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To cite this article: Ellianawati and A Budhiman 2020 *J. Phys.: Conf. Ser.* **1567** 042094

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The natural grating method in determining family heredity

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Abstract. Human hair is one of material used to identify heredity of an individual. There has been a lot of researches done by scientists in sophisticated ways to test inheritance based on hair characteristics. However, to teach this uniqueness at the school level can be done with a simple test. One of them with natural grating method. This study aims to analyze the interference patterns produced by hair from the diffraction process. Five non-blood related families were examined. A beam of 800 nm wavelength from the laser is passed through the hair and its lattice width is calculated. Lattice gap data obtained are then calculated the correlation value between mother and child father. The results of this simple analysis are not enough to support the inheritance relationship of one family. Obtained mystery figures that still need to be studied further. But found one family with twins who have the same width of hair gap. This finding is certainly very interesting to be taught to students at the school level.

1. Introduction

Teaching science at the school level is to teach the basics of scientists in solving problems in the natural environment. A simple approach can be taken to attract students to study science. One of them is about inheritance in the family. The study of inheritance is called genetics. The most widely studied inheritance theory is about mixed inheritance theory. Individuals inherit the average mix nature that parents take through sperm and egg cells. The characteristic carrier factor is DNA or deoxyribonucleic acid. DNA is a very long double helix nucleic acid, containing pieces of genes as units which compiles genetic information. DNA can determine characteristics and morphology such as skin colour, hair type, finger shape, and other special characteristics of humans [1-3].

Hair is part of human organs. There are straight or curly hair structures, and there are thick or thin. This hair structure is obtained through parent's DNA and to identify it requires a DNA test that is quite complicated and takes a long time. The structure of hair is similar to the structure of fiber. In physics, there is a simple method used to measure the thickness of a fiber through diffraction grating experiments [4,5]. A simple diffraction process that is carried out is passing light through the fiber. Fiber in this case functions as a narrow gap or lattice. Light is an electromagnetic wave that has the property of being deflected as it passes through a gap. Through this diffraction pattern the hair characteristics can be identified.



Diffraction grating is also called compound gap, which is a neatly arranged gap with a fairly close distance. This lattice constant is usually written in N data in fringes/cm. If light passes through a compound gap (lattice) then the light will penetrate and diffraction occurs. The width of this gap can be observed from the interference pattern on the screen. The resulting interference pattern has like a double separation of Young's experiment [6]. The lattice width can be determined from the equation $N = 1 / d$, where N is the number of gaps (lattice constants) and d is the distance between the lattice. In this experiment, the lattice is used to characterize the properties of hair in a family based on the hair lattice constants of family members.

2. Materials and Methods

Five families were involved in this study. Each family member is taken by a hair as a sample of this simple DNA test. The hair is placed one by one in the middle of the cell phone simcard as shown in Figure 1. The laser beam used for this grating experiment has a wavelength of 800 nm. Variable lattice distance to the screen is done and obtained interference pattern to the screen.

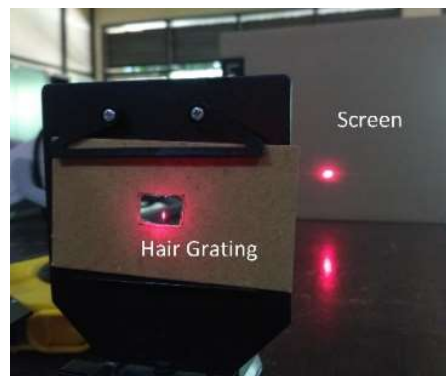


Figure 1. Set of natural grating method

The distance between the slit to the screen is 3 meters. The observed diffraction pattern is of orders 2 and 3 because this pattern is most clearly seen on the screen. The experiment was repeated five times in each diffraction data collection and the average value was taken. After obtaining the data of the slit width of each hair, a simple product moment correlation test is performed to analyze the relationship between mother and child, father and child, and father and mother.

3. Results and Discussion

In this research, order 2 and 3 interference patterns were taken to calculate the value of each hair. The research data is presented in Figure 2 to Figure 6.

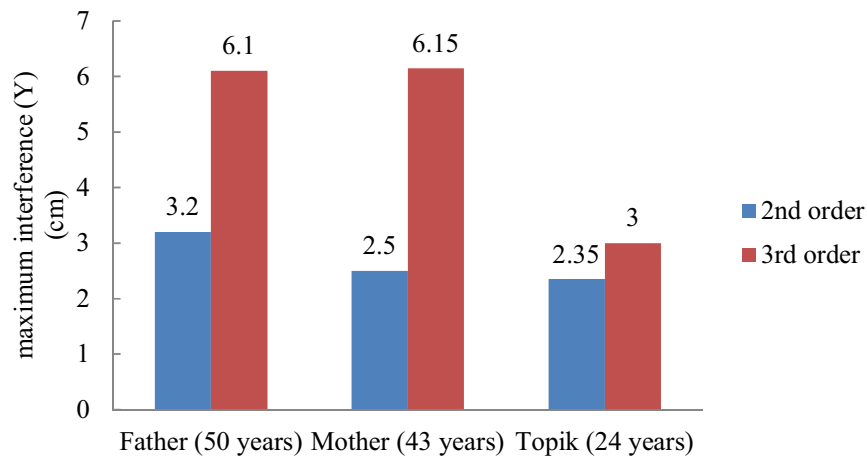


Figure 2. Topik family's hair diffraction pattern

In Figure 2, it appears that the diffraction pattern in Topik's hair bears a resemblance to the pattern of his mother's hair in the 2nd order. As for the 3rd order, the diffraction pattern on Topik's hair became half of the diffraction pattern of his parents.

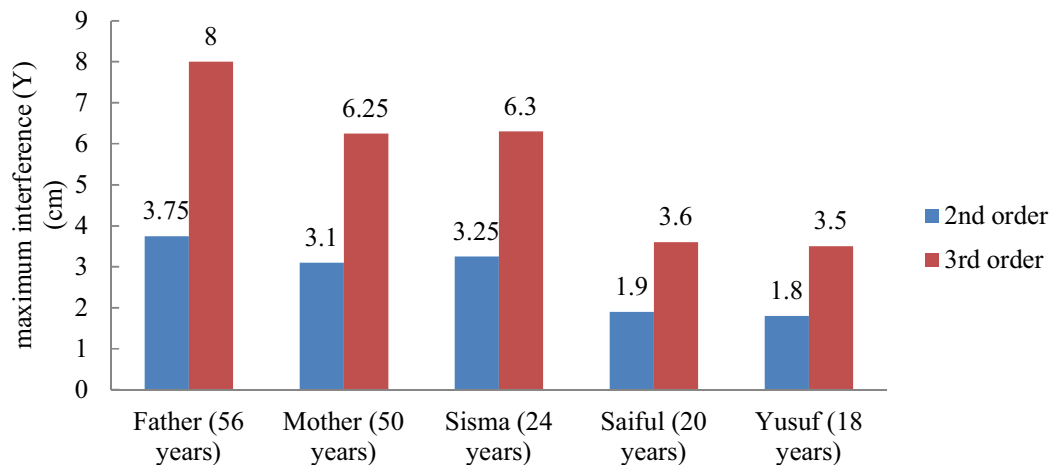


Figure 3. Sisma family's hair diffraction pattern

Figure 3 in the Sisma family, it appears that the Sisma' hair diffraction pattern is almost similar to both his parents in the 2nd order and similar to his mother in the 3rd order. As for her two younger brothers, the diffraction pattern of their hair is approximately half that of their parents' diffraction patterns both in the 2nd and 3rd orders.

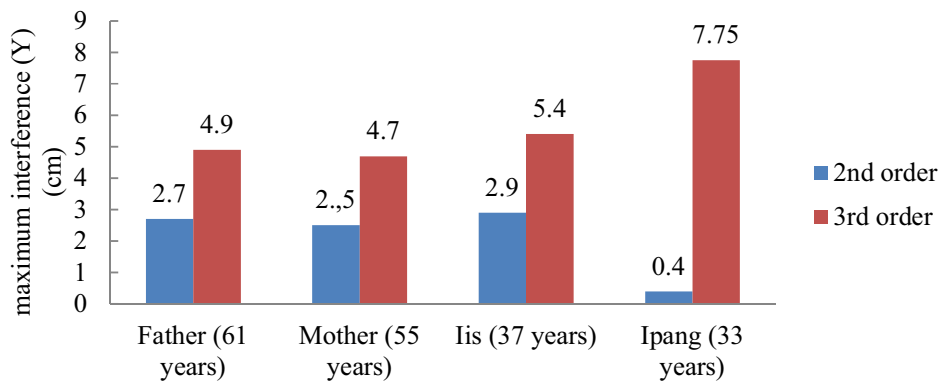


Figure 4. Iis family's hair diffraction pattern

The diffraction pattern of the Iis family hair in Figure 4 shows a quite different fact. Iis hair diffraction pattern is the same as both her parents in the 2nd and 3rd orders. As for Ipang's hair diffraction pattern, his younger brother, in the 2nd order is the same as his parents' hair diffraction pattern in the 3rd order. Ipang's hair diffraction pattern in the 3rd order is twice the length of his parents' hair diffraction pattern in the 3rd order.

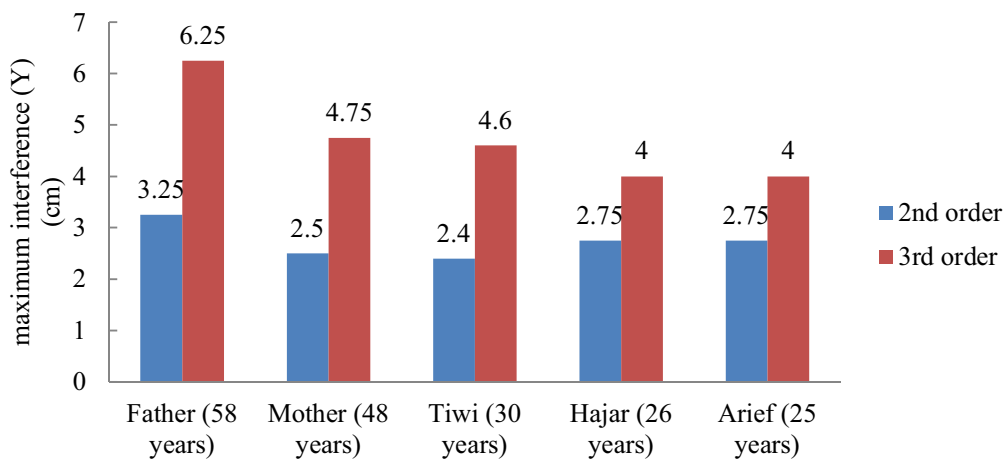


Figure 5. Tiwi family's hair diffraction pattern

The Tiwi family hair diffraction pattern data presented in Figure 5 is even more interesting. Tiwi's hair diffraction pattern in the 2nd and 3rd order bears a resemblance to her mother's hair diffraction pattern in the 2nd and 3rd order. Tiwi's two younger brothers are twins. Both have the same hair diffraction patterns in the 2nd and 3rd order and are similar to the mother's hair diffraction pattern in the same order.

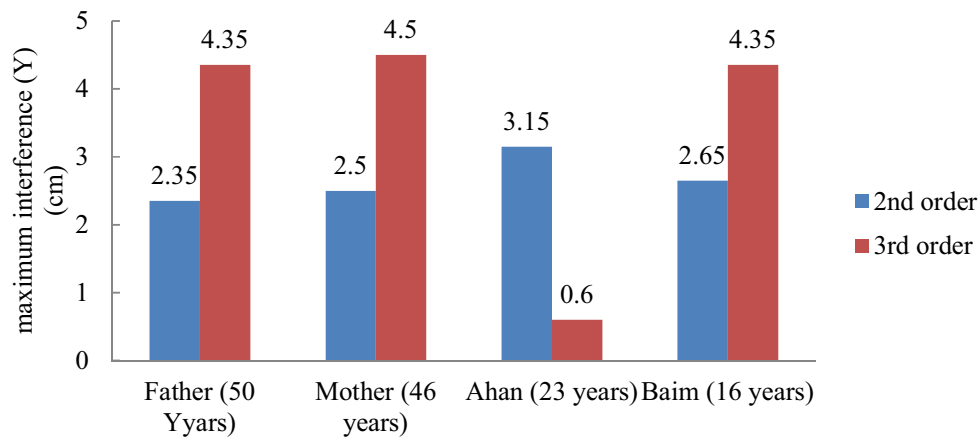


Figure 6. Ahan family's hair diffraction pattern

As for the Ahan family in Figure 6, different data from the other families are found. If usually the first child bears a strong resemblance to the mother, then in Ahan's family the second child is similar to his mother. As for Ahan, he did not have the same tendency of diffraction patterns in the 2nd and 3rd diffraction patterns to his parents.

Based on hair diffraction pattern data from the five families studied, it shows that there is a tendency of mothers as carriers of inheritance [7]. It also appears that the pattern that the older a person will change the pattern [8] the closer the same as the diffraction patterns of both parents. In twins, because they share genes [9,10], they have the same pattern.

To confirm the relationship of inheritance relationships between members in one family. A simple correlation test was performed with Pearson's correlation statistics and data obtained as presented in Table 1. The data in Table 1 shows that the strong relationship between mother and child as well as father and child with a constant score of 1. However, negative values that appear in the calculations still need further analysis. Both data appear in different families and different child sequences. Once again because it still uses this very simple statistical test, by correlating the order of 2 and 3 parents with children, it is still very open for further analysis with more sophisticated techniques.

Table 1. Pearson correlation of hair diffraction data of children and parents

Family	Name of child	Mother - Child	Father - Child
Topik Family	Topik	-1	-1
Sisma Family	Sisma	1	1
	Saiful	1	1
	Yusuf	1	1
Iis Famiy	Iis	1	1
	Ipang	1	1
Ahan Family	Ahan	1	1
	Baim	1	1
Tiwi Family	Tiwi	1	1
	Arief	-1	-1
	Hajar	-1	-1

Moreover, this study did not consider the lifestyle, hair care techniques, and nutritional intake of the respondents studied. Because based on the results of research, lifestyle, nutritional intake, and individual interactions will affect the structure of hair [11-15].

4. Conclusion

The findings from the results of this study may not have provided significant data. But the faithful information obtained can provide a keyword description of the similarities in the family and similarities in twins. Even aware that there are significant differences from the oldest child with a younger age. This simple natural grating experiment is easy to carry out and will be very interesting to train it to students at the school level.

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