Amyotrophic lateral sclerosis, occupational exposure to extremely low frequency magnetic fields and electric shocks: A systematic review and meta-analysis

Supplemental material

Table SI. Strategy and specific terms used in the literature search

PubMed	(((ALS[Title/Abstract]) OR Neurodegenerative[Title/Abstract]) OR motor neuron disease[Title/Abstract]) OR Amyotrophic lateral sclerosis[Title/Abstract] AND ((((((((((((((((((((Extremely low frequency[Title/Abstract] OR ELF[Title/Abstract]) OR EMF[Title/Abstract]) OR magnetic field[Title/Abstract]) OR electric field[Title/Abstract]) OR electromagnetic[Title/Abstract]) OR occupation[Title/Abstract]) OR job[Title/Abstract]) OR workplace[Title/Abstract]) OR electrical occupation[Title/Abstract]) OR (("electricity"[MeSH Terms] OR "electricity"[Title/Abstract]) AND work[Title/Abstract])) OR power line[Title/Abstract]) OR Occupational exposure[Title/Abstract]) OR work-related[Title/Abstract]) OR occupational[Title/Abstract]) OR exposure[Title/Abstract]) OR welder[Title/Abstract]) OR railway[Title/Abstract]) OR electric utility[Title/Abstract]) OR power plant[Title/Abstract]) OR welding[Title/Abstract]) OR garment[Title/Abstract] AND ("humans"[MeSH Terms] AND English[lang])
EMBASE	ALS:ab,ti OR neurodegenerative:ab,ti OR 'motor neuron disease':ab,ti OR 'amyotrophic lateral sclerosis':ab,ti AND ('extremely low frequency':ab,ti OR elf:ab,ti OR 'magnetic field':ab,ti OR 'electric field':ab,ti OR electromagnetic:ab,ti OR occupation:ab,ti OR job:ab,ti OR workplace:ab,ti OR 'electrical occupation':ab,ti OR 'electricity work':ab,ti OR 'power line':ab,ti OR 'occupational exposure':ab,ti OR 'work-related':ab,ti OR 'welder':ab,ti OR railway:ab,ti OR 'electric utility':ab,ti OR 'power plant':ab,ti OR welding:ab,ti OR garment:ab,ti OR emf:ab,ti) AND [english]/lim AND [humans]/lim
Web of Science	((“amyotrophic lateral sclerosis” OR “motor neuron disease” OR “neurodegenerative” OR ALS) AND (ELF OR “extremely low frequency” OR “magnetic field” OR “magnetic fields” OR “electric field” OR electromagnetic OR occupation OR occupation OR job OR workplace OR “electrical occupation” OR “'electricity work” OR “power line” OR “'occupational exposure'” OR “work-related” OR “welder” OR “railway” OR “electric utility” OR “power plant” OR welding OR garment OR EMF))

Table SII: Decision criteria for bias assessment among included studies

Bias source	**Weight**		
	Full (**)	**Partial (*)**	**None (-)**
Funders	Disclose the funding source	-	Did not disclose the funding source
Reporting	If, in the judgment of the reviewer, the most important STROBE checklist items applicable to the study were satisfied (80% of total items)	If, in the judgment of the reviewer, sufficient STROBE checklist items were satisfied (40-79%)	If, in the judgment of the reviewer, insufficient STROBE checklist items were satisfied (<40%)
Data analysis	standard statistical methods appropriate for that study, unless a convincing justification was provided for using non-standard statistical methods	appropriate standard methods were not used or no enough information was presented regarding data analyzing methods	-
Selection - participation bias	Case-control: Case and control selected from general population registries (census, data registries) or random digit dialing, participation rate >70% Cohort: Minimal lost-of follow-up (≤10%)	Case-control: control selected from hospitals, neighborhoods, or next of kin, or participation rate for population based controls ≤70% Cohort: Lost of follow-up >10%	case-control: No description about case or control groups. Cohort: No information about lost of follow-up
Confounding	Given the fact that non-genetic factors are considered to be relevant for ALS but no single factors has been identified with certainty, exposed and non-exposed should be comparable and/or potentially relevant confounders should be considered. (Adjustment for age and gender is required).	Minimal confounding adjustment, at least age and gender considered.	No confounding adjustment
Exposure assessment	Considering full occupational history, using direct exposure measurements or JEM based on objective occupational information (e.g. database of employer, pension founds, prospective self-reports, etc)	Direct exposure measurement or JEM based on objective occupational information (e.g. database of employer, pension founds, death certificates, census information, prospective self-reports, etc) without considering full occupational history.	JEM based on retrospective self-reported job information in the context of a specific EMF study, expert rating
Outcome misclassification	Clinical records or death certificates		Information, which is self-reported or from relatives reported

Table SIII. Selected studies for each category

First author, Year	Sex			Country			Exposure Criteria		Frequency of electricity		Source of outcome information		source of job/exposure information				Type of study	
	Male	Female	Both	USA	Sweden	Other	Job-based	Exposure-based	50 Hz (Europe)	60 Hz (USA)	Death certificates	Medical records	Death certificates	Questionnaire /interview	Census	Occupational records	Cohort	Case-control
Buckley, (1983)			✓			✓	✓		✓		✓		✓				✓	
Deapen, (1986)			✓	✓			✓			✓		✓		✓				✓
Gunnarsson, (1991)	✓				✓		✓		✓		✓				✓			✓
Gunnarsson, (1992)	✓				✓		✓		✓			✓		✓				✓
Strickland, (1996)	✓			✓			✓			✓		✓		✓				✓
Davanipour, (1997)			✓	✓				✓		✓		✓		✓				✓
Savitz #1, (1998)	✓			✓			✓			✓	✓		✓					✓
Savitz #2, (1998)	✓			✓			✓			✓	✓					✓	✓	
Noonan, (2002)	✓			✓				✓		✓	✓		✓					✓
Feychting, (2003)	✓				✓			✓	✓		✓				✓		✓	
Håkansson, (2003)	✓				✓			✓	✓		✓				✓		✓	
Park, (2005)			✓	✓				✓		✓	✓		✓					✓
Weisskopf, (2005)	✓			✓			✓			✓	✓			✓			✓	
Roosli, (2007)	✓					✓		✓	✓		✓					✓	✓	
Fang, (2009)			✓	✓			✓			✓		✓		✓				✓
Parlett, (2011)			✓	✓				✓		✓	✓				✓		✓	
Malek, (2014)			✓	✓			✓			✓		✓		✓				✓
Sorahan, (2014)			✓			✓		✓	✓		✓					✓	✓	
Fischer, (2015)			✓		✓			✓	✓			✓			✓			✓
Huss, (2015)			✓			✓		✓	✓		✓				✓		✓	
Vergara, (2015)			✓	✓				✓		✓	✓		✓					✓
Huisman, (2015)			✓			✓		✓	✓			✓		✓				✓
Koeman, (2017)	✓					✓		✓	✓		✓			✓			✓	
Pedersen, (2017)	✓					✓		✓	✓			✓				✓	✓	
Dickerson (2018)	✓					✓	✓		✓			✓				✓	✓	
Peters, (2019)			✓			✓		✓	✓			✓			✓			✓
Chen, (2019)			✓			✓	✓		✓			✓			✓			✓

Table SIV: The result risk of bias analysis among included studies

First author, (Year)	Bias source																					Total*
	Funders			Reporting			Data analysis			Selection - participation bias			Confounding			Exposure assessment			Outcome misclassification			
	Full	Partial	None	Full	Partial	None	Full	Partial	None	Full	Partial	None	Full	Partial	None	Full	Partial	None	Full	Partial	None	
Buckley, (1983)	**				*			*			*			*			*		**			9
Deapen, (1986)			0		*			*			*			*			*		**			7
Gunnarsson, (1991)	**				*		**			**					-		*		**			11
Gunnarsson, (1992)	**			**			**				*		**				*		**			12
Strickland, (1996)	**					0	**				*			*			*		**			10
Davanipour, (1997)			0	**			**				*			*		**			**			10
Savitz #1, (1998)			0		*			*		**			**				*		**			9
Savitz #2, (1998)	**			**				*		**			**			**			**			13
Noonan, (2002)			0	**			**			**			**				*		**			11
Feychting, (2003)	**			**			**			**				*			*		**			12
Håkansson, (2003)	**			**			**			**				*			*		**			12
Park, (2005)	**			**			**			**			**				*		**			13
Weisskopf, (2005)			-	**			**			**			**			**			**			12
Roosli, (2007)	**			**			**			**				*		**			**			13
Fang, (2009)	**			**			**				*		**				*		**			12
Parlett, (2011)	**			**			**				*		**				*		**			12
Malek, (2014)	**			**			**				*		**				*		**			12
Sorahan, (2014)	**			**			**			**			**			**			**			14
Fischer, (2015)	**			**			**			**			**				*		**			13
Huss, (2015)	**				*		**			**			**				*		**			12
Vergara, (2015)	**			**			**			**			**				*		**			13
Huisman, (2015)	**			**			**				*		**			**			**			13
Koeman, (2017)	**			**			**				*		**			**			**			13
Pedersen, (2017)	**			**			**				*			*		**			**			12
Dickerson (2018)	**			**			**				*		**				*		**			12
Peters, (2019)	**			**			**			**			**			**			**			14
Chen, (2019)	**			**			**				*		**			**			**			13

* The sum of stars (0-14): The total bias score for each included study; Low: pooled estimate of studies with score of >12; Moderate: pooled estimate of studies with score of 12; High: pooled estimate of studies with score of <12

** The sum stars (0-54): The score of each bias source among included studies.