

Sex differences in neuropsychiatric symptoms in Alzheimer's disease: A meta-analysis

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eTable 1 Search strategy literature search.

<p><i>Embase.com – inception until February 12, 2021</i></p> <p>('behavior'/de OR 'neuropsychiatry'/de OR 'neuropsychiatric inventory'/de OR 'apathy'/de OR 'agitation'/de OR 'restlessness'/de OR 'sleep'/exp OR 'aggression'/de OR 'anxiety'/de OR 'depression'/de OR 'delusion'/de OR 'hallucination'/de OR 'eating'/de OR 'euphoria'/de OR 'irritability'/de OR (((neuropsychiatr*) NEAR/3 (symptom* OR inventor*)) OR NPS OR apath* OR agitat* OR sleep* OR aggress* OR anxiet* OR anxious* OR depress* OR delus* OR hallucinat* OR eat* OR euphor* OR disinhibit* OR irritabilit* OR (irritable NEAR/3 mood*) OR ((aberrant*) NEAR/3 (motor*) NEAR/3 (behavior* OR behaviour*)) OR ((mild*) NEAR/3 (behav*) NEAR/3 (impairment*)) OR MBI OR BPSD):ab,ti,kw) AND ('Alzheimer disease'/de OR (Alzheimer* OR Alzeimer*):ab,ti,kw) AND ('gender and sex'/exp OR 'sex ratio'/de OR ((gender* OR sex*) NEAR/3 (differ* OR specific* OR factor* OR characterist* OR ratio*)):ab,ti,kw) NOT ((animal/exp OR animal*:de OR nonhuman/de) NOT ('human'/exp)) NOT [conference abstract]/lim</p>
<p><i>Medline ALL/PubMed – inception until February 12, 2021</i></p> <p>(Behavior/ OR Neuropsychiatry/ OR Apathy/ OR Psychomotor Agitation/ OR Sleep/ OR Aggression/ OR Anxiety/ OR Depression/ OR Delusions/ OR Hallucinations/ OR Eating/ OR Euphoria/ OR Irritable Mood/ OR (((neuropsychiatr*) ADJ3 (symptom* OR inventor*)) OR NPS OR apath* OR agitat* OR sleep* OR aggress* OR anxiet* OR anxious* OR depress* OR delus* OR hallucinat* OR eat* OR euphor* OR disinhibit* OR irritabilit* OR ((aberrant*) ADJ3 (motor*) ADJ3 (behavior* OR behaviour*)) OR ((mild*) ADJ3 (behav*) ADJ3 (impairment*)) OR MBI OR BPSD).ab,ti,kf.) AND (Alzheimer Disease/ OR (Alzheimer* OR Alzeimer*):ab,ti,kf.) AND (Sex Characteristics/ OR Sex/ OR Sex Factors/ OR exp Sex Distribution/ OR Sex Differentiation/ OR Gender Identity/ OR ((gender* OR sex*) ADJ3 (differ* OR specific* OR factor* OR characterist*)):ab,ti,kf.) NOT (exp animals/ NOT humans/) NOT (letter* OR news OR comment* OR editorial* OR congres* OR abstract* OR book* OR chapter* OR dissertation abstract*).pt.</p>
<p><i>Web of Science – inception until February 12, 2021</i></p> <p>TS=(((neuropsychiatr*) NEAR/2 (symptom* OR inventor*)) OR NPS OR apath* OR agitat* OR sleep* OR aggress* OR anxiet* OR anxious* OR depress* OR delus* OR hallucinat* OR eat* OR euphor* OR disinhibit* OR irritabilit* OR (irritable NEAR/2 mood*) OR ((aberrant*) NEAR/2 (motor*) NEAR/2 (behavior* OR behaviour*)) OR ((mild*) NEAR/2 (behav*) NEAR/2 (impairment*)) OR MBI OR BPSD)) AND ((Alzheimer* OR Alzeimer*)) AND (((gender* OR sex*) NEAR/2 (differ* OR specific* OR factor* OR characterist* OR ratio*))) NOT ((animal* OR rat OR rats OR mouse OR mice OR murine OR dog OR dogs OR canine OR cat OR cats OR feline OR rabbit OR cow OR cows OR bovine OR rodent* OR sheep OR ovine OR pig OR swine OR porcine OR veterinar* OR chick* OR zebrafish* OR baboon* OR nonhuman* OR primate* OR cattle* OR goose OR geese OR duck OR macaque* OR avian* OR bird* OR fish*) NOT (human* OR patient* OR women OR woman OR men OR man))) AND DT=(Article)</p>
<p><i>Cochrane Central Register of Controlled Trials – inception until February 12, 2021</i></p> <p>(((neuropsychiatr*) NEAR/3 (symptom* OR inventor*)) OR NPS OR apath* OR agitat* OR sleep* OR aggress* OR anxiet* OR anxious* OR depress* OR delus* OR hallucinat* OR eat* OR euphor* OR disinhibit* OR irritabilit* OR (irritable NEAR/3 mood*) OR ((aberrant*) NEAR/3 (motor*) NEAR/3 (behavior* OR behaviour*)) OR ((mild*) NEAR/3 (behav*) NEAR/3 (impairment*)) OR MBI OR BPSD):ab,ti,kw) AND ((Alzheimer* OR Alzeimer*):ab,ti,kw) AND (((gender* OR sex*) NEAR/3 (differ* OR specific* OR factor* OR characterist* OR ratio*)):ab,ti,kw)</p>
<p><i>PsycINFO – inception until February 12, 2021</i></p> <p>(Behavior/ OR Neuropsychiatry/ OR Apathy/ OR Agitation/ OR Sleep/ OR Aggressiveness/ OR Anxiety/ OR "Depression (Emotion) "/ OR Delusions/ OR Hallucinations/ OR Eating Behavior/ OR Euphoria/ OR Irritability/ OR (((neuropsychiatr*) ADJ3 (symptom* OR inventor*)) OR NPS OR apath* OR agitat* OR sleep* OR aggress* OR anxiet* OR anxious* OR depress* OR delus* OR hallucinat* OR eat* OR euphor* OR disinhibit* OR irritabilit* OR ((aberrant*) ADJ3 (motor*) ADJ3 (behavior* OR behaviour*)) OR ((mild*) ADJ3 (behav*) ADJ3 (impairment*)) OR MBI OR BPSD).ab,ti.) AND ("Alzheimer's Disease"/ OR (Alzheimer* OR Alzeimer*):ab,ti.) AND (Human Sex Differences/ OR Sex/ OR Gender Identity/ OR ((gender* OR sex*) ADJ3 (differ* OR specific* OR factor* OR characterist*)):ab,ti.) NOT ((animal.po. OR exp animals/) NOT human.po.) NOT (letter* OR news OR comment* OR editorial* OR congres* OR abstract* OR book* OR chapter* OR dissertation abstract*).pt.</p>
<p><i>Google Scholar – top 200 relevant references</i></p> <p>“gender sex difference differences factor ratio” “neuropsychiatric symptoms” apathy agitation sleep aggression anxiety depression delusion hallucination eating euphoria disinhibition irritability Alzheimer</p>

eTable 2. Study quality assessment according to Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

Author, year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Overall quality
Alberici et al., 2008 ¹	Yes	No	NR	NR	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Álvarez et al., 2014 ²	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Benoit et al., 2008 ³	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Bliwise et al., 2011 ⁴	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Burns et al., 1990a ⁵	No	Yes	Yes	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Burns et al., 1990b ⁶	No	Yes	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Chang et al., 2020 ⁷	Yes	No	NR	No	Yes	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Chareernboon et al., 2014 ⁸	Yes	Yes	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Chiu et al., 2012 ⁹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Colombo et al., 2018 ¹⁰	Yes	No	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Connors et al., 2018 ¹¹	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Del Prete et al., 2009 ¹²	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Delano-Wood et al., 2008 ¹³	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Derouesné et al., 1996 ¹⁴	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Eustace et al., 2001 ¹⁵	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Finger et al., 2017 ¹⁶	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Gomez-Gallego et al., 2020 ¹⁷	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Gormley et al., 1998a ¹⁸	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Gormley et al., 1998b ¹⁹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Hall et al., 2014 ²⁰	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Ikezaki et al., 2020 ²¹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Hsieh et al., 2019 ²²	Yes	Yes	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Kabeshita et al., 2016 ²³	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Kaiser et al., 2014 ²⁴	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Karttunen et al. 2011 ²⁵	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Kaufer et al., 1998 ²⁶	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Kwak et al., 2013 ²⁷	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Landes et al., 2005 ²⁸	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Lee et al., 2017 ²⁹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Leroi et al., 2003 ³⁰	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Levy et al., 1996 ³¹	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Linszen et al., 2018 ³²	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good

Author, year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Overall quality
Liu et al., 1999 ³³	Yes	Yes	Yes	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Matsuoka et al., 2018 ³⁴	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Migliorelli et al., 1995 ³⁵	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Moran M. et al., 2005 ³⁶	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Moran E.K. et al., 2008 ³⁷	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Müller-Thomsen et al., 2002 ³⁸	Yes	No	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Mulin et al., 2011 ³⁹	Yes	No	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
de Oliveira et al., 2017 ⁴⁰	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Ott et al., 1996 ⁴¹	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Porta-Etessam et al., 2011 ⁴²	Yes	No	Yes	Yes	Yes	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Pusswald et al., 2015 ⁴³	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Rozzini et al., 2007 ⁴⁴	Yes	Yes	Yes	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Shi et al., 2020 ⁴⁵	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Senanarong et al., 2004 ⁴⁶	Yes	No	NR	Yes	Yes	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Sinforiani et al., 2010 ⁴⁷	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Slifer et al., 2009 ⁴⁸	Yes	No	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Spalletta et al., 2010 ⁴⁹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Steffens et al., 2005 ⁵⁰	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Suma et al., 2018 ⁵¹	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Toyota et al., 2007 ⁵²	Yes	Yes	Yes	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Good
Treiber et al., 2008 ⁵³	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Troisi et al., 1996 ⁵⁴	Yes	No	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Tunnard et al., 2010 ⁵⁵	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Usman et al., 2010 ⁵⁶	Yes	Yes	Yes	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Vilalta-Franch et al., 2013 ⁵⁷	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Xing et al., 2015 ⁵⁸	Yes	No	NR	No	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor
Yang et al., 2017 ⁵⁹	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Yang et al., 2020 ⁶⁰	Yes	Yes	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Zeitzer et al., 2014 ⁶¹	Yes	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Fair
Zhao et al., 2012 ⁶²	No	No	NR	Yes	No	NA	NA	NA	No	NA	Yes	NA	NA	NA	Poor

Abbreviations: NR, not reported; NA, not applicable.

eTable 3. Characteristics of included studies

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Alberici et al., 2008 ¹	Italy	NR	25	16 (64.0 %)	9 (36.0 %)	79.2 (7.2)	NR	16.0 (7.8)	NR	NR	Total score	NPI
Álvarez et al., 2014 ²	Spain	Memory clinic	250	194 (77.6 %)	56 (22.4 %)	75.0 (7.4)	NR	17.5 (4.1)	NR	47.2%	Apathy	NPI-item >0
Benoit et al., 2008 ³	France	Memory clinic	684	487 (71.0%)	197 (28.7%)	77.9 (6.8)	NR	20.0 (4.23)	1.1 (1.1)	NR	Apathy, depression	NPI-items >0
Bliwise et al., 2011 ⁴	USA	Memory clinic	4192	2,387 (56.9%)	1,805 (43.1%)	76.2 (9.4)	>College 57.5%	21.6 (15.0)	NR	NR	Night-time behaviors	NPI-Q-item >0
Burns et al., 1990a ⁵	UK	Memory clinic, NH	174	139 (79.9%)	35 (20.1%)	80.5 (6.6)	NR	NR	NR	NR	Depression	GMSS >0
Burns et al., 1990b ⁶	UK	Memory clinic, NH	178	141 (79.2%)	37 (20.8%)	80.5 (6.6)	NR	NR	NR	NR	Aggression	SGRC >0
Chang et al., 2020 ⁷	Taiwan	Memory clinic	463	259 (55,9%)	204 (44,1%)	70.4 (7.7)	7.1 (4.9)	18.5 (7.3)	NR	30.2%	Total score, 12 NPI-items	NPI severity x frequency scores
Charernboon et al., 2014 ⁸	Thailand	Memory clinic	62	39 (62.9%)	23 (37.1%)	76.0 (6.7)	NR	18.3 (5.9)	NR	NR	No. NPS	NPI
Chiu et al., 2012 ⁹	Taiwan	Memory clinic	302	203 (67.2%)	99 (32.8%)	76.8 (8.8)	5.0 (4.6)	15.3 (8.3)	2.7 (2.5)	NR	Depression	NIMH-dAD diagnosis
Colombo et al., 2018 ¹⁰	Italy	Memory clinic	221 mild	108 (48.9%)	113 (51.1%)	76.4 (7.0) ^a	≥High School 41.8%	Range 18–26	NR	NR	12 NPI-items	NPI-items >0
Colombo et al., 2018 ¹⁰	Italy	Memory clinic	254 mod.	166 (65.4%)	88 (34.7%)	76.4 (7.0) ^a	≥ High School 41.8%	Range 10–17	NR	NR	12 NPI-items	NPI-items >0

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Connors et al., 2018 ¹¹	Australia	Memory clinic	445	223 (50.1%)	222 (49.9%)	78.7 (7.3)	>Secondary 33.7%	21.1 (5.3)	1.6 (1.9)	NR	Hallucinations, delusions	NPI-items >0
Del Prete et al., 2009 ¹²	Italy	Memory clinic	53	36 (67.9%)	17 (32.1%)	74.0 (7.1)	6.2 (4.0)	19.3 (4.5)	2.0 (1.4)	47.2%	Depression, Anxiety	NPI-items >0
Delano-Wood et al., 2008 ¹³	USA	Memory clinic	323	160 (49.5%)	163 (50.5%)	72.6 (9.2)	13.0 (4.0)	20.4 (5.5)	3.8 (2.4)	67.5%	Depression	DSM-III-R DD diagnosis
Derouesné et al., 1996 ¹⁴	France	Memory clinic	135	74 (54.8%)	61 (45.2%)	69.3 (8.9)	NR	17.1 (6.5)	4.3 (2.3)	NR	Total score	PBQ
Eustace et al., 2001 ¹⁵	Ireland	Memory clinic	150	103 (68.7%)	47 (31.3%)	76.5 (8.3)	NR	19.3 (4.7)	NR	NR	Aggression	BEHAVE-AD >0
Finger et al., 2017 ¹⁶	Canada	Memory clinic	758	315 (41.6%)	443 (58.4%)	75.3 (6.8)	15.6 (2.8)	26.4 (3.4)	NR	26.1%	Disinhibition	NPI-Q or NPI-item >0
Gomez-Gallego et al., 2020 ¹⁷	Spain	Primary healthcare, day centers	196	119 (60.7%)	77 (39.3%)	77.6 (8.0)	4.5 (2.8)	17.1 (5.0)	NR	NR	9 NPI-items	Severity x frequency scores
Gormley et al., 1998a ¹⁸	UK	Day center, inpatients	70	45 (64.0%)	25 (36.0%)	78.3 (6.7)	NR	12.7 (7.9)	NR	NR	Aggression	RAGE item 21 >0
Gormley et al., 1998b ¹⁹	UK	Day center, inpatients	70	45 (64.0%)	25 (36.0%)	78.3 (6.7)	NR	12.7 (7.9)	NR	NR	Psychotic symptoms	BEHAVE-AD >0
Hall et al., 2014 ²⁰	USA	Memory clinic	220	144 (72.0%)	76 (28.0%)	77.7 (6.9)	14.1 (3.2)	19.1 (6.1)	NR	59.0%	No. NPS	NPI-Q
Hsieh et al., 2020 ²²	Taiwan	Memory clinic, NH	460	280 (60.9 %)	180 (39.1 %)	77.2 (7.9)	<6y 55.0% >6y 45.0%	17.4 (6.4)	NR	22.0%	12 NPI-items	Severity x frequency scores
Ikezaki et al., 2020 ²¹	Japan	Memory clinic	230	159 (69.1%)	71 (30.9%)	77.3 (7.9)	11.3 (2.3)	23.3 (1.9)	2.3 (1.6)	NR	Total score, 10 NPI-items, depression	NPI everity x frequency scores, GDS-15

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Kabeshita et al., 2016 ²³	Japan	Memory clinic	684	478 (69.9%)	206 (30.1%)	76.3 (8.7)	11.0 (2.9)	18.8 (5.3)	NR	NR	Night-time behaviors	NPI-item >0
Kaiser et al., 2014 ²⁴	USA	Memory clinic	22 LO	7 (31.8%)	15 (68.2%)	80.3 (5.9)	NR	NR	3.5 (2.2)	NR	Anxiety	NPI-item >0
Karttunen et al., 2011 ²⁵	Finland	Memory clinic	240	123 (51.3%)	117 (48.7%)	75.1 (6.6)	7.5 (NR)	21.5 (3.4)	3.3 (2.1)	NR	Delusions, AMB, depression	NPI-items >0, BDI total score
Kaufer et al., 1998 ²⁶	USA	Memory clinic	85	41 (48.2%)	44 (51.8%)	75.9 (6.9)	NR	16.6 (7.7)	NR	NR	Total score	NPI
Kwak et al., 2013 ²⁷	Korea	Memory clinic	230	142 (61.7%)	88 (38.3%)	74.7 (7.8)	8.9 (5.8)	19.2 (5.8)	2.9 (2.2)	NR	Delusions	NPI-item >0
Landes et al., 2005 ²⁸	USA	Memory clinic	131	70 (53.4%)	61 (46.6%)	75.1 (8.1)	13.0 (3.3)	18.5 (6.9)	NR	NR	Apathy, depression	DAIR, BRDS total scores
Lee et al., 2017 ²⁹	Korea	Memory clinic	66 mild	39 (57.4%)	27 (39.7%)	77.0 (7.0)	9.6 (4.6)	22.4 (2.5)	NR	NR	12 NPI-items	Severity x frequency scores
Lee et al., 2017 ²⁹	Korea	Memory clinic	59 mod.	39 (66.1%)	20 (33.9%)	77.3 (7.5)	6.4 (5.1)	14.7 (2.4)	NR	NR	12 NPI-items	Severity x frequency scores
Leroi et al., 2003 ³⁰	USA	Community based	201	138 (53.1%)	63 (46.9%)	84.6 (6.7)	12.4 (3.0)	15.9 (7.7)	4.7 (3.3)	33.0%	Psychosis	NPI delusions or hallucinations >0
Levy et al., 1996 ³¹	USA	Placebo arm of RCT	181	100 (55.0%)	81 (45.0%)	74.0% <76.0	≥College 50.0%	72.0% <23.0	NR	NR	Depression, agitation, psychosis	ADAS-Non-Cog >0
Linszen et al., 2018 ³²	Netherlands	Memory clinic	1,227	629 (51.3%)	598 (48.7%)	66.6 (7.9)	NR	21.0 (17–24) ^c	NR	61.9%	Hallucinations	NPI-item >0
Liu et al., 1999 ³³	Taiwan	Memory clinic	141	78 (55.3%)	63 (44.7%)	72.7 (8.7)	7.9 (5.8)	NR	NR	NR	Depression	DSM-III-R DD diagnosis

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Matsuoka et al., 2018 ³⁴	Japan	Memory clinic	63	44 (69.8%)	19 (30.2%)	79.0 (6.9)	NR	20.1 (4.2)	1.8 (1.4)	NR	Night-time behaviors	NPI-item >0
Migliorelli et al., 1995 ³⁵	Argentina	Memory clinic	103	76 (73.8%)	27 (26.2%)	73.6 (7.5)	10.0 (4.9)	18.7 (6.5)	4.3 (2.5)	NR	Depression	DSM-III-R MD, dystemia diagnosis
Moran E.K. et al., 2008 ³⁷	USA	Memory clinic	103	68 (66.0%)	35 (34.0%)	79.0 (6.0)	NR	16.5 (6.2)	NR	NR	Psychotic symptoms	BEHAVE-AD >0
Moran M. et al., 2005 ³⁶	Ireland	Memory clinic	224	157 (70.1%)	67 (29.9%)	74.9 (7.7)	NR	18.3 (5.3)	NR	NR	Sleep disturbance	BEHAVE-AD >0
Mulin et al., 2011 ³⁹	Multicenter (Europe, USA, Argentina)	Memory clinic	132	88 (66.7%)	44 (33.3%)	79.2 (6.5)	NR	18.3 (4.6)	NR	NR	Apathy	Apathy in AD diagnosis
Müller-Thomsen et al., 2002 ³⁸	Germany	Memory clinic	137	93 (67.9%)	44 (32.1%)	71.3 (8.9)	9.3 (1.6)	18.1 (6.2)	3.2 (2.4)	60.5%	Depression	ICD-10 DD diagnosis
de Oliveira et al., 2017 ⁴⁰	Brazil	Memory clinic	201	141 (70.1%)	60 (29.9%)	73.5 (6.3)	NR	NR	NR	53.7%	10 NPI-items	NPI-items >0, Severity x frequency scores
Ott et al., 1996 ⁴¹	USA	Memory clinic	125	75 (60.0%)	50 (40.0%)	74.7 (6.0)	12.1 (6.7)	18.3 (5.6)	2.9 (1.6)	NR	Total score, depression	DBDS, CSDD
Porta-Etessam et al., 2011 ⁴²	Spain	Memory clinic, NH, day center	1,248	850 (68.1%)	398 (31.9%)	77.8 (6.7)	NR	15.7 (4.3) ^d	2.0 (1.3)	NR	Depression	CSDD >9
Pusswald et al. 2015 ⁴³	Austria	Memory clinic	286	173 (60.5%)	113 (39.5%)	79.0 (73–84) ^c	8.5 (9–13) ^c	22.5 (19–25) ^c	2.0 (1–3) ^c	NR	Depression	GDS-15
Rozzini et al., 2007 ⁴⁴	Italy	Memory clinic	135	99 (73.3%)	36 (26.7%)	75.5 (7.2)	5.9 (3.0)	20.9 (3.9)	2.2 (1.1)	NR	Depression	DSM-IV dAD diagnosis

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Senanarong et al., 2004 ⁴⁶	USA	Memory clinic	277	188 (68%)	89 (32%)	76.3 (8.0)	13.0 (3.6)	19.2 (6.5)	NR	NR	Agitation	NPI-items >0, Severity x frequency scores
Shi et al., 2020 ⁴⁵	China	Memory clinic	158	86 (54.4%)	72 (45.6%)	73.1 (5.6)	NR	23.8 (1.8)	NR	NR	Any NPS	NPI-Q >0
Sinforiani et al., 2010 ⁴⁷	Spain	Memory clinic	600	386 (64.3%)	214 (35.7%)	75.1 (6.5)	5.5 (4.3)	19.2 (3.5)	NR	NR	Total score	NPI
Slifer et al., 2009 ⁴⁸	USA	Memory clinic	528	337 (63.8%)	191 (36.2%)	72.2 (6.2)	NR	NR	NR	48.7%	Depression	GDS >9
Spalletta et al., 2010 ⁴⁹	Italy	Memory clinic	1,015	723 (71.2%)	292 (28.8%)	74.6 (0.2)	6.2 (0.1)	18.3 (0.2)	2.7 (0.1)	NR	12 NPI-items	Severity x frequency scores
Steffens et al., 2005 ⁵⁰	USA	Community based	149	24 (16.1%)	125 (83.9%)	77.3 (5.0) ^e	NR	NR	NR	NR	12 NPI-items	NPI-items >0, Severity x frequency scores
Suma et al., 2018 ⁵¹	Japan	Memory clinic	853	578 (67.8%)	275 (32.2%)	79.0 (6.5)	10.3 (2.6)	18.8 (4.1)	NR	NR	Eating behaviors	CNAQ <29
Toyota et al., 2007 ⁵²	Japan	Memory clinic	261 LO	181 (69.3%)	80 (30.7%)	78.5 (5.1)	9.5 (2.3)	19.0 (6.0)	3.2 (2.4)	NR	Delusions	NPI-item >0
Toyota et al., 2007 ⁵²	Japan	Memory clinic	46 EO	22 (47.8%)	24 (52.2%)	58.8 (5.0)	11.8 (2.7)	17.4 (6.3)	3.5 (2.0)	NR	Delusions	NPI-item >0
Treiber et al., 2008 ⁵³	USA	Community based	254	173 (68.1%)	81 (31.9%)	85.7 (6.6)	13.3 (2.9)	NR	1.9 (1.3)	NR	Disinhibition	NPI Severity x frequency scores
Troisi et al., 1996 ⁵⁴	Italy	Memory clinic	42	25 (59.5%)	17 (40.5%)	76.2 (6.1)	6.6 (4.7)	14.2 (5.9)	NR	NR	Depression	HRSD-PSY subscore
Tunnard et al., 2011 ⁵⁵	UK	Memory clinic	111	76 (68.5%)	35 (31.5%)	75.2 (6.2)	8.1 (4.0)	20.8 (4.8)	4.0 (2.9)	NR	Apathy	NPI-item >0

Study	Country	Sample	N total	N (%) females	N (%) males	Age M (SD)	Education M (SD)	MMSE M (SD)	Disease duration M (SD)	% APOE-ε4 carriers	NPS	Outcome measure
Usman et al., 2010 ⁵⁶	Pakistan	Memory clinic	76	42 (55.3%)	34 (44.7%)	67.7 (6.7)	>12y 10.5%	68.4% <20.0	NR	NR	Depression	HRSD >7
Vilalta-Franch et al., 2013 ⁵⁷	Spain	Memory clinic	491	348 (70.9%)	143 (29.1%)	75.2 (6.6)	5.9 (3.7)	NR	2.7 (2.3)	NR	Psychosis	PoAD diagnosis
Xing et al., 2015 ⁵⁸	China	Memory clinic	158 mild	84 (53.2%)	74 (46.8%)	70.9 (9.6)	7.6 (5.2)	17.5 (5.2)	NR	34.8%	12 NPI-items	NPI-items >0
Xing et al., 2015 ⁵⁸	China	Memory clinic	157 mod.	92 (58.6%)	65 (41.4%)	67.7 (10.4)	6.1 (4.7)	12.3 (5.5)	NR	39.4%	12 NPI-items	NPI-items >0
Yang et al., 2017 ⁵⁹	China	Community based	104	75 (72.1%)	29 (27.9%)	71.8 (60–85)	≥Secondary 15.4%	21.3 (4.8) ^f	NR	NR	Depression	GDS-30 total score
Yang et al., 2020 ⁶⁰	China	Memory clinic	158	84 (53.2%)	74 (46.8%)	74.1 (5.8)	NR	14.5 (7.6)	NR	NR	Depression	HRSD ≥17
Zeitzer et al., 2013 ⁶¹	France	Memory clinic	92	46 (50%)	46 (50%)	77.9 (6.6)	NR	21.0 (5.5)	NR	NR	Apathy	NPI-item >2
Zhao et al., 2012 ⁶²	China	Memory clinic	83	40 (48.2%)	43 (51.8%)	74.0 (8.3)	8.7 (4.0)	18.0 (7.7)	3.7 (3.1)	NR	Apathy	NPI-item >0

Abbreviations: MMSE, Mini-mental state examination; NPS, neuropsychiatric symptoms; NR, not reported; USA, United States of America; UK, United Kingdom; EO, early-onset; LO, late-onset; AMB, aberrant motor behaviors; NPI, Neuropsychiatric Inventory; NPI-Q, Neuropsychiatric Inventory Questionnaire; GMSS, Geriatric Mental State Schedule; SGRC, Stockton Geriatric Rating Scale; ICD-9, International Classification of Diseases; DD, depressive disorder; NIMH-dAD, National Institute of Mental Health criteria for depression in Alzheimer’s disease (Olin et al. [2002] Am J Geriatr Psychiatry; DSM, Diagnostic and Statistical Manual of Mental Disorders; PBQ, Psychobehavioral Questionnaire; BEHAVE-AD, Behavioural pathology in Alzheimer’s disease; RAGE, Rating scale for aggressive behaviour in the elderly; BDI, Beck Depression Inventory; DAIR, Dementia Apathy Interview and Rating; BRSD, Behavior Rating Scale for Dementia; ADAS-Non-Cog, non-cognitive section of the Alzheimer’s disease Assessment Scale; DBDS, Dementia Behavior Disturbance Scale; CSDD, Cornell Scale for Depression in Dementia; GDS, Geriatric Depression Scale; CNAQ, Council of Nutrition Appetite Questionnaire; HRSD-PSY,

Intrapsychic subscore of the Hamilton Rating Scale for Depression; PoAD, psychosis in Alzheimer's disease (Jeste & Finkel [2000] Am J Geriatr).

^a M(SD) of total sample including mild and moderate AD

^b Studies reported corrected effect sizes

^c Median (interquartile range)

^d Baseline MMSE scores of subsample of patients who had six months follow-up assessments available (N=852/N=1248).

^e M (SD) age of total dementia population (N=211) of which 149 patients had AD

^f M(SD) of the Montreal Cognitive Assessment (MoCA)

eTable 4. Meta-regression analyses on the prevalence of specific neuropsychiatric symptoms in Alzheimer’s disease dementia

NPS	K	Clinically relevance (presence vs relevance)	Method of assessment (proxy vs self-report)	NPI vs non-NPI	Mean age	Mean education in years	Mean MMSE score	Mean disease duration in years	%APOE-E4 carriers
Aberrant motor behaviors	7	NR	NR	NR	$k=7, QM=0.22, p=0.64, estimate=-0.03$	NA	NA	NR	NR
Agitation	11	NA	NR	$k=11, QM=0.98, p=0.33, NPI OR=0.67 [0.36-1.55], nonNPI OR=0.99 [0.63-1.55]$	$k=10, QM=3.02, p=0.08, estimate=-0.08$	NA	$k=7, QM=0.01, p=0.93, estimate=0.01$	NR	NR
Anxiety	8	NR	NR	NR	$k=8, QM=0.54, p=0.46, estimate=-0.09$	NA	NA	NR	NA
Apathy	12	NA	NR	NA	$k=12, QM=0.02, p=0.89, estimate=-0.01$	NA	$k=10, QM=0.53, p=0.47, estimate=-0.05$	NA	NA
Delusions	12	NR	NR	NR	$k=12, QM=0.00, p=0.99, estimate=0.00$	$k=7, QM=1.65, p=0.20, estimate=0.10$	$k=10, QM=0.01, p=0.92, estimate=0.00$	$k=6, QM=5.19, p=0.02, estimate=0.32$	NA
Depressive symptoms	20	$k=20, QM=0.09, p=0.76, presence OR=1.66 [1.21-2.28], clinical relevance OR=1.55 [1.13-2.11]$	$k=20, QM=0.05, p=0.83, Proxy OR=1.63 [1.25-2.12], Self-report OR=1.54 [1.00-2.37]$	$k=20, QM=0.09, p=0.77, NPI OR=1.67 [1.17-2.39], nonNPI OR=1.56 [1.17-2.08]$	$k=19, QM=0.91, p=0.34, estimate=-0.04$	$k=9, QM=0.00, p=0.95, estimate=0.01$	$k=13, QM=0.16, p=0.69, estimate=0.02$	$k=8, QM=0.30, p=0.59, estimate=0.13$	$k=7, QM=0.04, p=0.84, estimate=0.00$
Disinhibition	8	NR	NR	NR	$k=8, QM=8.20, p=0.004, estimate=-0.11$	NA	NA	NR	NA

NPS	K	Clinically relevance (presence vs relevance)	Method of assessment (proxy vs self- report)	NPI vs non- NPI	Mean age	Mean education in years	Mean MMSE score	Mean disease duration in years	%APOE-E4 carriers
Euphoria	6	NR	NR	NR	<i>k=6, QM=2.87, p=0.09, estimate=0.14</i>	NA	NA	NR	NR
Halluci- nations	9	NR	NR	NR	<i>k=9, QM=0.12, p=0.73, estimate=0.01</i>	NA	<i>k=6, QM=0.01, p=0.92, estimate=0.01</i>	NR	NA
Irritability	6	NR	NR	NR	<i>k=6, QM=1.09, p=0.30, estimate=-0.08</i>	NA	NA	NR	NR
Sleep disturbances	8	NR	NR	NR	NA	NA	<i>k=8, QM=0.11, p=0.74, estimate=-0.02</i>	NR	NR

Abbreviations: NR, not reported; NA, not available due to the low number of studies.

Meta-regression analyses were not possible for eating behaviors, psychotic symptoms, and studies reporting on ≥ 1 NPS due to the low number of studies available.

eTable 5. Meta-regression analyses on severity of specific of specific neuropsychiatric symptoms in Alzheimer’s disease dementia

NPS	k	Method of assessment (proxy vs self-report)	NPI vs non-NPI	Mean age of patients in years	Mean education in years	Mean MMSE score	Mean disease duration in years	%APOE E4 carriers
Aberrant motor behaviors	10	NR	NA	$k=10, QM=0.00, p=0.96, \text{estimate}=0.00$	$k=7, QM=0.31, p=0.58, \text{estimate}=-0.09$	$k=8, QM=0.13, p=0.72, \text{estimate}=0.03$	NA	NA
Agitation	12	NR	NA	$k=12, QM=0.12, p=0.73, \text{estimate}=-0.02$	$k=8, QM=0.63, p=0.43, \text{estimate}=-0.09$	$k=10, QM=0.00, p=0.99, \text{estimate}=0.00$	NA	NA
Anxiety	11	NR	NA	$k=11, QM=0.00, p=0.99, \text{estimate}=0.00$	$k=7, QM=0.77, p=0.38, \text{estimate}=-0.48$	$k=9, QM=0.00, p=0.95, \text{estimate}=0.02$	NA	NA
Apathy	12	NR	NA	$k=12, QM=0.04, p=0.83, \text{estimate}=0.01$	$k=8, QM=0.40, p=0.52, \text{estimate}=0.05$	$k=10, QM=0.01, p=0.91, \text{estimate}=-0.01$	NA	NA
Delusions	11	NR	NA	$k=11, QM=0.13, p=0.72, \text{estimate}=0.02$	$k=7, QM=0.12, p=0.73, \text{estimate}=-0.06$	$k=9, QM=0.30, p=0.58, \text{estimate}=0.04$	NA	NA
Depressive symptoms	17	$k=17, QM=0.39, p=0.54, \text{proxy } g=0.61 [-0.01-1.22], \text{self-report } g=0.29 [-0.48-1.07]$	$k=17, QM=0.39, p=0.54, \text{NPI } g=0.61 [-0.01-1.22], \text{nonNPI } g=0.29 [-0.48-1.07]$	$k=17, QM=0.03, p=0.86, \text{estimate}=-0.01$	$k=11, QM=0.93, p=0.33, \text{estimate}=-0.14$	$k=15, QM=0.05, p=0.82, \text{estimate}=-0.02$	NA	NA
Disinhibition	11	NR	NA	$k=11, QM=0.42, p=0.52, \text{estimate}=-0.03$	$k=7, QM=1.89, p=0.17, \text{estimate}=0.14$	$k=9, QM=0.21, p=0.65, \text{estimate}=0.02$	NA	NA
Eating behavior	6	NA	NA	$k=6, QM=0.99, p=0.32, \text{estimate}=0.01$	NA	$k=6, QM=2.81, p=0.09, \text{estimate}=0.04$	NA	NA
Euphoria	11	NR	NA	$k=11, QM=0.06, p=0.81, \text{estimate}=0.01$	$k=7, QM=0.42, p=0.52, \text{estimate}=-0.06$	$k=9, QM=0.12, p=0.73, \text{estimate}=0.02$	NA	NA
Hallucinations	11	NR	NA	$k=11, QM=0.05, p=0.83, \text{estimate}=-0.01$	$k=7, QM=1.93, p=0.16, \text{estimate}=-0.22$	$k=9, QM=0.11, p=0.74, \text{estimate}=-0.03$	NA	NA

NPS	k		Assessment (NPI vs non-NPI)	Mean age of patients in years	Mean education in years	Mean MMSE score	Mean disease duration in years	%APOE E4 carriers
Irritability	11	<i>NR</i>	<i>NA</i>	<i>k=11, QM=0.00, p=0.97, estimate= 0.00</i>	<i>k=7, QM=0.01, p=0.93, estimate= 0.00</i>	<i>k=9, QM=0.16, p=0.68, estimate= -0.01</i>	<i>NA</i>	<i>NA</i>
Sleep disturbances	6	<i>NR</i>	<i>NA</i>	<i>k=6, QM=0.04, p=0.83, estimate= 0.00</i>	<i>NA</i>	<i>k=6, QM=4.40, p=0.04, estimate= 0.05</i>	<i>NA</i>	<i>NA</i>
Total score NPS measure	14	<i>NR</i>	<i>NA</i>	<i>k=14, QM=0.00, p=0.99, estimate= 0.00</i>	<i>k=7, QM=1.04, p=0.31, estimate= -0.17</i>	<i>k=12, QM=0.03, p=0.87, estimate= 0.02</i>	<i>NA</i>	<i>NA</i>

Abbreviations: NR, not reported; NA, not available due to the low number of studies.

Meta-regression analyses were not possible for psychotic symptoms due to the low number of studies available.

eTable 6. Publication bias measures for all meta-analyses conducted

	<i>k</i>	Begg's rank test (τ)	P value	Egger's regression test (t)	P value
NPS prevalence					
Aberrant motor behaviors (excluding outlier)	6	0.29	0.78	-0.07	1.00
Agitation (excluding outlier)	10	-0.56	0.03	-2.82	0.02
Anxiety	8	-0.21	0.55	-0.63	0.55
Apathy	12	-0.36	0.12	-1.13	0.28
Any NPS (excluding outlier)	4	-0.33	0.75	-0.36	0.76
Delusions	12	0.33	0.15	1.74	0.11
Depressive symptoms	20	0.20	0.23	3.49	<0.01
Disinhibition	8	0.00	1.00	0.29	0.78
Eating behavior	5	0.20	0.82	-0.06	0.96
Euphoria	6	0.07	1.00	-0.14	0.90
Hallucinations	9	0.50	0.08	1.68	0.14
Irritability (excluding outlier)	5	-0.20	0.82	-1.44	0.24
Psychotic symptoms (excluding outlier)	4	-0.33	0.75	-0.32	0.78
Sleep disturbances	8	-0.14	0.72	-0.05	0.96
NPS severity					
Aberrant motor behaviors (excluding outlier)	9	-0.22	0.48	-0.72	0.50
Agitation (excluding outlier)	11	-0.16	0.54	-0.63	0.54
Anxiety (excluding outlier)	10	0.11	0.73	-0.03	0.98
Apathy (excluding outlier)	11	0.24	0.36	0.62	0.55
Delusions (excluding outlier)	10	-0.20	0.48	-0.77	0.46
Depressive symptoms (excluding outlier)	16	-0.03	0.89	0.18	0.86
Disinhibition (excluding outlier)	10	-0.29	0.29	-0.96	0.36
Eating behavior	6	-0.07	1.00	-0.07	0.94
Euphoria (excluding outlier)	10	-0.07	0.86	0.16	0.88
Hallucinations (excluding outlier)	10	-0.20	0.48	-0.29	0.78
Irritability	11	-0.27	0.28	-0.76	0.47
Total score NPS measure (excluding outlier)	13	-0.18	0.44	-1.27	0.23
Sleep disturbances	8	-0.14	0.72	-0.05	0.96

Abbreviations: *k*, number of studies; NPS, neuropsychiatric symptoms.

eTable 7. Duval and Tweedie's trim-and-fill method to adjust for potential publication bias

Meta-analysis	<i>k</i>	<i>OR</i> [95% <i>CI</i>]^a	<i>z</i>-statistic	<i>P</i>	<i>Q</i>-statistic	<i>P Q</i>-statistic	<i>I</i>²-statistic
Prevalence agitation	10	1.00 [0.75, 1.35]	0.01	0.99	16.63	0.06	46.06
<i>Trim-and-fill</i>	13	1.20 [0.87, 1.66]	1.12	0.26	29.06	0.004	60.56
Prevalence depressive symptoms	20	1.60 [1.28, 1.98]	4.20	<0.001	51.99	<0.001	58.19
<i>Trim-and-fill</i>	21	1.55 [1.25, 1.94]	3.90	< 0.001	56.11	< 0.001	59.14

Abbreviations: *k*, number of studies; *OR*, odds ratio; *NPS*, neuropsychiatric symptoms.

^a *OR*=1 no sex differences, *OR*>1 female sex associated with *NPS*; *OR*<1 male sex associated with *NPS*.

eTable 8. Sex differences in the prevalence of neuropsychiatric symptoms for meta-analyses that excluded outliers

NPS	<i>k</i>	OR [95% CI] ^a	z-statistic	<i>P</i>	<i>Q</i> -statistic	<i>P Q</i> -statistic	<i>I</i> ² -statistic
Aberrant motor behaviors	6	1.47 [1.09, 1.98]	2.53	0.01	2.51	0.78	0.00
<i>including outlier</i> ²⁵	7	1.21 [0.79, 1.84]	0.87	0.39	14.16	0.03	57.41
Agitation	10	1.00 [0.75, 1.35]	0.01	0.99	16.63	0.06	46.06
<i>including outlier</i> ⁶	11	0.87 [0.60, 1.25]	-0.77	0.44	28.57	0.002	66.49
Any NPS	4	1.35 [0.78–2.35]	1.07	0.28	4.01	0.25	32.74
<i>including outlier</i> ⁵⁰	5	1.06 [0.56, 2.01]	0.17	0.86	8.73	0.07	57.49
Irritability	5	1.14 [0.83, 1.56]	0.80	0.43	6.11	0.19	0.00
<i>including outlier</i> ⁴⁰	6	0.90 [0.55, 1.46]	-0.44	0.66	12.86	0.02	61.62
Psychotic symptoms	4	1.62 [1.12, 2.33]	2.56	<0.01	1.98	0.58	0.00
<i>including outlier</i> ¹⁹	5	1.17 [0.60, 2.32]	0.46	0.64	12.74	0.01	73.02

Abbreviations: *k*, number of studies; OR, odds ratio; NPS, neuropsychiatric symptoms.

^a OR=1 no sex differences, OR>1 female sex associated with NPS; OR<1 male sex associated with NPS.

eTable 9. Sex differences in the severity of neuropsychiatric symptoms for meta-analyses that excluded outliers

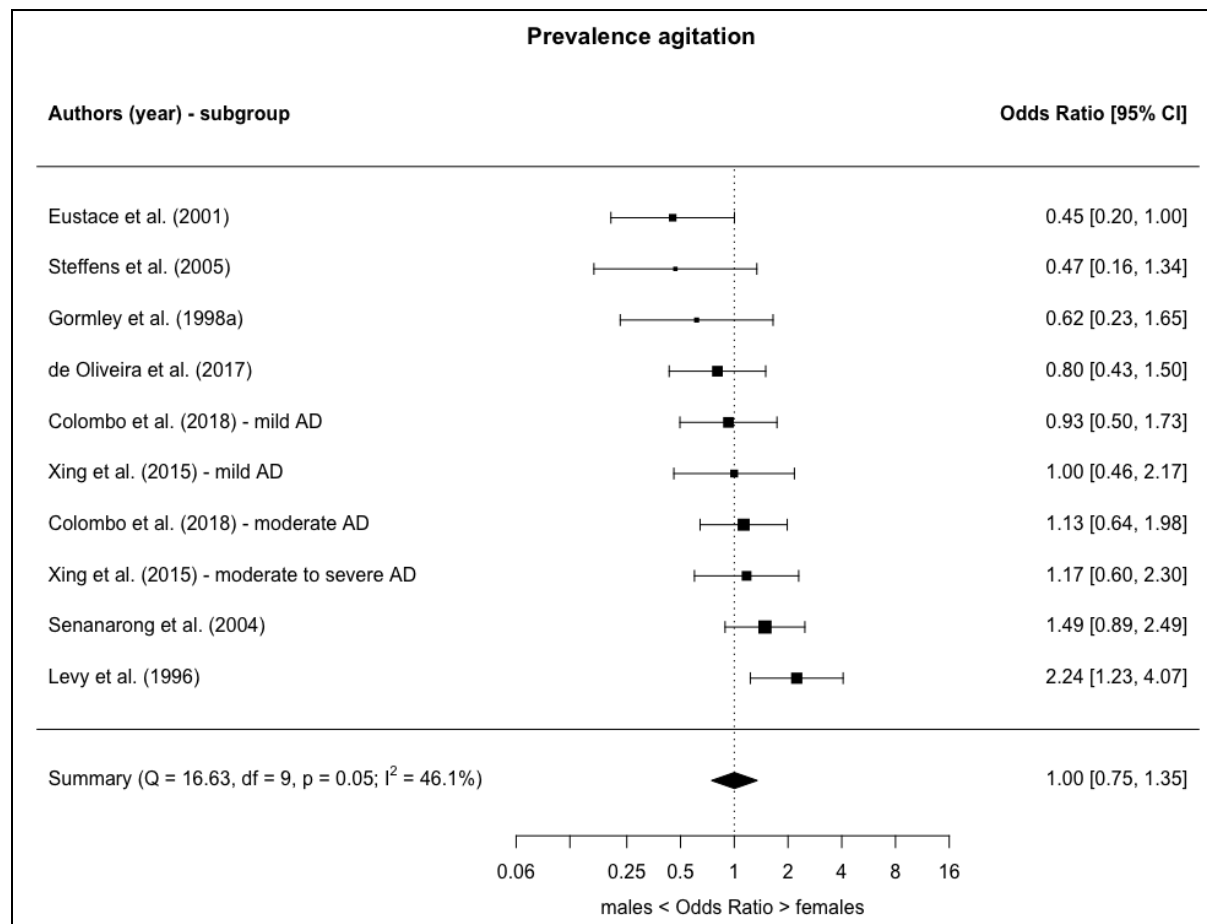
NPS	k	Hedges' <i>g</i> [95% CI] ^a	z-statistic	<i>P</i>	<i>Q</i> -statistic	<i>P Q</i> -statistic	<i>I</i> ² -statistic
Aberrant motor behaviors	9	0.17 [0.08, 0.26]	3.56	<0.001	3.25	0.92	0.00
<i>including outlier</i> ⁴⁹	10	0.35 [-0.04, 0.74]	1.76	0.08	372.89	<0.001	95.21
Agitation	11	0.01 [-0.07, 0.10]	0.26	0.79	12.53	0.25	3.12
<i>including outlier</i> ⁴⁹	12	0.16 [-0.20, 0.52]	0.87	0.39	471.66	<0.001	95.45
Anxiety	10	0.11 [0.00, 0.22]	1.98	0.05	13.27	0.01	25.15
<i>including outlier</i> ⁴⁹	11	0.73 [-0.50, 1.97]	1.17	0.24	1544.28	<0.001	99.50
Apathy	11	-0.10 [-0.18, -0.01]	-2.25	0.02	5.00	0.89	0.00
<i>including outlier</i> ⁴⁹	12	-0.21 [-0.47, 0.05]	-1.61	0.11	244.64	<0.001	90.71
Depressive symptoms	16	0.24 [0.14, 0.34]	4.59	<0.001	30.15	0.02	44.29
<i>including outlier</i> ⁴⁹	17	0.49 [0.05, 0.96]	2.00	0.05	1140.34	<0.001	97.85
Delusions	10	0.19 [0.04, 0.34]	2.53	0.01	19.99	0.02	58.78
<i>including outlier</i> ⁴⁹	11	0.34 [-0.03, 0.72]	1.83	0.07	381.71	<0.001	95.17
Disinhibition	10	0.08 [-0.05, 0.21]	1.16	0.25	17.01	0.05	46.48
<i>including outlier</i> ⁴⁹	11	-0.06 [-0.30, 0.20]	-0.43	0.67	179.25	<0.001	89.63
Euphoria	10	0.00 [-0.10, 0.10]	-0.04	0.97	8.10	0.52	14.55
<i>including outlier</i> ⁴⁹	11	0.11 [-0.11, 0.33]	0.96	0.33	144.78	<0.001	86.49
Hallucinations	10	0.07 [-0.13, 0.26]	0.65	0.51	36.63	<0.001	77.20
<i>including outlier</i> ⁴⁹	11	0.25 [-0.15, 0.65]	1.20	0.23	452.69	<0.001	95.87
Total score NPS measure	13	0.04 [-0.04, 0.12]	1.03	0.31	7.54	0.82	0.00
<i>including outlier</i> ⁴⁹	14	0.29 [-0.24, 0.83]	1.07	0.29	1021.77	<0.001	97.89

Abbreviations: k, number of studies; OR, odds ratio; NPS, neuropsychiatric symptoms.

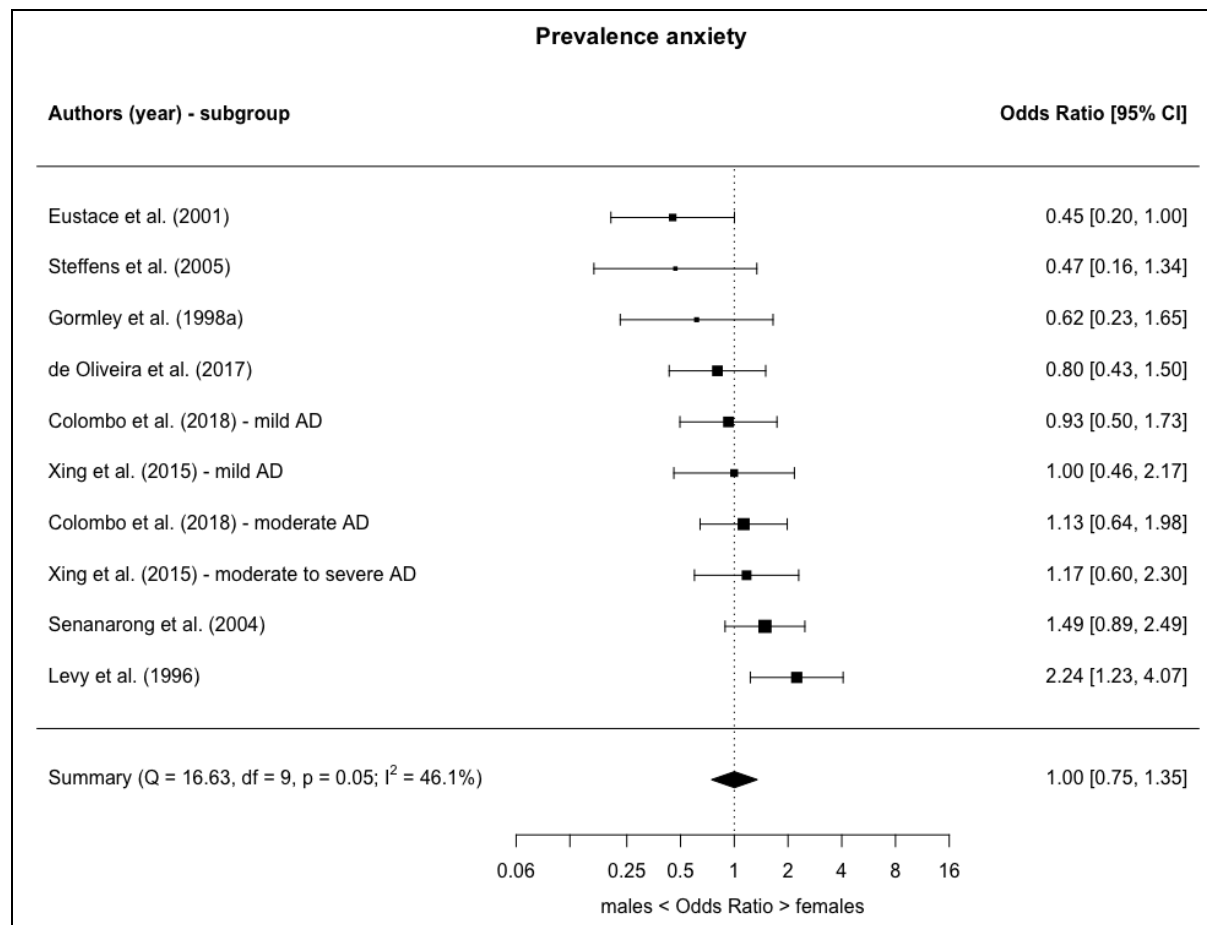
^a Hedges' *g* >0 female sex associated with NPS; Hedges' *g* <0 male sex associated with NPS

eFigure 1. Forest plots meta-analyses prevalence specific NPS

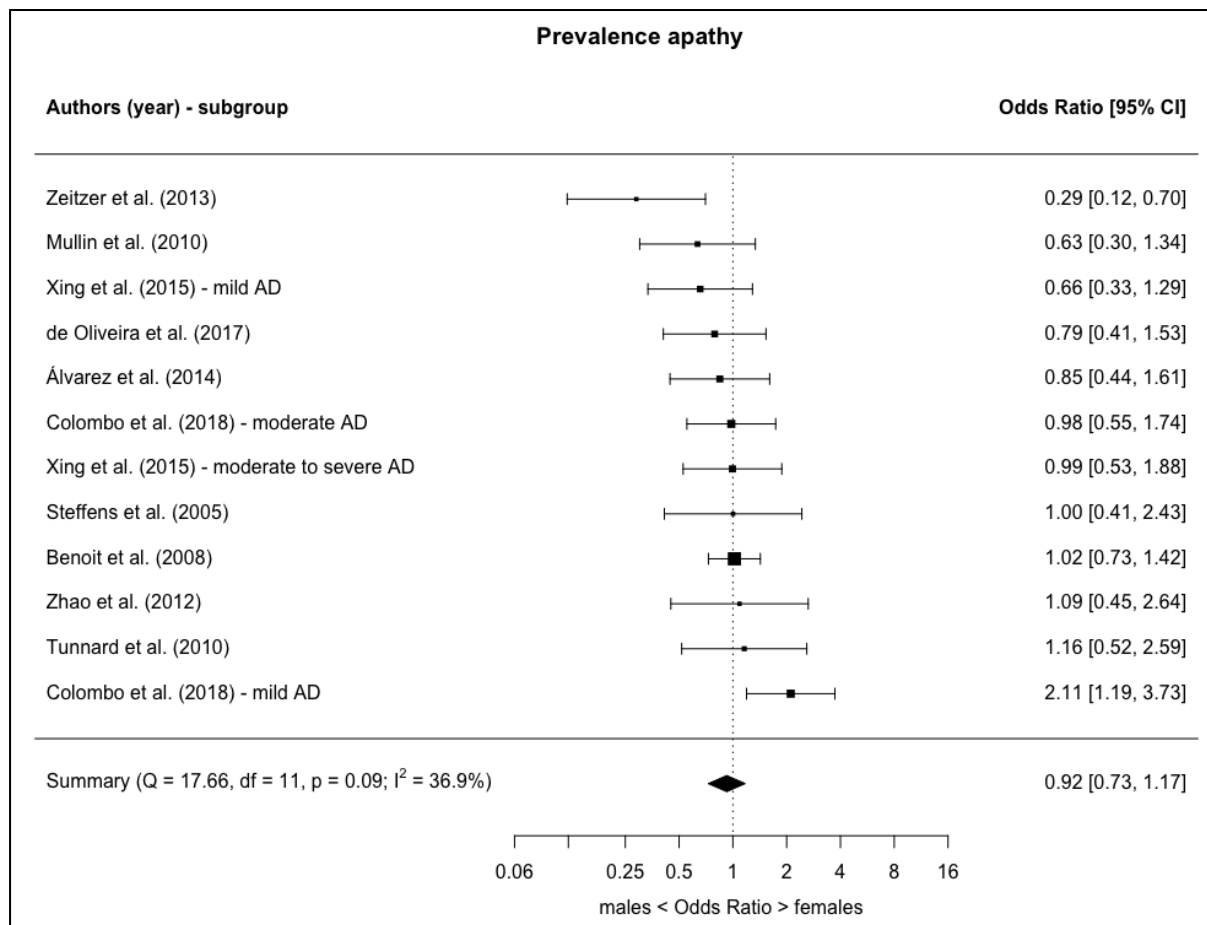
A) Forest plot prevalence agitation



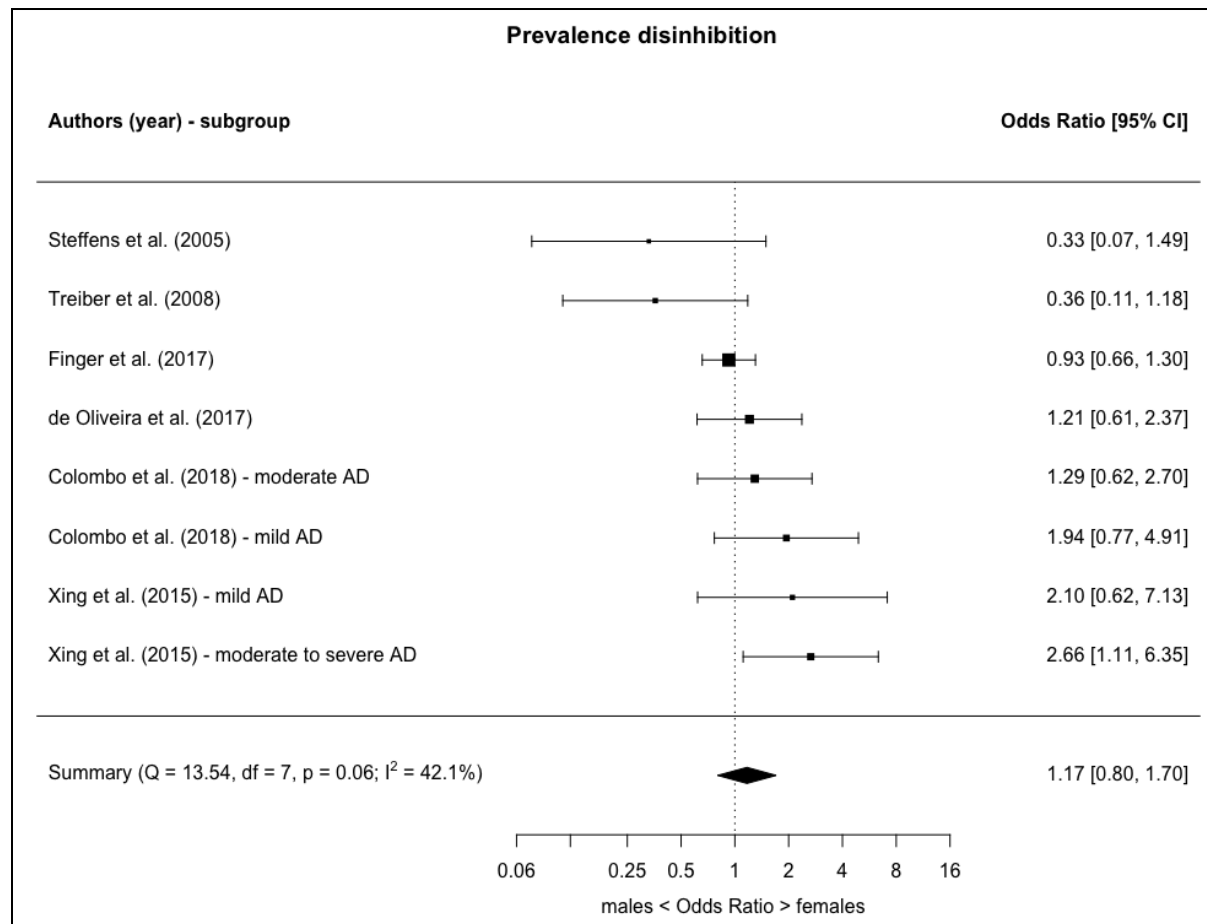
B) Forest plot prevalence anxiety



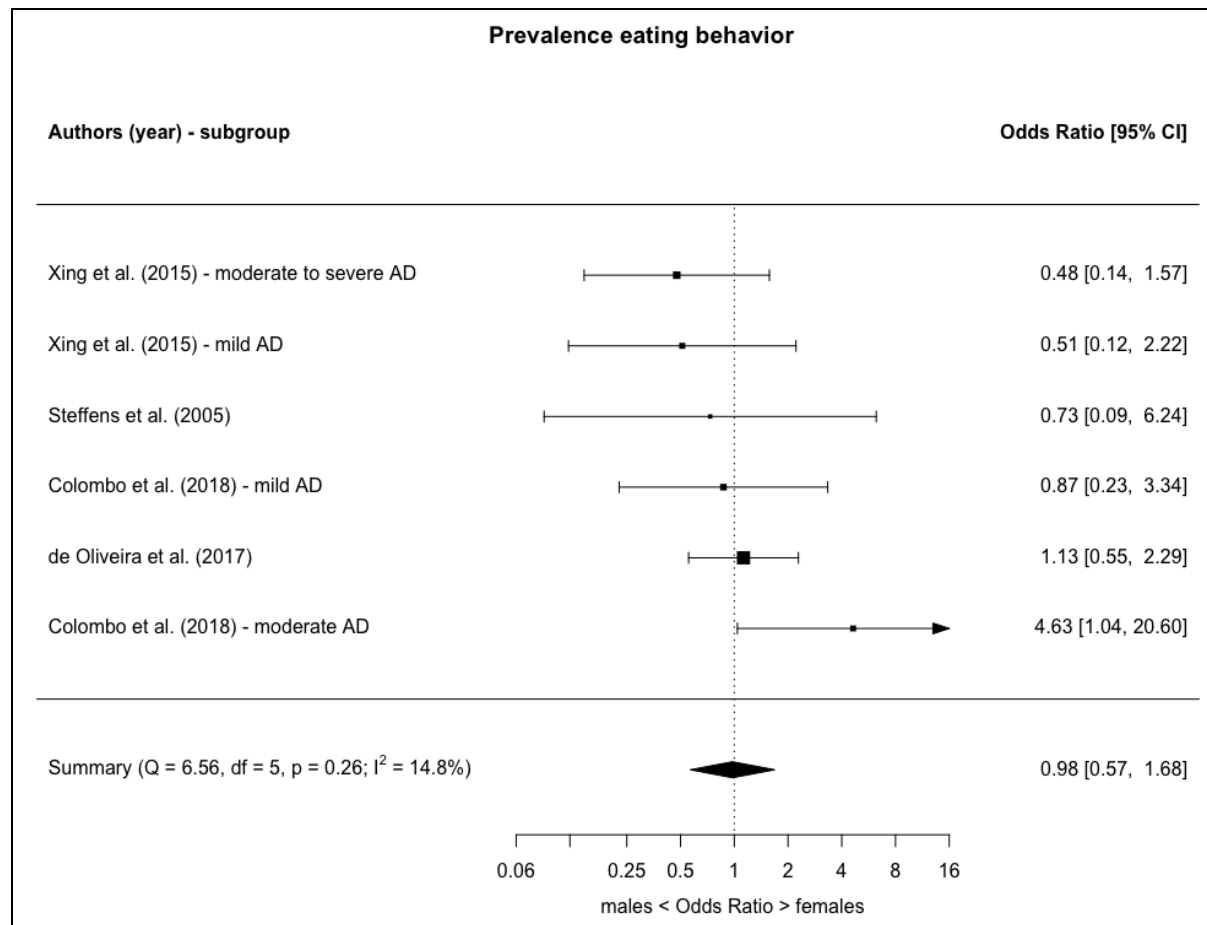
C) Forest plot prevalence apathy



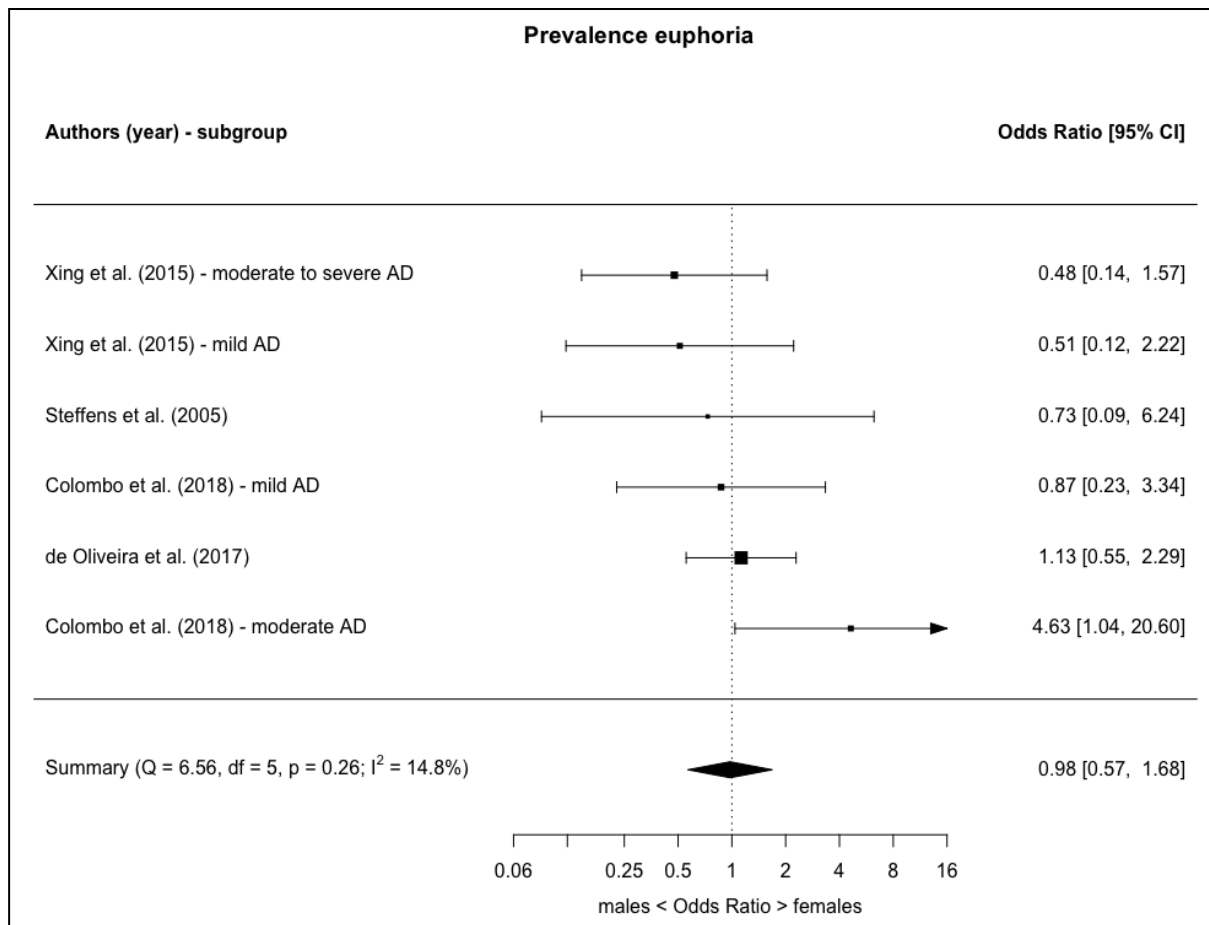
D) Forest plot prevalence disinhibition



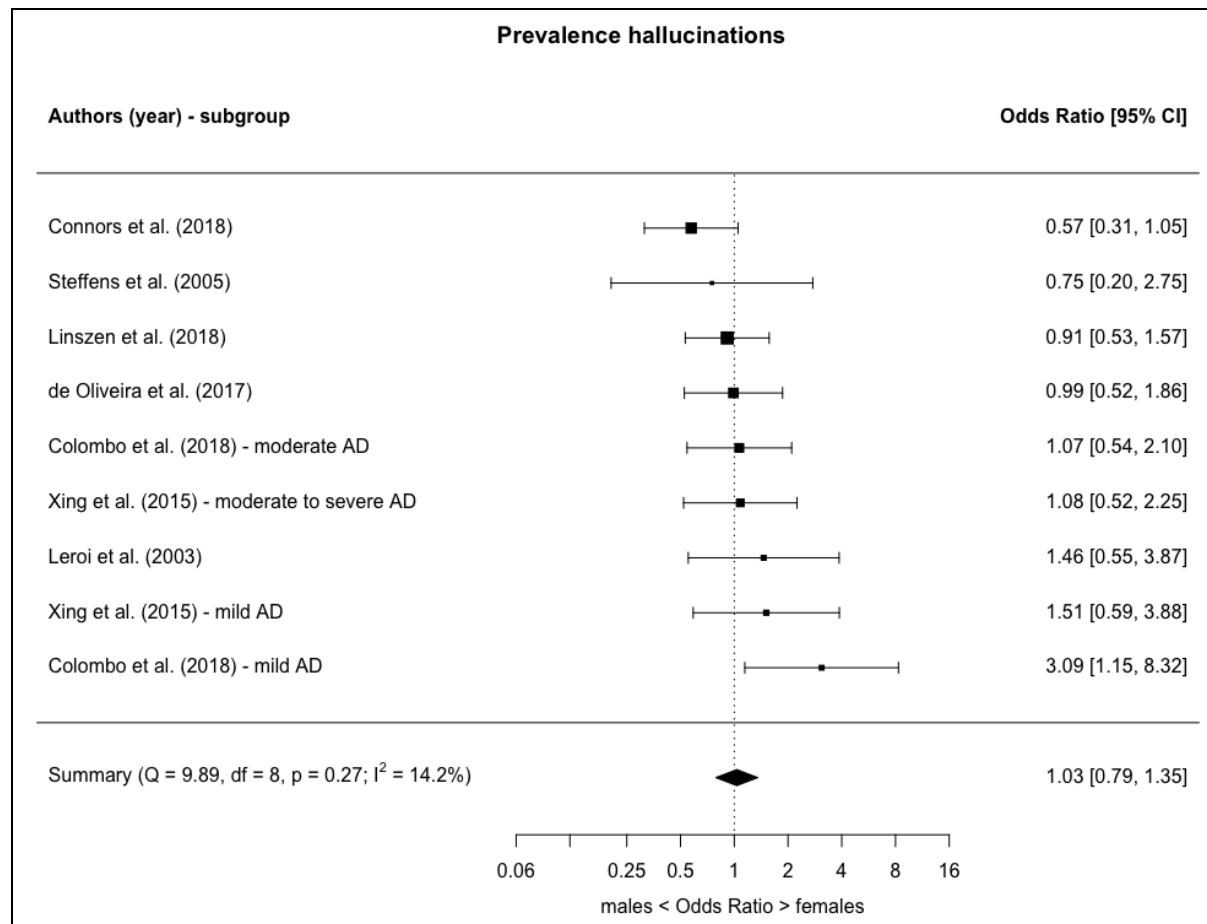
E) Forest plot prevalence eating behavior



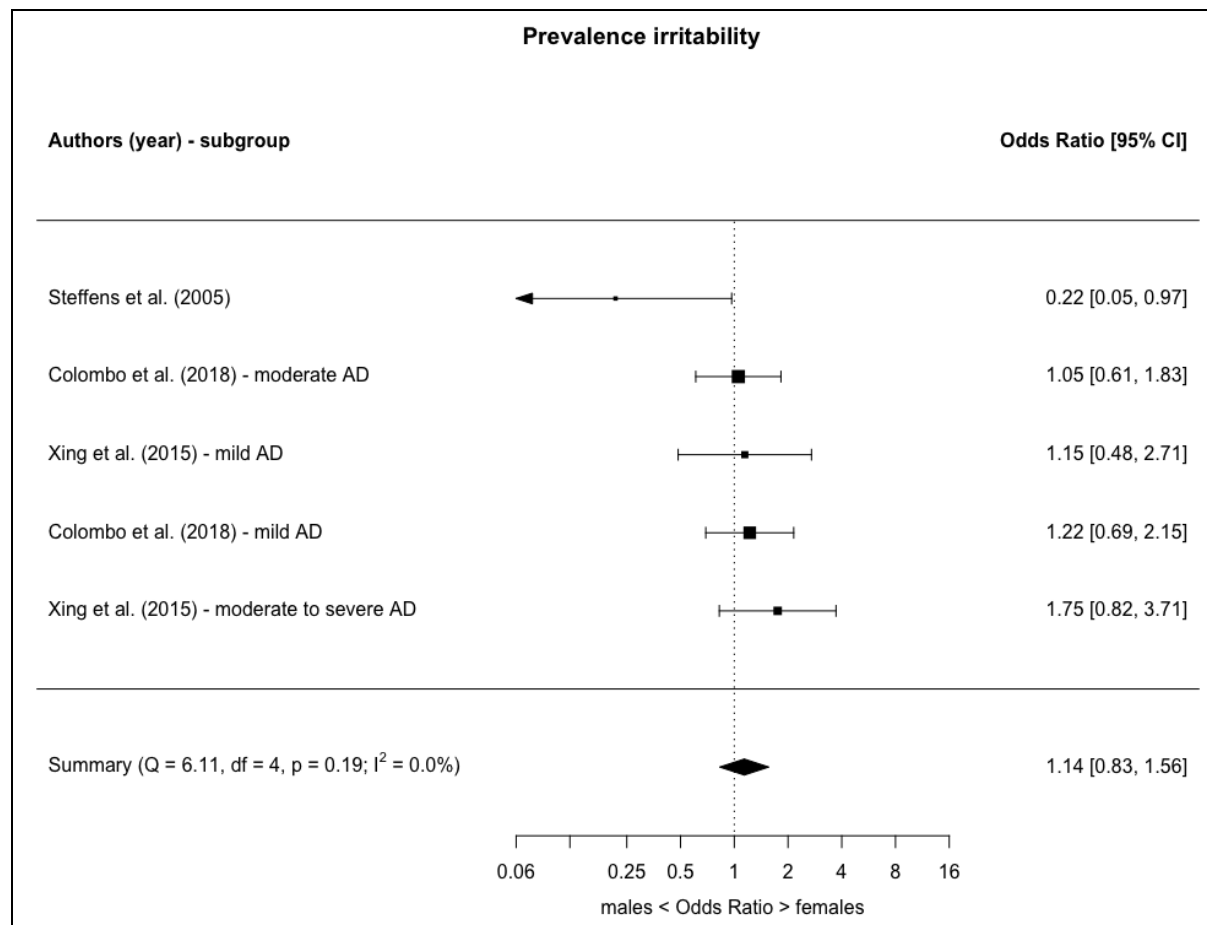
F) Forest plot prevalence euphoria



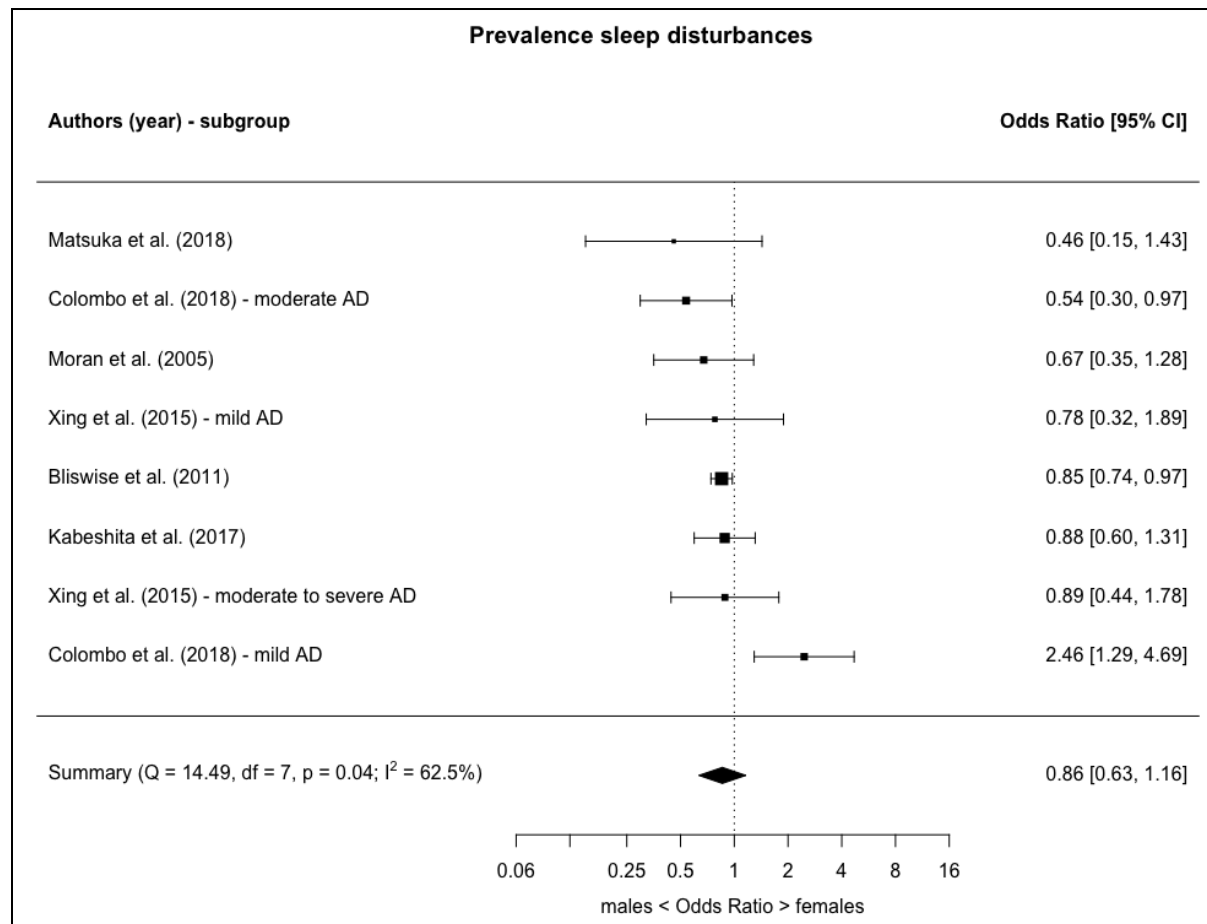
G) Forest plot prevalence hallucinations



H) Forest plot prevalence irritability

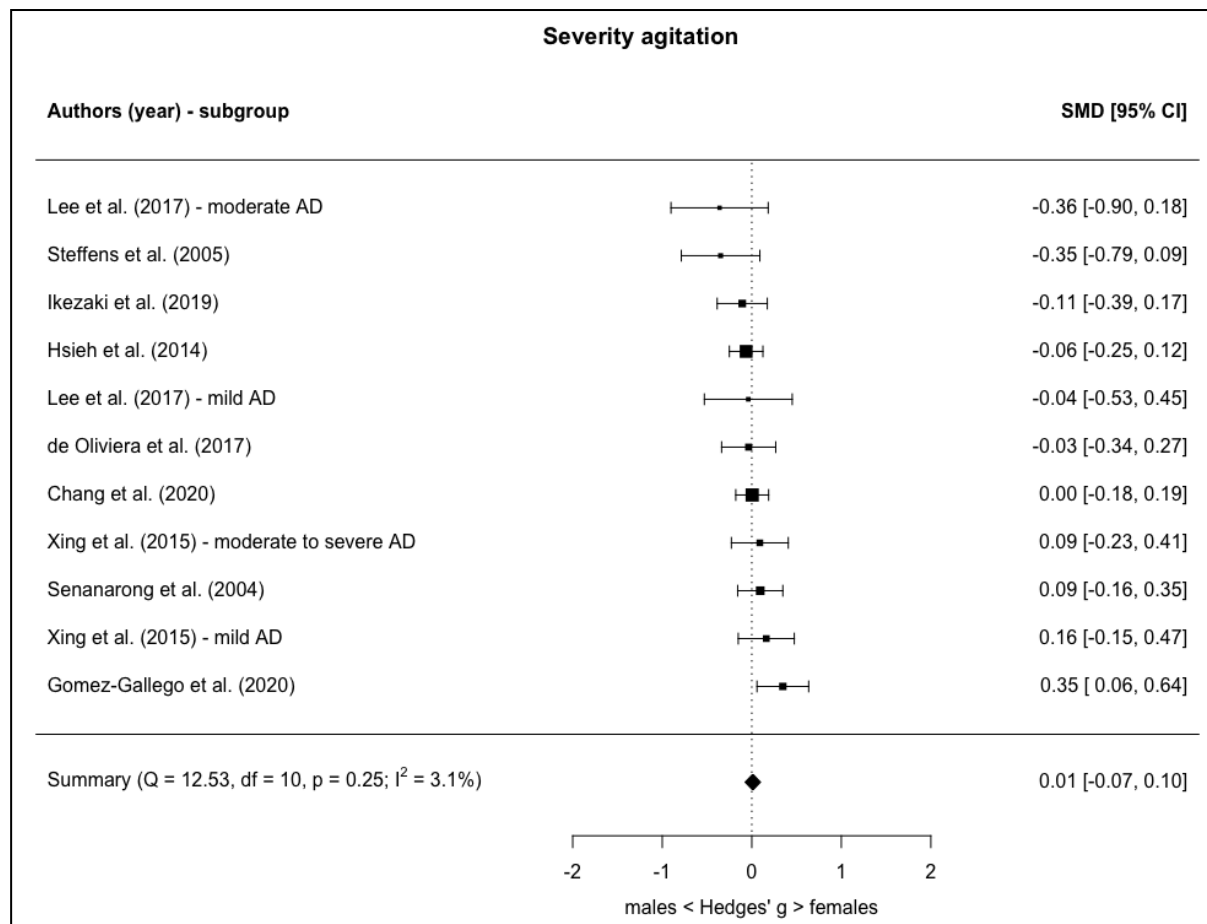


I) Forest plot prevalence sleep disturbances

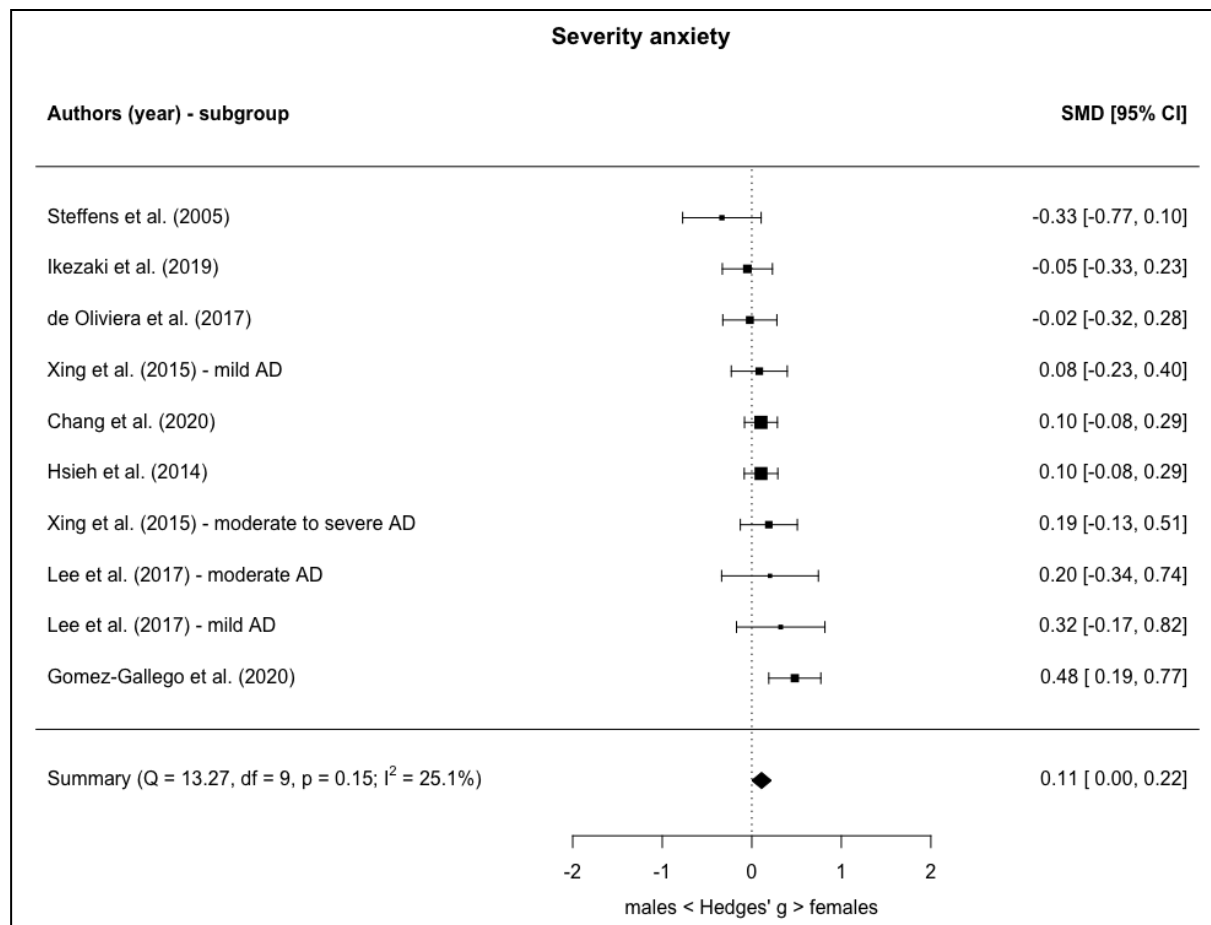


eFigure 2. Forest plots meta-analyses severity specific NPS

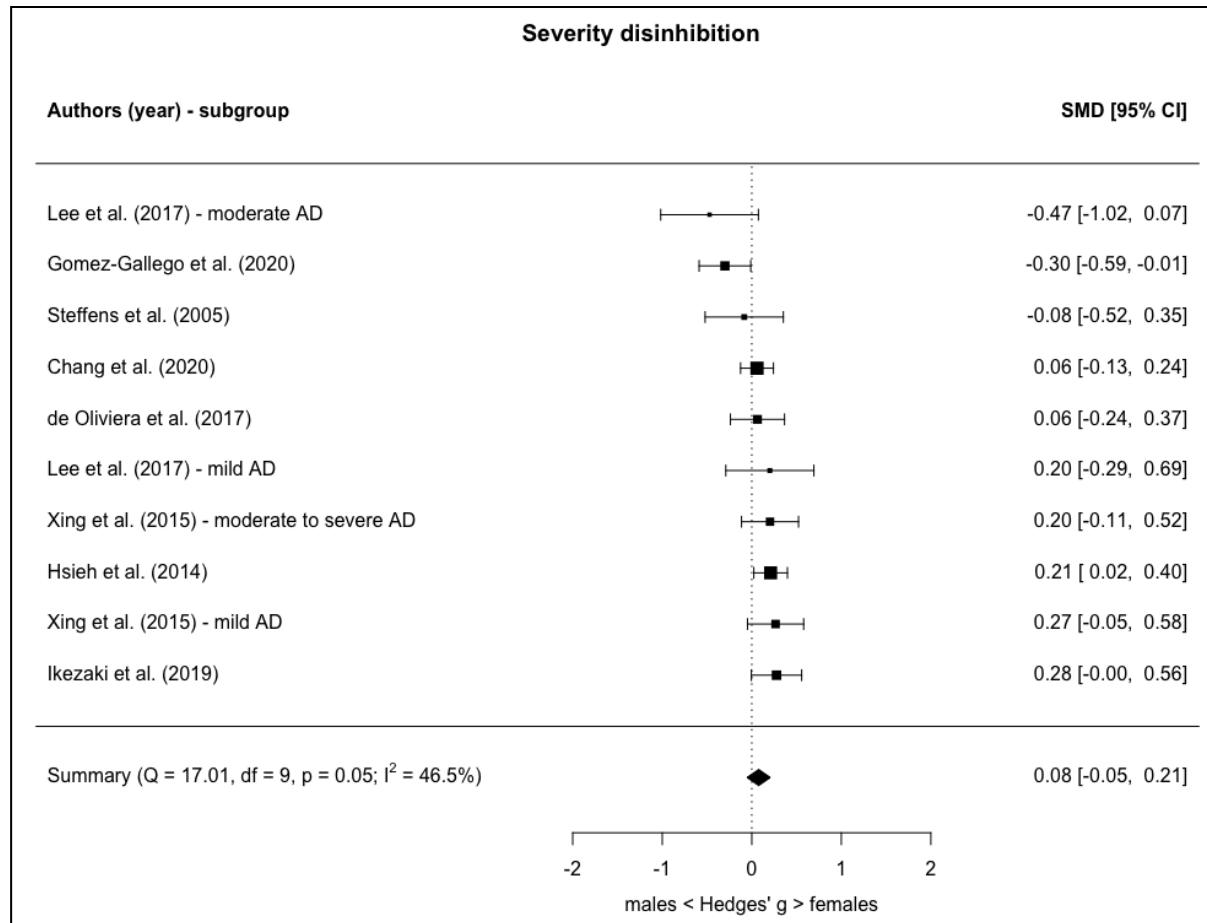
A) Forest plot severity agitation



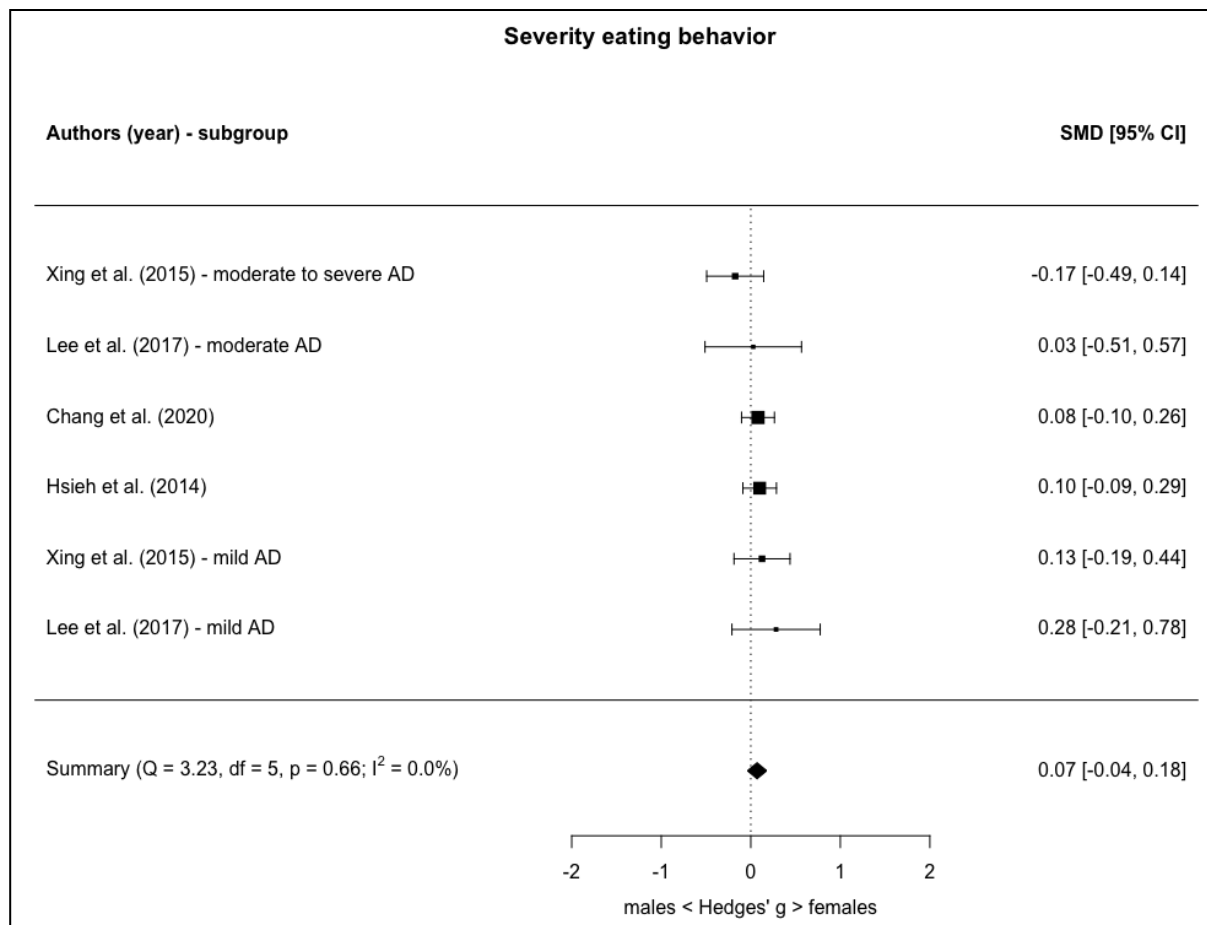
B) Forest plot severity anxiety



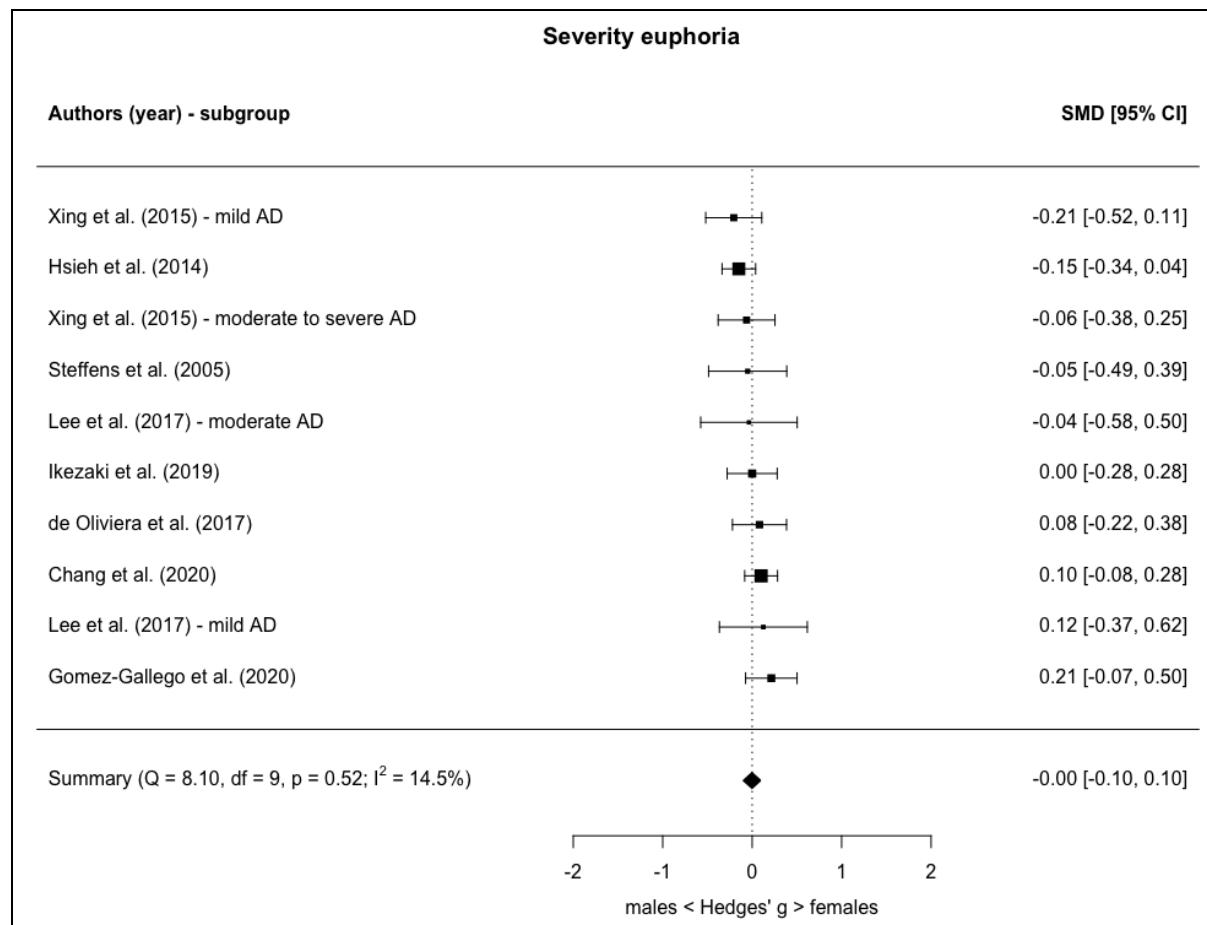
C) Forest plot severity disinhibition



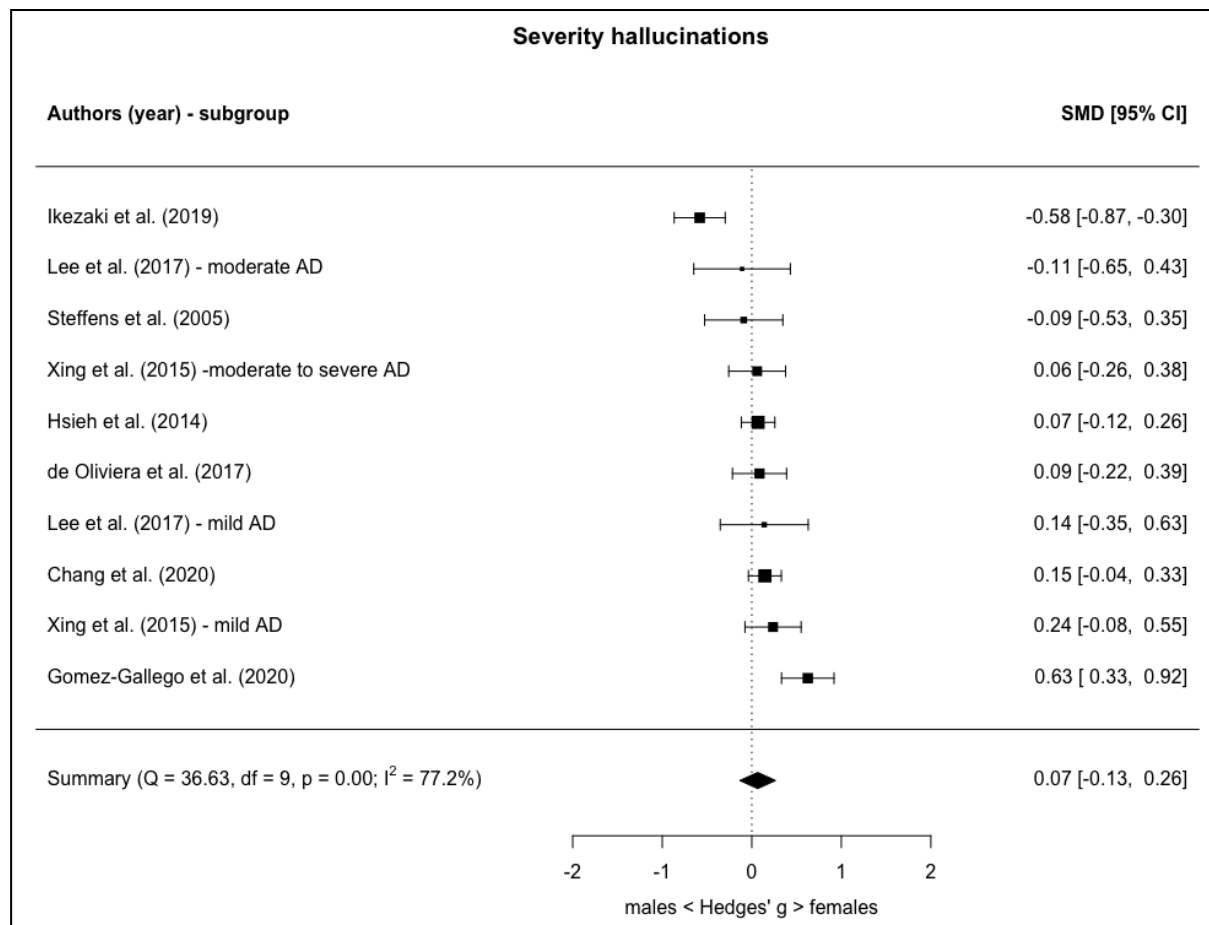
D) Forest plot severity eating behavior



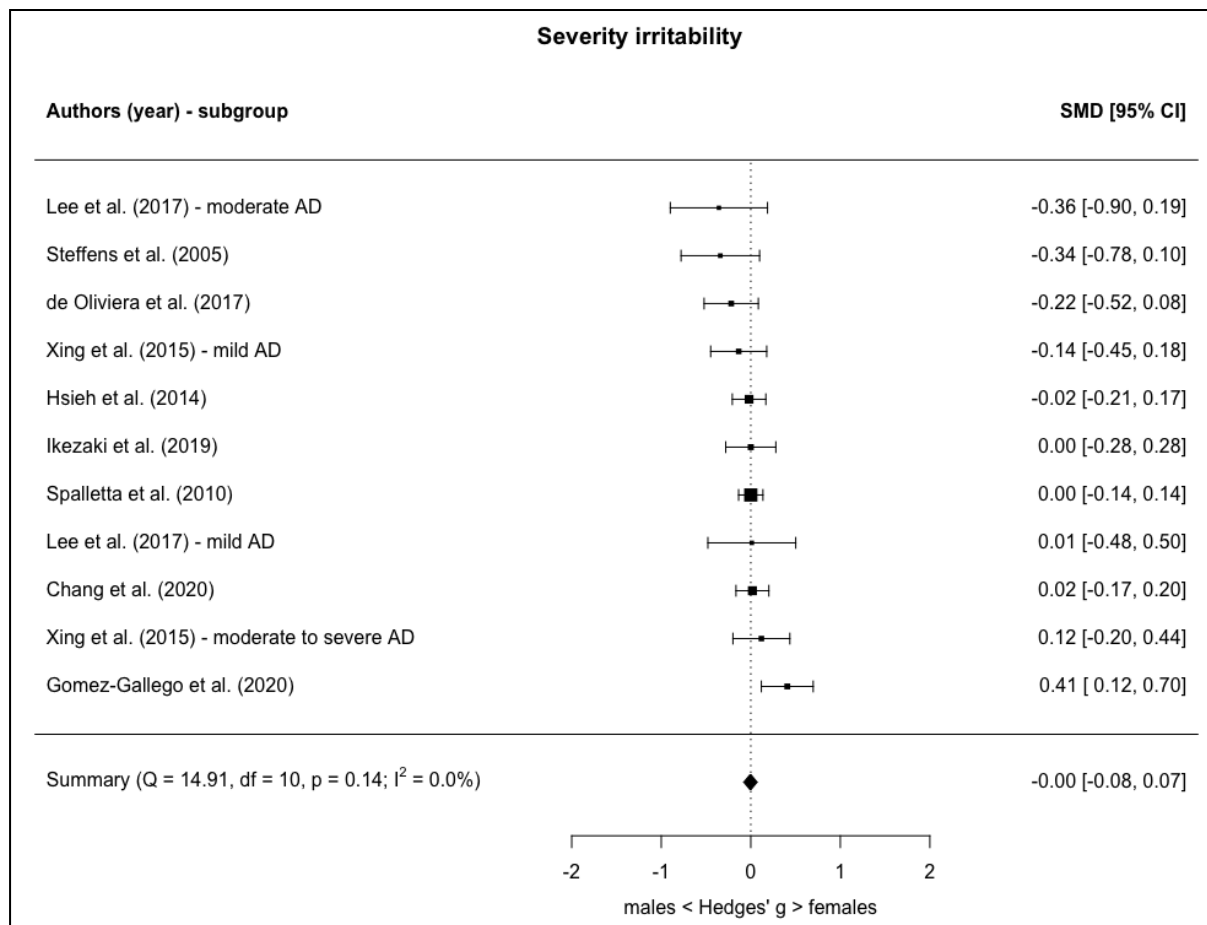
E) Forest plot severity euphoria



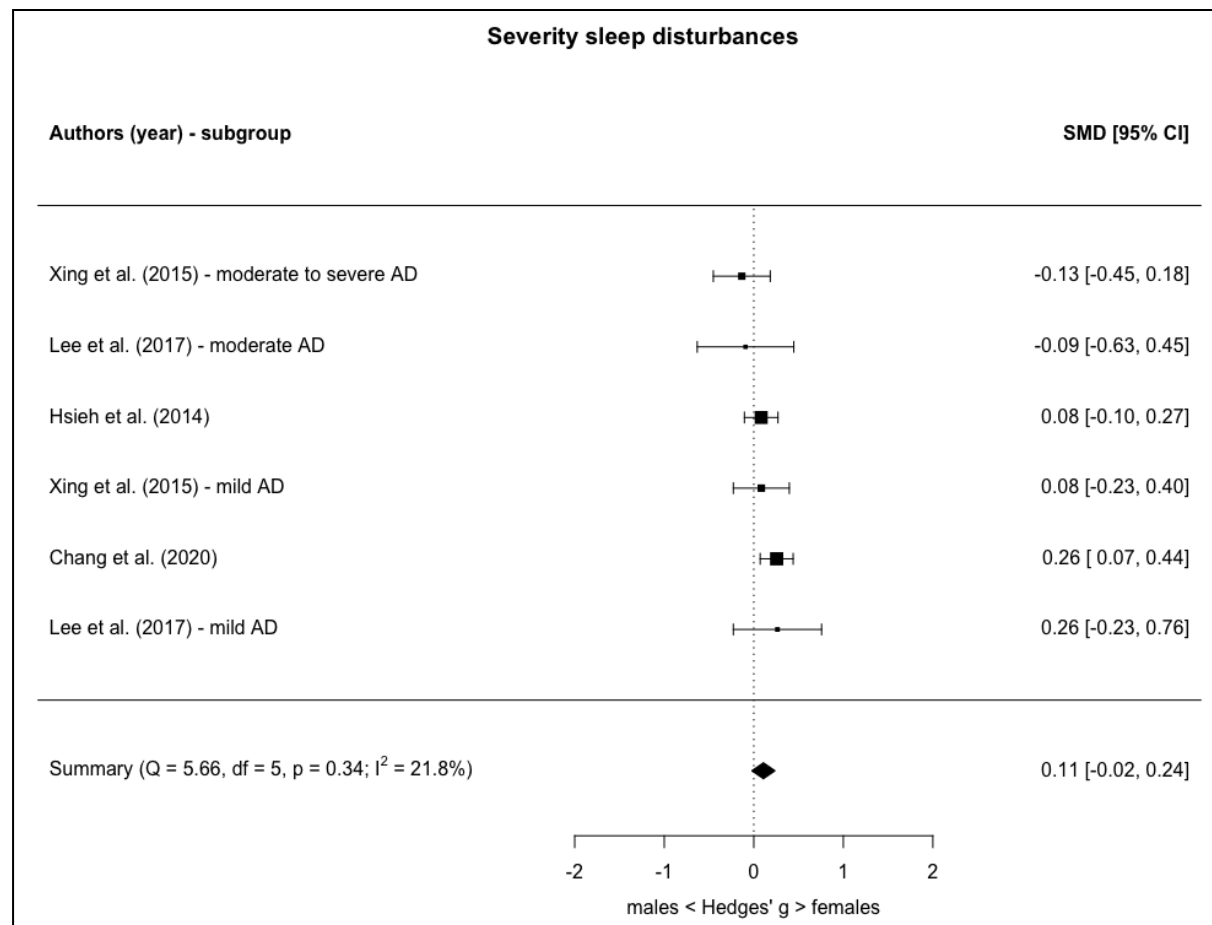
F) Forest plot severity hallucinations



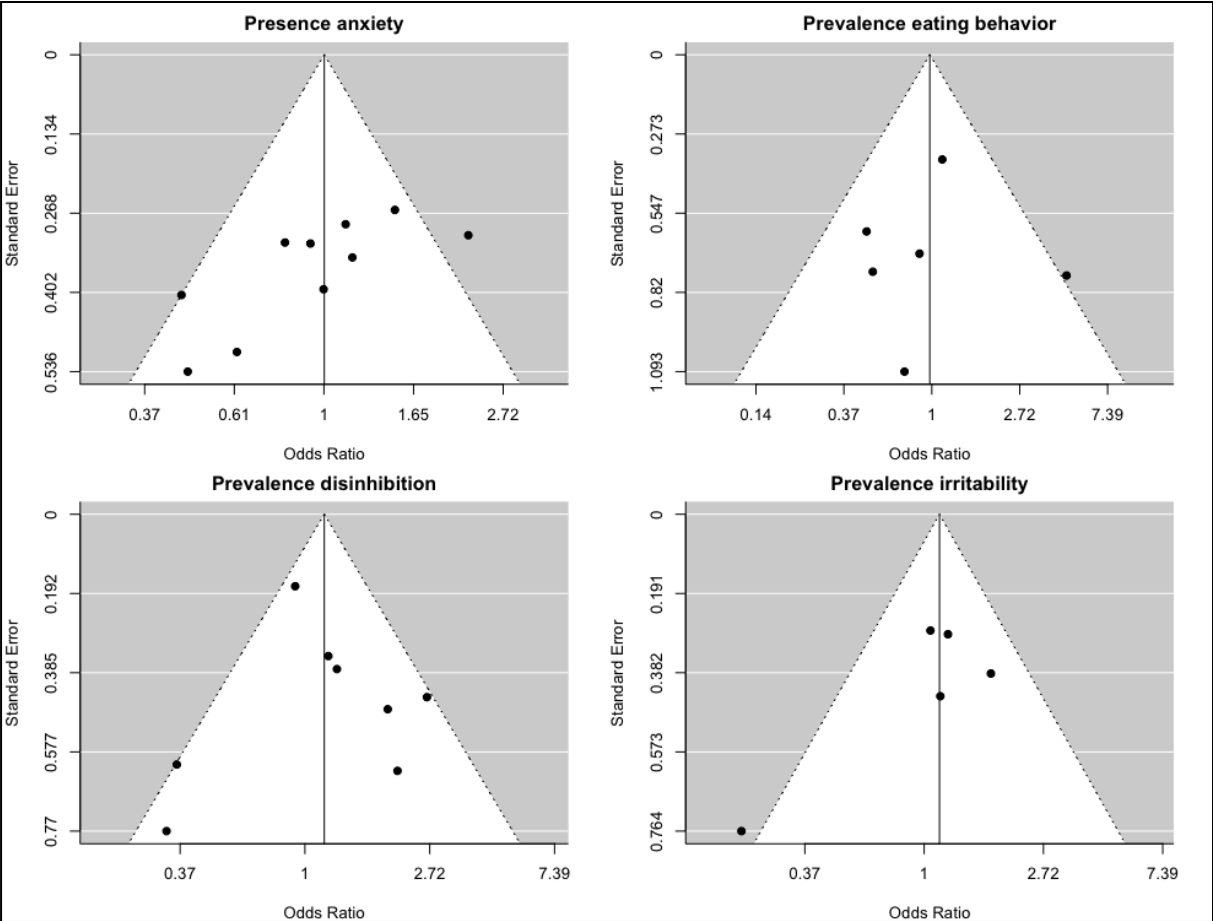
G) Forest plot severity irritability



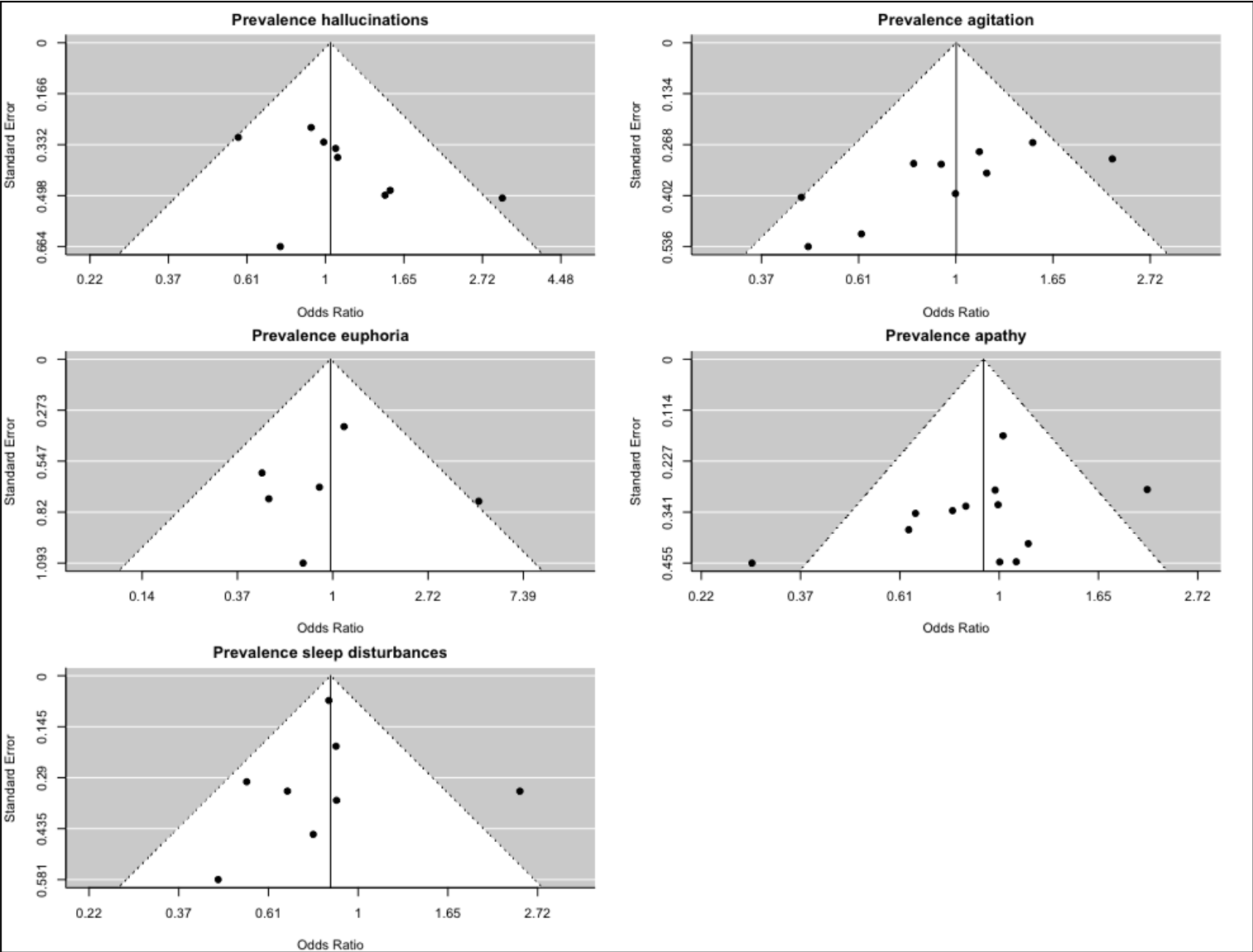
H) Forest plot severity sleep disturbances



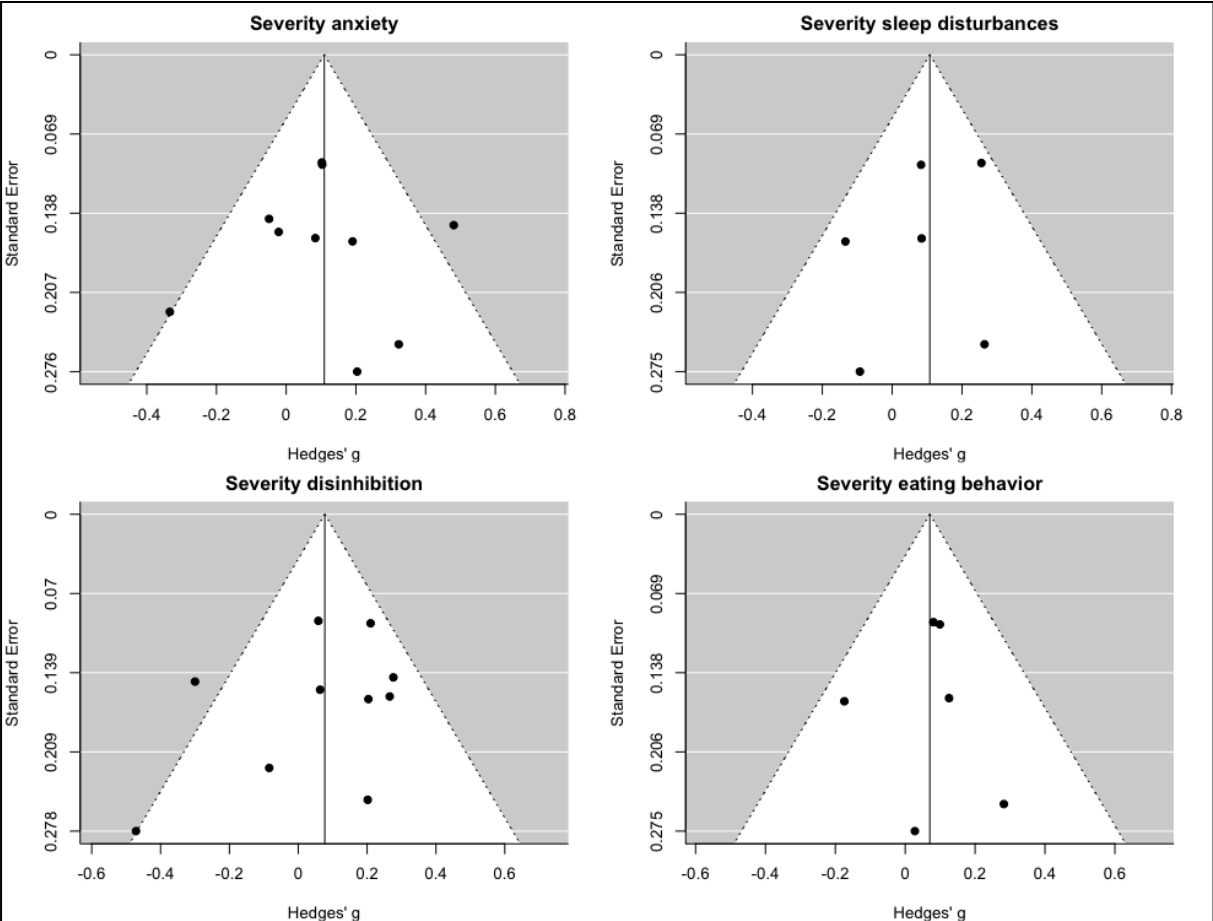
eFigure 3. Funnel plots of meta-analyses specific NPS prevalence



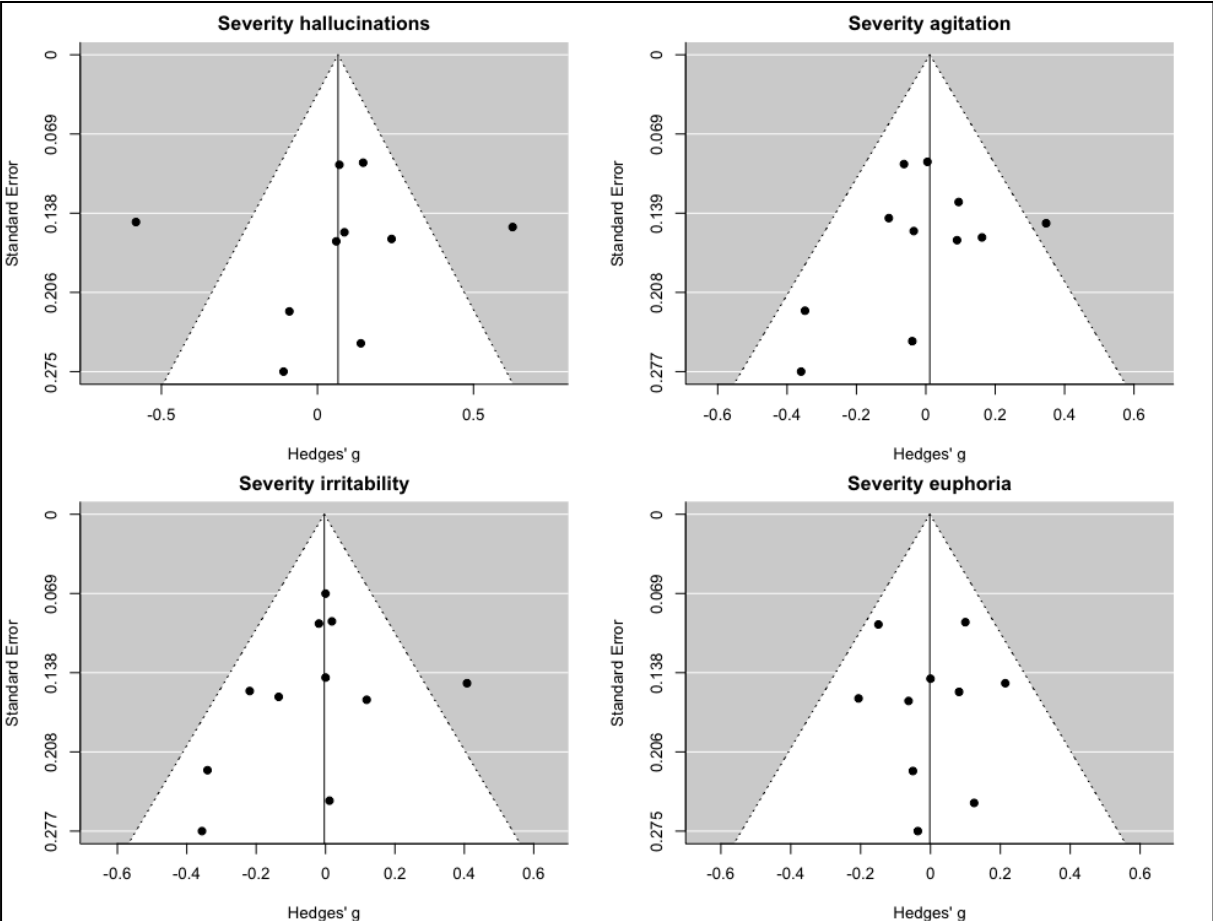
eFigure 3 (continued). Funnel plots of meta-analyses specific NPS prevalence



eFigure 4. Funnel plots of meta-analyses specific NPS severity



eFigure 4 (continued). Funnel plots of meta-analyses specific NPS severity



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