



Letter to the Editor

Poland may be a high risk area for multiple sclerosis based on weather patterns*Ernest Lad Heisten IV**Ohio State University Alumni Association, Columbus, OH, USA*

ARTICLE INFO

Article history
Received 28 May 2017
Accepted 6 July 2017
Available online 24 April 2018

Keywords
Hyponatremia
Hepatic encephalopathy
Liver cirrhosis

Doi
10.29089/2017.17.00035

User license
This work is licensed under a
Creative Commons Attribution –
NonCommercial – NoDerivatives
4.0 International License.

**1. INTRODUCTION**

Information on multiple sclerosis (MS) in Poland has been sparse historically. Few studies have been conducted and the few that have were very localized. The only two of note were a comparison study conducted between 1965 and 1981 rates¹ and a very recent study of a single region south of Warsaw.² The latter was not comprehensive enough to determine associations between MS prevalence and weather in Poland, and the former may have been faulty based on a less obvious fact that was highlighted by the latter study: MS rates were shown to be much lower in men than they were in women. With a prevalence in the former of 69.7 and in the latter of 159.6 for an average rate of 115.7/100 000. The former study showed a rough average of prevalence of 61.11/100 000 in 1965 and 45.08/100 000 in 1981. This would lead the author of this article to suspect that the former study was only analyzing the rates of men for whatever reason. As for the latter study, its prevalence rate would appear to be more consistent with the weather pat-

terns of Poland and the rates that would be expected under such weather patterns if a recent study of MS prevalence and average weather was considered. That study³ showed that MS prevalence rates peaked at 8°C, which is the same temperature at which the TRPM8 temperature receptor in the body is known to have the highest activity. The Broła et al. study was conducted in the region of Świętokrzyskie where, according to the Norwegian Meteorological Institute, the average temperature was 7.99°C⁴ at its capital city of Kielce. This is not very different from the temperature for peak prevalence and the apparently high prevalence rate of 115.7/100 000 may reflect that.

In the Wender et al. study of 1985 there was one study location that was noted for having a high prevalence rate: That of Leszno, of which the rate was 96.22/100 000 in 1965 and 130.97/100 000 in 1981. That location had an average temperature of 7.75°C. If those rates were adjusted for possible gender bias it would give a rate of 158.8/100 000 in 1965 and 217.4/100 000 in 1981. The difference between these two prevalence rates was addressed in that study as being due to an in-

crease in the population of individuals under the age of 25: MS typically does not show symptoms until at least a person's late 20s. In addition it was noted that there was an almost equal number of definite cases between 1965 and 1981: 1302 in 1965 vs. 1244 in 1981. The only major change was in probable cases: 255 in 1965 vs. 64 in 1981. It's the author's opinion that this reflects improvements in diagnostic criteria and education about MS symptoms rather than any real change in MS cases. Leszno's increase was not explained in Wender et al. and may well be due to an increase in definite cases over probably cases stemming from better diagnostic methods.

There is the established fact that Poland has many areas with an average temperature range that is what could be the danger zone for MS prevalence. The only mitigating factor in the fact that variation from that average temperature is very wide compared to the UK, where the low variation from the peak TRPM⁸ reactivity temperature produces the highest MS rates in the world of 193/100 000 in the Orkney Islands⁶ and 152/100 000 in the Shetland Islands⁷ (Table 1). These areas have an average variation from their average temperatures of 7.83°C and 7.125°C, respectively, of less than 4°C difference.⁴ In Poland the variation is 7°C–8°C difference from the average temperatures of the locations of consideration mentioned here. It needs to be recognized, regardless, that much of Poland appears to have an average temperature around 8°C, with Gniezno having an average temperature of 8.21°C and Leszno an average temperature of 7.90°C.⁴ If these locations are indicative of average temperature in the rest of the country then it is possible that MS could be much more widespread and serious in Poland that what is currently accepted.

2. AIM

To determine if Poland's MS prevalence rate could be estimated based on other location with the same average yearly temperature range of between 7°C–9°C.

3. MATERIAL AND METHODS

Variation from average yearly temperature was measured by regression line analysis for locations of MS prevalence with an average yearly temperature that were specific locations (not regions) and had an average yearly temperature 7°C–9°C. The results were considered significant if $P < 0.05$.

4. RESULTS

Variation away from this average temperature is a significant factor in the aggravation or mitigation of MS prevalence rates (Table 1, Figure 1). Regression line analysis of the variation from the average yearly temperature vs. MS prevalence rate was significant ($P < 0.001$).

Table 1. Locations of MS prevalence rates used in this study.

Location	Variation from average yearly temperature	MS prevalence per 100 000	Average yearly temperature
Leszno, Poland	7.90352338 ⁴	130.97 ¹	7.775 ⁴
Gniezno, Poland	7.470406261 ⁴	122.83 ¹	8.216666667 ⁴
Shetland Islands, UK	3.21 ⁴	152 ⁷	7.125 ⁴
Gothenburg, Sweden	6.7 ⁴	96 ¹²	7.78 ⁴
Kielce, Poland	7.998693075 ⁴	115.7 ²	8.31 ⁴
Berne, Switzerland	6.698094483 ⁴	110 ¹⁴	8.641666667 ⁴
Montrose, UK	4.247806921 ⁴	184 ⁹	8.525 ⁴
Edinburgh, UK	4.280682472 ⁴	187 ¹⁰	8.766666667 ⁴
County Donegal, Ireland	3.895092094 ⁴	184 ⁸	8.158333333 ⁴
Orkney Islands, UK ⁵	3.378900664 ⁴	193 ⁶	7.833333333 ⁴
Aberdeen, UK	4.146438779 ⁴	145 ¹¹	8.125 ⁴
Copenhagen, Denmark	6.228818653 ⁴	112 ¹³	8.2 ⁴
Gorski Kotar, Croatia	6.793557554 ⁵	124 ¹⁵	7.38 ⁵

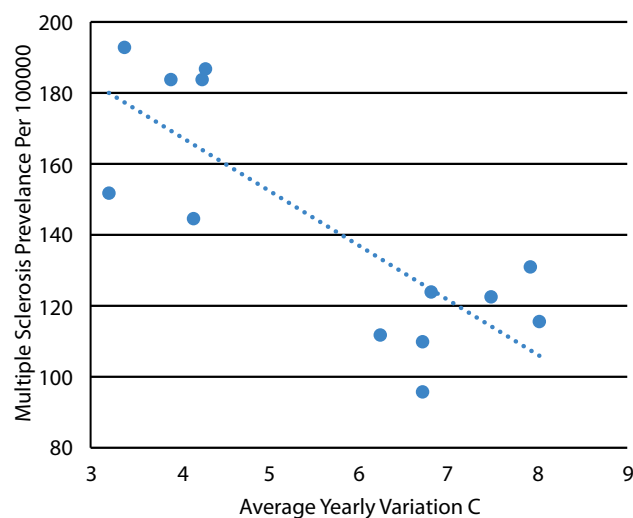


Figure 1. Average variation from average yearly temperature plotted vs. MS prevalence rates. The association was $P < 0.0017$.

5. DISCUSSION

In regards to the other locations themselves most of these are located in or near the British Isles,^{6–13} which is noted for having the highest MS prevalence rates in the world. Berne, Switzerland¹⁴ and the Gorski Kotar region of Croatia¹⁵ are noteworthy for having high MS prevalence rates without possessing the same northern latitude of the other locations. Both possess their low average yearly temperature due to their high altitude locations and corresponding mountain weather effects instead of a high northern latitude.

6. CONCLUSIONS

Poland's variation from average temperature is higher than the other tested locations, which likely mitigates MS prevalence in this country below those locations. Regardless, Poland's MS prevalence could be expected to be above 105/100 000 based on the resulting trendline for this association.

Conflict of interest

Author declare to have no conflict of interest.

Acknowledgements

This research was conducted independently and not on behalf of the Ohio State Alumni Association. No conflict of interest exists in this relationship.

References

- 1 Wender M, Pruchnik-Grabowska D, Hertmanowska H, et al. Epidemiology of multiple sclerosis in Western Poland – a comparison between prevalence rates in 1965 and 1981. *Acta Neurol Scand.* 1985;72(2):210–217. <https://doi.org/10.1111/j.1600-0404.1985.tb00866.x>.
- 2 Broła W, Sobolewski P, Flaga S, et al. Prevalence and incidence of multiplesclerosis in central Poland, 2010–2014. *BMC Neurol.* 2016;16:134. <https://doi.org/10.1186/s12883-016-0662-8>.
- 3 Heisten E. Peak TRPM8 Activity is associated with MS prevalence [in print].
- 4 Norwegian Meteorological Institute Average Yearly Temperature Reports for listed locations. <https://www.yr.no>. Accessed: April 4, 2018.
- 5 Croatian Meteorological Institute. Average Yearly temperature for Gorski Kotar region. (Parg). <http://klima.hr/klima.php?id=k1¶m=srednjak&Grad=parg>. Accessed: April 4, 2018.
- 6 Cook SD, Cromarty JI, Tapp W, Poskanzer D, Walker JD, Dowling PC. Declining incidence of multiple Sclerosis in the Orkney Islands. *Neurology.* 1985;35(4):545–551. <https://doi.org/10.1212/WNL.35.4.545>.
- 7 Poskanzer DC, Prenney LB, Sheridan JL, Kondy JY. Multiple sclerosis in the Orkney and Shetland Islands. I: Epidemiology, clinical factors, and methodology. *J Epidemiol Community Health.* 1980;34(4):229–239. <https://doi.org/10.1136/jech.34.4.229>.
- 8 McGuigan C, McCarthy A, Quigley C, Bannan L, Hawkins S, Hutchinson M. Latitudinal variation in the prevalence of multiple sclerosis in Ireland, an effect of genetic diversity. *J Neurol Neurosurg Psychiatry.* 2004;75(4):572–576. <http://dx.doi.org/10.1136/jnnp.2003.012666>.
- 9 Forbes RB, Wilson SV, Swingler RJ. The prevalence of multiple sclerosis in Tayside, Scotland: do latitudinal gradients really exist? *J Neurol.* 1999;246(11):1033–1040. <https://doi.org/10.1007/s004150050509>.
- 10 Rothwell P, Charlton D. High incidence and prevalence of multiple sclerosis in south east Scotland: evidence of a genetic predisposition. *J Neurol Neurosurg Psychiatry.* 1998;64(6):730–735. <https://doi.org/10.1136/jnnp.64.6.730>.
- 11 Phadke JG, Downie AW. Epidemiology of multiple sclerosis in the north-east (Grampian region) of Scotland—an update. *J Epidemiol Community Health.* 1987;41(1):5–13. <https://doi.org/10.1136/jech.41.1.5>.
- 12 Svenningsson A, Runmarker B, Lycke J, Andersen O. Incidence of MS during two 15 year periods in the Gothenburg region of Sweden. *Acta Neurol Scand.* 1990;82(3):161–168. <https://doi.org/10.1111/j.1600-0404.1990.tb04483.x>.
- 13 Koch-Henriksen N. The Danish Multiple Sclerosis Registry: a 50-year follow-up. *Mult Scler.* 1999;5(4):293–296. <https://doi.org/10.1177/135245859900500418>.
- 14 Beer S, Jurg K. High Prevalence of Multiple Sclerosis in Switzerland. *Neuroepidemiology.* 1994;13(1–2):14–18. <https://doi.org/10.1159/000110353>.
- 15 Sepcic J, Materljan E, Antonelli L, Sepcic-Grahovac D. Multiple Sclerosis Cluster in Gorski-Kotar, Croatia, Yugoslavia. In: Battaglia MA, ed. *Multiple sclerosis research*. Amsterdam: Elsevier Science Publishers; 1989:165–169.