interpreted data: Y.-L.C; writing original draft preparation, Y.-L. C; writing review and editing, L.C,Y.L ; supervision, Z.-Q.C., T.-J.L., R.-Y. L., K.-L.H., S. X., T.-Y. L. and R.-Y. G. . All authors have read and agreed to the published version of the manuscript.

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