Effect of climatic temperature on the age of onset of Huntington’s chorea

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SYNOPSIS The ages of 1,403 subjects at onset of Huntington’s chorea were drawn from the literature and related to the mean annual, January, and July temperatures of their place of residence. When the data were converted into mean annual, winter, and summer isotherms covering a range of 10°F (5.6°C), there was a statistically significant decrease in age of onset as the temperature increased. Over the ranges studied, winter temperatures exerted a stronger effect than summer temperatures. To reduce interference by ethnic factors, the analysis was repeated on North American subjects with similar results. It is suggested that repeated infections may provoke chorea and that the observed lowering of the age of onset is associated with increased susceptibility to infection on passing from cold to warm climates.

A distinctive feature of Huntington’s chorea is the variable age at which signs first appear. Although it is often regarded as a disease of adulthood with an onset at about 40 years of age, this figure is misleading unless due account is taken of its standard deviation of some 12 years. Cases presenting from the first year of life (Pleydell, 1954; Bird and Paulson, 1971), to the eighth decade (Orbeck and Quelprud, 1954; Lyon, 1962) have been documented. It is clear that some of this variation is genetic in origin (Reed and Chandler, 1958; Brackenridge, 1972); specific environmental factors involved in the appearance of symptoms are more difficult to demonstrate.

It is commonly observed that movements worsen under the strain of testing situations, and it is natural to speculate that the interaction between a sensitive personality and disturbing life-events may actuate pathogenesis. Pregnancy has been suggested several times (Tieke, 1934; Panse, 1942; Spengler, 1956) as a possible agent provocateur, but the work of Oepen et al. (1963) and the independence of age of onset and sex (Brackenridge, 1971) argue against its prominence. Climate imposes a degree of discomfort in most parts of the world and it seemed plausible that the illness could appear earlier in areas of extreme heat or cold than in temperate regions. The null hypothesis was therefore formulated that the age at onset of Huntington’s chorea was unrelated to climatic temperature.

METHODS

Following Wendt (1959), the definition proposed by Panse (1942) has been adopted in the present study; onset has been dated from the first appearance of psychiatric or neurological signs attributed retrospectively to Huntington’s chorea. Providing that ages of onset were recorded to within three years and unless they had resided in different isothermal regions (defined below), subjects were drawn from all the descriptions in the source references cited in Appendix III of Brackenridge (1972) with the following additions: Althaus (1880), MacLeod (1881), King (1885), Diller (1889), Phelps (1892), Collins (1898), Evans (1908), Mülfer (1903), Strümpell (1908), Bahr (1912), Seip (1928), Casper (1930), von Sánta (1931), Buck (1934), Kloos (1938), Lion and Kahn (1938), Chamberlain (1943), Cronin (1943), Reisner (1944), Laane (1951), Major (1951), Leese et al. (1952), Shimam (1956), Souder (1954), Saeter (1958), Mackenzie-Van Der Noordaa (1960), Olman and Friedman (1961), Müller-Küppers and
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Using contour-maps, each subject was allocated to a particular isothermal region, covering a 10° F (5.6° C) span of temperature, according to area of residence. Three types of isotherm were selected: mean annual temperature (Bartholomew, 1942) and January and July temperatures (Lewis and Campbell, 1951). The latter were taken to represent winter or summer when the hemisphere was northern or southern, respectively. The null hypothesis was tested by comparing the mean isothermal ages of onset by analysis of variance or the non-parametric Kruskal-Wallis test (Kruskal and Wallis, 1952).

RESULTS

Because of the predominance of European and North American subjects, distribution in terms of mean annual temperature was irregular (Table 1). There was, however, an obvious trend for the mean age of onset to fall as the temperature rose. As heterogeneity of the variances was of borderline significance, mean isothermal onset ages were compared using the Kruskal-Wallis test. The statistic H (a measure of population-differences and distributed essentially as $\chi^2$) with 3 DF equalled 29.37, for which $P < 0.001$. The decline in age of onset was therefore significant.

Mean annual temperature is a poor index of climatic stress, as extremes of heat and cold can fluctuate widely about a given mean. Possible differential effects of the seasons were therefore examined. The distribution of subjects among the five winter isotherms were: 10–19° F (104), 20–29° F (261), 30–39° F (829), 40–49° F (150), and 50–59° F (59). The distribution among the four summer isotherms were: 50–59° F (195),

<table>
<thead>
<tr>
<th>Mean annual temperature (°F)</th>
<th>Subjects (no.)</th>
<th>Mean ± SE of age of onset (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 to 39</td>
<td>32</td>
<td>40.4 ± 1.7</td>
</tr>
<tr>
<td>40 to 49</td>
<td>1,048</td>
<td>33.9 ± 0.2</td>
</tr>
<tr>
<td>50 to 59</td>
<td>199</td>
<td>31.6 ± 1.0</td>
</tr>
<tr>
<td>60 or higher</td>
<td>124</td>
<td>29.4 ± 1.1</td>
</tr>
</tbody>
</table>

FIGURE Variation of age of onset of Huntington's chorea with winter temperature (left) and summer temperature (right).
60–69° F (778), 70–79° F (355), and 80–89° F (75). The Figure shows that the greater decline in age of onset occurs over the winter rather than the summer range of temperatures. When age of onset was regressed on temperature, winter values were best fitted by the quadratic equation

\[
\text{Onset-age} = 31\cdot0 + 0\cdot32W + 0\cdot007W^2,
\]

where \(W\) denotes the mid-point of a winter isotherm in °F. The ratio of the variance due to regression to the variance about the regression curve was 8:94 with 2 and 1,400 DF (\(P<0\cdot001\)). Summer values were adequately represented by the linear equation

\[
\text{Onset-age} = 42\cdot0 - 0\cdot13S,
\]

where \(S\) denotes the mid-point of a summer isotherm in °F. The F-ratio of 7:23 with 1 and 1,401 DF (\(P<0\cdot01\)) indicated that the regression line accounted for an appreciable proportion of the variance.

Tables 2 and 3 summarize the analyses of variance performed on the data. Over the temperature ranges studied, cold exerted a greater effect on age of onset than heat, the variance ratio for which was barely significant. Sex was not an important factor, although there was an appreciable interaction with winter isotherms. Division of subjects according to sex led to the demonstration that cold climate delayed onset in females (\(F=4\cdot98\) with 4 and 699 DF, \(P<0\cdot001\)) to a greater extent than in males (\(F=2\cdot74\) with 4 and 694 DF, \(P<0\cdot028\)).

Because of differing cultures and ethnic groups, it is possible that national characteristics were responsible for at least part of these results. As the largest homogeneous group of subjects were North American, analyses of variance were repeated on these 364 white Caucasians. Fortunately, there is a relatively wide range of temperatures on this subcontinent to make such tests reasonably sensitive. Variances of onset ages applicable to winter and summer conditions were heterogeneous; Kruskal-Wallis tests were therefore made on the data. Winter conditions (\(H=55\cdot79\) with 3 DF, \(P<0\cdot001\)) were again a stronger determinant of onset age than summer conditions (\(H=9\cdot39\) with 2 DF, \(P<0\cdot01\)). In each case the ages of onset were inversely related to temperature as previously found for all subjects. Reduction of ethnic factors therefore failed to affect the main features of the results.

**DISCUSSION**

From the results presented, it appears that the first signs of Huntington’s chorea occur at an earlier age in hot climates. The extent of the decrease in age with increasing temperature depends on the climatic index used. As the mean annual temperature rises by some 40° F (22° C) from northern Sweden to tropical regions such as India, the average age at onset falls by about a decade. In seasonal terms, it is clear that winter exerts a greater effect than summer. Nevertheless, the age at onset gradients are similar over the first four isotherms of each season; it is only the last winter isotherm (50–59° F) which gives rise to its predominance. The shape of the winter curve bears only a partial resemblance to the parabola which arises if stress, caused by extreme temperatures, induces chorea prematurely. Instead, it seems that low degrees of heat and cold are not conducive to an early onset but that higher temperatures progressively pose a greater threat.

It is important to establish whether the present results represent actual physical effects of temperature or of some factor dependent on
temperature. It is not possible to distinguish
between these alternatives solely from the present
study. The application of heat may aggravate
some of the symptoms of multiple sclerosis
(Simons, 1937) and other neurological disorders
(Nelson et al., 1958); no direct effect of tempera-
ture seems to have been reported for Hunting-
ton's chorea. Lacking such evidence, it is sugges-
ted that the lowering of the age of onset of
chorea is associated with the increased sus-
cceptibility to infection on passing from temperate
to tropical areas.

Some authors (Hughes, 1925; Brothers, 1964)
have noted the appearance of Sydenham's
chorea in persons who develop Huntington's
chorea later in life. Bruyn (1968) interprets this
as a predisposition to react with chorea after
stress or infection: 'an individual who, at
mature age, develops chorea due to the metabolic
defect he has inherited may, at tender age, betray
this if a cerebral infection (rheumatism) comes
into play'. Streptococcal infection is commonly
associated with Sydenham's chorea (Matthews
et al., 1960), and Taranta (1959) has shown in a
prospective study that it can follow infections
with group A streptococci after an interval of
tree to six months.

In a retrospective study of stress in Hunting-
ton's chorea, Korenyi et al. (1972) found that
trauma and infection headed the list of putative
somatic precipitants of the disorder. If it is
granted that infections provoke an earlier
appearance of symptoms than would otherwise
be the case, a geographical gradient of the type
described here could be anticipated.

REFERENCES

Psychiatrie, 10, 139–145.

Bahr, M. A. (1912). Some clinical observations in three cases
of Huntington's chorea. Medical Record, 82, 756–758.


Bird, M. T., and Paulson, G. W. (1971). The rigid form of

Brackenridge, C. J. (1971). A genetic and statistical study of
some sex-related factors in Huntington's disease. Clinical
Genetics, 2, 267–286.

Brackenridge, C. J. (1972). Familial correlations for age at
onset and age at death in Huntington's disease. Journal of
Medical Genetics, 9, 23–32.

and Tasmania. Journal of the Neurological Sciences, 1, 405–
420.

Bruyn, G. W. (1968). Huntington's chorea. Historical,
clinical and laboratory synopsis. In Handbook of Clinical
Neurology. Vol. 6, pp. 298–378. Edited by P. J. Vinken and

Buck, C. A. (1934). Huntington's chorea, with the report of a

chorea. Journal of the Iowa State Medical Society, 57, 336–
340.

Casper, J. (1930). Chorea Huntington. Zentralblatt für
gesamte Neurologie und Psychiatrie, 57, 855–856.

Chamberlain, L. C. (1943). Abstract of clinical history of
case 2. New Orleans Medical and Surgical Journal, 96, 57–
62.

Collins, J. (1898). The pathology and morbid anatomy of
Huntington's chorea, with remarks on the development and
treatment of the disease. American Journal of the
Medical Sciences, 116, 275–291.

Cronin, E. J. (1943). Huntington's chorea. New Zealand
Medical Journal, 42, 231.

Diller, T. (1889). Some observations on the hereditary form
of chorea, with the report of a case. American Journal of
the Medical Sciences, 98, 585–593.

chorea. Lancet, 2, 940.

Fau, R., Chateau, R., Tommasi, M., Grosilambert, R.,
d'une forme rigide et myoclonique de maladie de

Finn, R. (1970). The three-century history of an Iowa family
with Huntington's chorea. Journal of the Iowa Medical
Society, 60, 89–93.

Argentina, 57, 1733–1734.

Hughes, E. M. (1925). Social significance of Huntington's

King, C. (1885). Hereditary chorea. New York Medical

Kloos, G. (1938). Gehäute erbliche Taubheit in einer
Huntington-Familie. Münchener Medizinische Wochen-
schrift, 85, 94–96.

Korenyi, C., and Whittier, J. R. (1967). Drug treatment in
117 cases of Huntington's disease with special reference to

Success in huntington's disease (chorea). Diseases of the

one-criterion variance analysis. Journal of the American
Statistical Association, 47, 583–621.

Laane, C. L. (1951). Den tidlige diagnose av chorea

A pedigree of Huntington's chorea. Annals of Eugenics, 17,
92–112.


Lion, E. G., and Kahn, E. (1938). Experiential aspects of
Huntington's chorea. American Journal of Psychiatry, 95,
717–727.

Lyon, R. L. (1962). Huntington's chorea in the Moray Firth

Mackenzie-van der Noordaa, M. C. (1960). De door Westphal
beschreven variënt van de ziekte van Huntington. Neder-
landsch tijdschrift voor geneeskunde, 104, 1625–1627.

MacLeod, M. D. (1881). Cases of choreic convulsions in
persons of advanced age. Journal of Mental Science, 27, 194–
200.

New York State Medical Journal, 51, 2779–2782.


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