Supplemental Table 2. Studies reporting the prevalence of diabetes in multiple sclerosis

Study (Year)	Region/ Sub-Region	Source/ Population	Prevalence Day/Period	Diagnostic Criteria: MS/ Established By	Diagnostic Criteria: Diabetes/ Established By	Crude Overall Prevalence (95%CI)	Age-Standardized Overall Prevalence (95%CI)	Crude Prevalence (95%CI)		Standardized Prevalence (95%CI)		Quality Score
								Males	**Females**	**Males**	**Females**	
Allen[7] (2008)	United States/ New York	SPARCS/ 95% of New York State acute care hospitalizations	1988-2002	ICD-9-CM 340.0 as secondary discharge diagnosis	Diabetes: ICD-9-CM 250 as primary or secondary discharge diagnosis	Diabetes 1,054/9,949 = 10.6%	NR	NR	NR	NR	NR	4/8
Barcellos[15] (2006)	United States/ California	Dataset consisting of 176 families, each family with at least 1 index case of multiple sclerosis 176 "index cases" and 386 "overall MS cases"	NR	Neurologist diagnosed/Stringently ascertained and clinically characterized multiple sclerosis	Mailed questionnaire, telephone interview/Age of onset was used to differentiate between type-1 and type-2 diabetes mellitus	Type 1 Diabetes ~0.2% (overall cases) Raw numbers not provided	NR	NR	NR	NR	NR	4/9

Study	Country	Source	Dates	Diagnosis	Comparison	Prevalence						Quality
Buchanan[16] (2006)	United States	Randomly selected from NMSS membership	Oct 2004-Jan 2005	Mailed Survey	Diabetes: Telephone survey/ Mailed survey	Urban 13.7% Adjacent rural 27.1% Remote rural 11.8%	NR	NR	NR	NR	NR	2/9
Christiansen[5] (2010)	Denmark	DNRP	1977-2006	ICD-10 G35.9, ICD-8 340 (prior to 1993)	Diabetes: DNRP codes	Diabetes 178/13,963 = 1.27%	NR	NR	NR	NR	NR	6/8
Dallmeijer[17] (2009)	Netherlands/ Amsterdam	Newly diagnosed MS, source NR	NR	NR	Diabetes: CIRS (medical records review)	Diabetes 6/146 = 4.11%	NR	NR	NR	NR	NR	2/9
De Keyser[18] (1988)	England/ London	Patients at the National Hospital for Nervous Diseases with clinically or laboratory supported definite MS	1979-1984	Neurologist diagnosed: Poser	Medical records	Type I Diabetes Mellitus 4/828 = 0.48%	NR	NR	NR	NR	NR	3/8
Deretzi[19] (2010)	Greece/ North	Neurology department/ RRMS	Jan 200-Jan 2009	Neurologist diagnosed: McDonald 2001	Insulin dependent diabetes mellitus Neurologist	Type I diabetes 33/981 = 3.36%	NR	NR	NR	NR	NR	6/9

		patients			administered questionnaire, confirmed by hospitalization records and medical reports							
Eaton[20] (2007)	Denmark	Hospitalized MS population	1997- 2001	Administrative data codes (ICD8 340.0, ICD10 G35)	Type I Diabetes[c] ICD-8 250.0 ICD-10 E10	Type I diabetes 147/9,961 = 1.48%	NR	NR	NR	NR	NR	4/8
Edwards[21] (2004)	England/ Nottingham	Outpatient MS clinic	NR	MS clinic database	Type I Diabetes: Registry/Clinical Database/Chart Review	6/658 = 0.91%	NR	NR	NR	NR	NR	2/8
Fleming[11] (1994)	United States	Hospitalized Medicare MS population, age ≥ 65 years	1989	ICD-9-CM code 340	Diabetes: Administrative data code (code NR)	Diabetes Uncomplicated Type II: 3.08/100 Diabetes Uncomplicated Type I: 1.94/100 Diabetes with complications Type I NOS: 0.86/100	NR	NR	NR	NR	NR	4/8
Fromont[23]	France	Whole	Oct 31, 1995-	Neurologist,	Diabetes/	Diabetes	NR	NR	NR	NR	NR	7/8

(2013)		population of newly diagnosed MS patients with ALD status before age 45 years	Oct 31, 2004	ALD status 25	Administrative data codes ALD 8	115/22,087 = 0.52%						
Finlayson[2][2] (2013)	United States/Illinois	Community-dewlling recruited from advertisements	NR	Self-report	Self-report	Diabetes 15/178 = 8.43%	NR	NR	NR	NR	NR	2/9
Henderson[24] (2000)	Australia/ Queensland	Royal Brisbane Hospital Department of Neurology/ Admitted patients	1992-1997	Initially identified from medical records ICD 340, 205/later confirmed neurologist diagnosis (Poser)	Diabetes Mellitus Type I/ Mailed questionnaire	Diabetes Mellitus Type I 1/117 = 0.85%	NR	NR	NR	NR	NR	4/9
Hoppenbrouwers[25] (2007)	Netherlands	Genetically isolated community	NR	Poser	Type I Diabetes/ Interview, self-report. Defined by the Expert committee on the Diagnosis and	Type I Diabetes 0/48 = 0%	NR	NR	NR	NR	NR	7/9

					Classification of Diabetes Mellitus							
Horton[26] (2010)	Canada/ Manitoba United States/ Ohio	Participants recruited from 2 different MS clinics	Oct 2008-Oct 2009	MacDonald 2005; diagnosed by neurologist at MS clinic	Diabetes The Self-Administered Comorbidity Questionnaire (validated questionnaire) and medical records review	Diabetes 17/404 = 4.2% by medical records and questionnaire	NR	NR	NR	NR	NR	5/8
Hussein[27] (2006)	Saudi Arabia	MS Center	1991-1997	NR	Type I and II Diabetes: Clinical Database/Medical Chart Review	Type I: 11/1,206 = 0.92% (0.38-1.46) Type II: 81/1,206 = 6.75% (6.74-6.76)	NR	NR	NR	NR	NR	1/9
Jadidi[28] (2013)	Sweden	M&H Co Database, incident MS	1987-2009	ICD-8 340 ICD-9 340 ICD-10 G35	Diabetes: Administrative data codes	Diabetes 105/7,664 = 1.37%	NR	NR	NR	NR	NR	5/8
Kang[8]	Taiwan	NHIRD	2007	At least two	Type I: ICD-9-CM	Type I: 3/898 =	NR	NR	NR	NR	NR	4/8

(2010)		population, age ≥15 years		claims with ICD-9-CM code 340 in 2007, under care of certified neurologist,	250.01, 250.03, 250.11, 250.13, 250.21, 250.23, 250.31, 250.33, 250.41, 250.43, 250.51, 250.61,250.63, 250.71, 250.73, 250.81, 250.83, 250.91, 250.93 Type II: All ICD-9-CM 250 excluding Type I Diabetes at least one hospital or two ambulatory claims	0.33% Type II: 77/898 = 8.57%						
Kanjwal[29] (2010)	United States/ Toledo, Ohio	Patients followed up at the University of Toledo Autonomic Disorder Center	1998-2008	Neurologist (criteria not specified)	Medical chart review	Diabetes 2/9= 22.2%	NR	NR	NR	NR	NR	3/8
Khan[9] (2007)	Australia/ Melbourne	MS database Royal	Jan 2005-Feb 2005	Neurologist diagnosed: Poser	Self-report	Diabetes 2/62 = 3.23%	NR	NR	NR	NR	NR	3/9

		Melbourne Hospital		and Paty								
Langer-Gould[30] (2010)	United States/ Northern California	KPNC population	1994-December 2005	Diagnostic codes entered by neurologists and GPs , MS-specific medications, MRI (codes/criteria not specified)	Type I Diabetes: At least two administrative data codes by a specialist (KPNC) (codes not specified)	Type I Diabetes 45/5,296 = 0.85%	NR	NR	NR	NR	NR	6/8
Laroni[31] (2006)	Italy/ Veneto	Multiple Sclerosis Centre of Veneto Region	NR	Poser	Type I Diabetes: Medical chart review/interviews/ Self Report	Type I Diabetes 9/245 = 3.7%	NR	NR	NR	NR	NR	5/8
LaVela[10] (2012)	United States	National cohort of male Veterans with MS, members of veteran service organization	2003, 2004	Veterans Benefits Department confirmed	Diabetes: Telephone and mailed survey (Multiple Sclerosis- Health Care Questionnaire using questions similar to BRFSS)	Diabetes NR	NR	182/, 1,142 = 15.9%	NR	NR	NR	4/8
Lindegard[32]	Sweden	Native Swedes born	1970-1979	ICD 340, 341 inpatient records	Diabetes: ICD 250, inpatient	Young males 2.9%	NR	Young males	Young females	NR	NR	4/8

(1985)		1911-1940 in Gothenburg			records	Older males 6.9% Young females 1.4% Older females 6.4%		2.9% Older males 6.9%	1.4% Older females 6.4%			
Lu[33] (2013)	Canada/ British Columbia	British Columbia MS database	Apr 1998-March 2009	Poser, McDonald 2005	Diabetes or abnormal glucose: Administrative data (codes not specified)	Diabetes 17/432 = 4%	NR	NR	NR	NR	NR	5/8[33]
Marrie[35] [a](2008) Marrie[a] [b](2011)	United States	NARCOMS Registry population (volunteers)	October 2006	Self-report	Diabetes: Online/Mailed Survey	Diabetes 532/8,785 = 6.1% At MS Onset: 52/8740 = 0.6% At MS Diagnosis: 108/8740 =1.2%	NR	NR	NR	NR	NR	5/9[35]

Study	Country/Region	Population	Time period	Criteria	Comorbidity definition	Diagnosis/Prevalence						Quality
Marrie[34] (2012)	Canada/ Manitoba	Entire Manitoba population	April 1, 1984-March 31, 2007	1984–1997 all cases with ≥7 hospital or physician claims for MS. 1998-2007 all cases with ≥3 hospital, physician or prescription claims for MS.	Diabetes: CCDSS ICD-9 250, ICD-10 E10-E14 ≥2 hospital or physician claims in 5 years	Diabetes NR	7.62% (6.63-8.61)	NR	NR	NR	NR	8/8
Marrosu[36] ^ (2002)	Italy/ Sardinia	MS Clinic in Cagliari	Jan 1, 1989-Dec 31, 2000	Poser	Type I Diabetes: Criteria reported by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus Medical chart review/ Interviews	Diabetes 20/1090= 3.0%	NR	2.0%	3.0%	NR	NR	4/9
Marrosu[37] ^ (2004)	Italy/ Sardinia	MS Clinic in Cagliari	Jan 1, 1989-Dec 31, 2002	Poser	Type I Diabetes: Criteria reported by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus Medical chart	Type I Diabetes 31/1049= 3.0%*	NR	NR	NR	NR	NR	3/9

					review							
Midgard[38] (1996)	Norway/ Hordaland County	Identified through two population-based incidence studies	Jan 1, 1976- Dec 31, 1986	Bauer	Diabetes (?Type I) Interviews completed by neurologists	Type I Diabetes 0/155 = 0%	NR	NR	NR	NR	NR	6/9
Nuyen[39] (2006)	Netherlands	DNSGP	2001	ICPC code N86	Diabetes: Consultation with GP during (1-year period). ICPC codes T87, T88, T90	Diabetes 4/241 = 1.7%	NR	NR	NR	NR	NR	5/8
Paz Soldan[40] (2012)	United States/ Minnesota	MS patients attending the Mayo Clinic or Olmsted Medical Centre	2000	Poser	Diabetes: Medical Chart Review	Diabetes 28/201 = 13.9%	NR	NR	NR	NR	NR	6/8
Pitzalis[41] (2008)	Italy/ Sardinia	MS Clinics in Cagliari, multiplex families	NR	NR	Type I Diabetes: Medical Chart Review/ Interviews	Type I Diabetes 12/116 = 9.4%	NR	NR	NR	NR	NR	1/9
Ramagopa lan[42] (2007)	Canada	19 MS Clinics in Canada	From 1993- not specified	Poser and/or Macdonald 2005	Type I Diabetes: Medical chart review/	Type I Diabetes 19/5031 = 0.4%	NR	5/1,298 = 0.39%	14/3,733 = 0.38%	NR	NR	5/9

Study	Country	Population	Time	MS diagnosis	Comorbidity ascertainment	Result						Quality
					Standardized administered questionnaires							
Seyfert[43] (1990)	Germany/ Berlin	All patients admitted to hospital for MS	NR (18 month follow-up)	Neurologist diagnosed: Poser	Neurologist-administered questionnaire/ Confirmed by biological tests and medical records review	Diabetes 0/101 = 0%	NR	NR	NR	NR	NR	5/8
Sheu[44] (2013)	Taiwan	LHID 2000 Database of Taiwan, incident MS enrolled in registry of catastrophic illness, and age >18 years	Jan 2002-Dec 2009	ICD-9-CM code 340 and certified by neurologist (Poser)	Diabetes: LHID Database. Codes not specified	Diabetes 36/316= 11.4%	NR	NR	NR	NR	NR	5/8
Tremlett[45] (2002)	Wales	Diagnosis of MS recorded after 1993 and registered in database	1993-1999	Administrative data codes (GPMD) (code not specified)	Type I Diabetes: Administrative data code and prescription of insulin	Type I Diabetes 0/320 = 0%	NR	NR	NR	NR	NR	6/8

			1995-1999									
Wertman[46] (1992)	Israel	Israeli National Neurological Disease Register, all MS patients diagnosed 1950-1985	1950-1985	Rose	Type I Diabetes: Medical Chart Review/ Clinical assessment by health professional	Type I Diabetes 8.98/1000 = 0.90%	NR	NR	NR	NR	NR	4/8
Wynn[47] (1990)	United States/ Minnesota	Mayo Clinic clinical records/ 206 incident cases	1930-1984	Neurologist diagnosed: Poser	Clinical chart review	Insulin dependant diabetes mellitus 3/206 = 1.46% Non-insulin dependant diabetes mellitus 8/206 = 3.88%	NR	NR	NR	NR	NR	5/8

*Calculated by hand. Value not provided by author.

a- Self-reported diagnoses of MS previously validated in random sample of study population against medical records and physician report; b – reported in another manuscript using the same study population

c- ICD-8 250.0 does not specifically identify type I diabetes.

^High likelihood of overlap between study populations of Marrosu, et al. (2002) and Marrosu, et al. (2004). Not possible to determine the level of overlap from information provided.

NR: Not Reported, SPARCS: New York Department of Health Statewide Planning and Research Cooperate System, NMSS: National Multiple Sclerosis Society, DNRP: Danish National Registry of Patients, CIRS: Cumulative Illness Rating Scale, ALD: (affections de longue duree), M&H Co Database- Migration and Health Cohort Database (contains over 15 linkable Swedish national registers), NHIRD: National Health Insurance Research Database, KPNC: Kaiser Permanente Northern California, NARCOMS: North American Research Committee on Multiple Sclerosis, GPMD: General Practice Morbidity Database. ICPC: International Classification of Primary Care, LHID 2000 Database: Taiwan Longitudinal Health Insurance Database