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Normal reference value of red blood cell count of Chinese young men and geographical factors

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Regression analysis

AIM: This paper aims at supplying a scientific basis for unifying the normal reference value standard of red blood cell count of Chinese young men.
METHODS: The research is made to study the relationship between the normal reference value of 41,759 examples of red blood cell count of young men and 8 geographical factors in 334 areas in China, which is determined by the microscopical counting method.
RESULTS: It is found that the correlation of geographical factors and the normal reference value of red blood cell count of young men is quite significant ($F = 224.98$, $P = 0.000$). By using the method of stepwise regression analysis, one regression equation is inferred.
CONCLUSION: If geographical values are obtained in a certain area, the normal reference value of red blood cell count of young men in this area can be reckoned by using the regression equation. Furthermore, according to the geographical factors, China can be divided into eight districts: Northeast China District, North China District, Shanxi-Shaanxi-Inner Mongolia District, Middle and Lower reaches of the Changjiang River District, Southeast China District, Northwest China District, Southwest China District, and Qinghai-Tibet Plateau District.

Red blood cell count is an important index of hematology. At present, it is difficult to achieve the accuracy in clinical diagnosis because of the lacking of a unified standard of the normal reference value of young men's red blood cell count in China. To supply a scientific basis for unifying the normal reference value standard of red blood cell count of Chinese young men, many researchers have measured the normal reference value of the local young men's red blood cell count.[1-127] But there is no report about the relationship between the normal reference value of young men's red blood cell count and geographical factors.[128-130] By using the method of stepwise regression analysis, this paper indicates that there are certain regular patterns between the normal reference value of young men's red blood cell count and geographical factors.

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Materials

The normal reference value of young men's red blood cell count

The normal reference values of healthy young men's red blood cell count from various administrative units (hospitals, research institutes, and universities) have been collected in China. It includes the normal reference values of

41,759 young men's red blood cell count tested in 334 units. The ages of the volunteers range from 18 to 25 years old. It is a mean value of young men's red blood cell count in each area, and 50 to 210 random samples have been studied in every area. The determination of the normal reference value of young men's red blood cell count is performed according to the microscopical counting method.[131] The experiment done by adopting this method includes the following steps: take one minor test tube, add 2.0 mL red blood cell diluents into it, get 10 μL blood with clean dry micro-straw, scrape the surplus blood off the tip of the micro-straw, inject the bottom of the blood cell diluents gently, and suck the upper clear liquid to gargle micro-straw 2 to 3 times, then mix it immediately. After resting the mixture standing for 2 to 3 minutes, cell numbers should be counted in turn with a high-magnification microscope, on the principle of counting the upper and left rather than the lower and right, visual counting should be carried on.

The geographical factors

The geographical factors come from relevant geographical works and dictionaries.[132-134] The selected geographical factors include altitude (X_1), annual sunshine duration (X_2), annual percentage of sunshine duration (X_3), annual mean air temperature (X_4), annual range of air temperature (X_5), annual mean relative humidity (X_6), annual precipitation amount (X_7), and annual mean wind speed (X_8).

Altitude (X_1)

The mean sea level which is determined by long time observation of sea level is called mean sea level. If one point is higher than mean sea level, its height is called altitude; the measured unit is in meters (m).

Annual sunshine duration (X_2)

A time that the center of sun rises from the eastern horizon and falls into the western is called the possible sunshine hours. Because sun can be shaded by fog or affected by obstacles, the actual sunshine time is called the observed sunshine hours. The amount of the observed sunshine hours in 1 year is called annual sunshine duration; the measured unit is in hours (h).

Annual percentage of sunshine duration (X_3)

The percentage of observed sunshine duration which takes up in the possible sunshine duration for a given year; the measured unit is in percentage (%).

Annual mean air temperature (X_4)

Air temperature is defined as the temperature in screen at 1.5 month above the ground surface. The average of routinely observed values for a given year is called annual mean air temperature; the measured unit is in degrees centigrade (°C).

Annual range of air temperature (X_5)

The difference which is between means temperature of the warmest month and the coldest month in 1 year; the measured unit is in degrees centigrade (°C).

Annual mean relative humidity (X_6)

The ratio of actual vapor pressure in air to saturation vapor pressure at current temperature is called relative humidity. The average of routinely observed values for a given year is called annual mean relative humidity; the measured unit is in percentage (%).

Annual precipitation amount (X_7)

Precipitation amount is defined as the accumulated depth in a horizontal container that collected the liquid or solid precipitation (after melting) fallen from the sky. The amount by taking an addition of daily total precipitation for a given year is called annual precipitation amount; the measured unit is in millimeters (mm).

Annual mean wind speed (X_8)

Wind speed is defined as the horizontal distance that the air moves in unit time. The average of routinely observed values for a given year is called annual mean wind speed; the measured unit is in meters per second (m/s).

Correlation analysis and regression analysis

Correlation analysis

By using the method of mathematical correlation analysis,[135] single correlation coefficients between the normal reference value of young men's red blood cell count and eight geographical factors [altitude (X_1), annual sunshine duration (X_2), annual percentage of sunshine duration (X_3), annual mean air temperature (X_4), annual range of air temperature (X_5), annual mean relative humidity (X_6), annual precipitation amount (X_7), annual mean wind speed (X_8)] can be calculated, respectively: $r_1 = 0.880$ ($P_1 = 0.000$), $r_2 = 0.459$ ($P_2 = 0.000$), $r_3 = 0.442$ ($P_3 = 0.000$), $r_4 = -0.794$ ($P_4 = 0.000$), $r_5 = -0.110$ ($P_5 = 0.044$), $r_6 = -0.640$ ($P_6 = 0.000$), $r_7 = -0.536$ ($P_7 = 0.000$), $r_8 = 0.155$ ($P_8 = 0.004$). If P value is higher than 0.05, it means the correlation is not significant. If P value is lower than 0.01, it means the correlation is quite significant. If it occurs between 0.05 and 0.01, the correlation is just significant.

Regression equation

According to the normal reference value of young men's red blood cell count and geographical factors, one regression equation is inferred by using the method of stepwise regression analysis:

$$\hat{Y} = 3.022 + 0.0003380X_1 + 0.009673X_3 - 0.01336X_4 + 0.01040X_5 + 0.01137X_6 + 0.0003244X_7 \pm 0.55.$$

In the above equation, $\hat{Y}$ is the normal reference value of young men's red blood cell count ($\times 10^{12}$/L); X_1 is the altitude (m); X_3 is the annual percentage of sunshine dura-