PRINCIPLE OF BLOOD GROUP INHERITANCE AND CALCULATION OF ITS RATIO

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Abstract

This paper shows the principle of blood group inheritance and gives the calculation of its ratio based on the law of genetic inheritance of paper. Besides, reason of atavism has been also provided, which is valuable for the research on genetics. Author in this paper think Principle of blood group inheritance and calculation of its ratio improve the non-systematicness and uncertainty. Simple and feasible calculation methods of disease rate are provided for diseases of autosomal dominant (AD), autosomal recessive (AR), X-linked dominant inheritance (XR) and Y-linked inheritance, which is valuable for the research on the genetics in future.

Keywords: Blood group; Principle of inheritance; Ratio of inheritance

Introduction

Blood groups gain importance in the recent advance research [1]. ABO blood type is also associated with the risk of cancer and heart disease [2, 3]. The blood groups are genetically transmitted and have great role in the inheritance principle [4, 5]. It means the blood groups need attention to revisit the principle of inheritance. The current study is aimed to reconsider the principle of inheritance and calculate its ratio applying new approaches.

Materials and Methods

Two lemmas

There is much regularity which comes from statistics of inheritance results in the inheritance research. Will people propose the possible results and ratio of inheritance from the principle angle, the answer is yes. First of all, the law of genetic inheritance will be introduced [6].

Genetic Behavior is divided into dominant inheritance and recessive inheritance. Assume that D represents for dominant inheritance factor in offspring, and d represents for recessive inheritance factor in offspring. Two inheritance factors can be dependent or independent. Dependent means there is cross effect between D and d, that is, (Dd) is also an inheritance result.

The possible results may be D or d when inheritance factors of male parent and female parent are independent;

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\[ D, d, (Dd)^+, (Dd)^-, D(Dd)^+, d(Dd)^+ \]

\[ D(Dd)^-, (Dd)^-d \]

when inheritance factors of male parent and female parent are dependent.

Binomial equation formula:

\[ (D + d)^n = \sum_{i=0}^{n} C_n^i D^i d^{n-i} \]

where \( C_n^i = \frac{n!}{i!(n-i)!} \).

Coefficients of the odd and even items in the expansion are equal.

Expansion \((D + d)^n\) fit such expansion:

\[ (D + d)^n = \sum_{i=0}^{n} C_n^i D^i d^{n-i} \]

is just all of the possible results of the \( n-1 \)th generation.

Lemma 1 : When male parent and female meet dominant inheritance; inheritance factors fit such addition principle 1:

\[ D \oplus D = D ; \]

\[ D \oplus d = D ; \]

\[ d \oplus D = D ; \]

\[ d \oplus d = d . \]

Lemma 2 : When male parent and female meet recessive inheritance; inheritance factors fit such addition principle 2:

\[ D \oplus D = d ; \]

\[ D \oplus d = D ; \]

\[ d \oplus D = D ; \]

\[ d \oplus d = d . \]

Gene inheritance law :

1) All of the possible inheritance results of the \( n-1 \)th generation fit such expansion:

\[ (D + d)^n = \sum_{i=0}^{n} C_n^i D^i d^{n-i} \]

\[ C_n^0 D^n + C_n^1 D^{n-1} d + C_n^2 D^{n-2} d^2 + \ldots + C_n^n d^n \]

where \( C_n^i = \frac{n!}{i!(n-i)!} \);

2) Inheritance factors meet distributive law (separate regularity);

3) Inheritance factors meet associative law (law of independent assortment);

4) Dominant inheritance meets addition principle 1;

5) Recessive inheritance meets addition principle 2;

6) When D and d are independent, possible results are D or d;

7) When D and d are dependent, Dd will be regarded as inheritance factor which also have dominant inheritance \((Dd)^+\) and recessive inheritance \((Dd)^-\) (linkage inheritance), and possible results are:

\[ D, d, (Dd)^+, (Dd)^-, D(Dd)^+, D(Dd)^-d \]

\[ D(Dd)^-, (Dd)^-d . \]
Note: when \( n = 2 \), this inheritance law is just Mendel’s law.

**Principle of blood group inheritance and calculation of its ratio**

In the blood groups, type A and type B are dominant inheritance, type AB is double-dominant linked inheritance, and type O is recessive inheritance.

**Blood groups of parents:**

<table>
<thead>
<tr>
<th>Blood Groups of Parents</th>
<th>Possible Blood Groups of Children</th>
<th>Ratios of Blood Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and A</td>
<td>A,A,O</td>
<td>A,O=3:1</td>
</tr>
<tr>
<td>A and B</td>
<td>A,B,A,B,O</td>
<td>AB:A:B:O=1:1:1:1</td>
</tr>
<tr>
<td>A and O</td>
<td>A,A,O</td>
<td>A,O=1:1</td>
</tr>
<tr>
<td>B and B</td>
<td>B,B,O</td>
<td>B,O=3:1</td>
</tr>
<tr>
<td>O and O</td>
<td>O,O</td>
<td>O=1</td>
</tr>
<tr>
<td>O and AB</td>
<td>O,A</td>
<td>A:B=1:1</td>
</tr>
<tr>
<td>B and O</td>
<td>B,B,O</td>
<td>B,O=1:1</td>
</tr>
<tr>
<td>AB and AB</td>
<td>A,A,B,A,B,O</td>
<td>A,AB:B=1:2:1</td>
</tr>
</tbody>
</table>

**Reason of atavism**

Atavism happens in the case of recessive linked inheritance according to the inference 5 and inference 6 in paper [6], that is, inheritance happens in even-generation, without odd-generation, such as hemophilia, red blindness, DMD and leukocyte glucose-6-phosphate dehydrogenase deficiency.

**Results and Discussion**

Through applying mathematical logics and approaches, the Principle of blood group inheritance and calculation of its ratio improve the non-systematicness and uncertainty. Roach et al. [7], analyzed the whole-genome sequences of a family of four, consisting of two siblings and their parents to understand the genetic inheritance.

Furthermore, this research also solves the inheritance mechanism in the coming generation applying the approach used here. Similar findings were suggested by Salmon and Salmon [8], for the Blood Groups and Genetic Markers Polymorphism and Probability of Paternity.

**Conclusions**

Author in this paper think Principle of blood group inheritance and calculation of its ratio improve the non-systematicness and uncertainty. Simple and feasible calculation methods of disease rate are provided for diseases of autosomal dominant (AD), autosomal recessive (AR), X- linked dominant inheritance (XR) and Y- linked inheritance, which is valuable for the research on the genetics in future.

**Reference**