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# Factors Determining Intention to Pursue Genetic Testing for People in Taiwan

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***Abstract*—**The Ottawa Charter for Health Promotion proposed that the role of health services should shift the focus from cure to prevention. Nowadays, besides having physical examinations, people could also conduct genetic tests to provide important information for diagnosing, treating, and/or preventing illnesses. However, because of the incompletion of the Chinese Genetic Database, people in Taiwan were still unfamiliar with genetic testing. The purposes of the present study were to: (1) Figure out people's attitudes towards genetic testing. (2) Examine factors that influence people's intention to pursue genetic testing by means of the Health Belief Model (HBM). A pilot study was conducted on 249 Taiwanese in 2017 to test the feasibility of the self-developed instrument. The reliability and construct validity of scores on the self-developed questionnaire revealed that this HBM-based questionnaire with 40 items was a well-developed instrument. A total of 542 participants were recruited and the valid participants were 535 (99%) between the ages of 20 and 86. Descriptive statistics, one-way ANOVA, two-way contingency table analysis, Pearson's correlation, and stepwise multiple regression analysis were used in this study. The main results were that only 32 participants (6%) had already undergone genetic testing; moreover, their attitude towards genetic testing was more positive than those who did not have the experience. Compared with people who never underwent genetic tests, those who had gone for genetic testing had higher self-efficacy, greater intention to pursue genetic testing, had academic majors in health-related fields, had chronic and genetic diseases, possessed Catastrophic Illness Cards, and all of them had heard about genetic testing. The variables that best predicted people's intention to pursue genetic testing were cues to action, self-efficacy, and perceived benefits (the three variables all correlated with one another positively at high magnitudes). To sum up, the HBM could be effective in designing and identifying the needs and priorities of the target population to pursue genetic testing.

***Keywords*—**Genetic testing, intention to pursue genetic testing, Taiwan, health belief model.

## I. Introduction

THE approach of healthcare has been gradually shifting from "disease treatment" to "disease prevention" [1]. Improvements in medical technology not only advanced the practice of medicine, but also had a significant impact on medical prevention strategies. Nowadays, in addition to traditional physical examinations, genetic tests might be used to identify increased risks of health problems.

Gou Tai-ming, also known as Terry Gou, chairman of Foxconn Technology Group, announced to donate NT$15 billion to National Taiwan University in 2007 to fund bio-medical engineering projects and the construction of a cancer hospital [17]. After his wife died of breast cancer and his younger brother died from leukemia, CEO Terry Gou wanted to compile a "Chinese genetic database" to aid in the fight against cancer. He hoped that one day genetic testing for cancer could be an affordable and faster tool, which would enable early detection and prevention of cancer.

Genetic testing was still an emerging issue in Taiwan. One of the main reasons might be that it was not covered under the National Health Insurance program. On the other hand, according to Wang's research, even though the majority of Taiwan people regarded genetic testing as contributing to improve the quality of genetic medicine, people still needed to receive further education or training prior to responding to genetic testing issues [2]. In order to provide an in-depth investigation of this issue, the theoretical framework for the present study was based on the HBM [3] and the main purposes were to: (1) Assess the degree to which people's preferences in genetic testing. (2) Understand which attributes were relevant for people who had completed genetic tests. (3) Examine whether the components of the HBM had an independent effect on people's intention to engage in genetic testing. Fig. 1 displayed the variables used in the analyses in this study.

## II. Literature Review

### A. The Current Status of Genetic Testing in Taiwan

In general, genetic testing referred to use laboratory methods to identify changes in chromosomes, genes, or proteins. And the results could be used to aid physicians in the diagnosis and therapy of many diseases. There were three basic methods to implement genetic tests: biochemical tests, cytogenetic tests, and molecular genetic tests [4]. Although advances in genetic testing improved doctors' ability to diagnose and treat certain illnesses, there were still some limits. Genetic tests could identify a particular problem gene, but it might not always predict how severely that gene would affect the individual who. Moreover, many illnesses were caused by a combination of high-risk genes and environmental factors.

Genetic testing in Taiwan was about to expand. Because it was not easy to establish a fairly standard protocol for genetic testing, the current trends in genetic testing were still limited to traditional platforms, such as prenatal diagnosis by karyotyping and newborn screening for congenital metabolic and endocrine diseases. Therefore, some widespread genetic tests were still unavailable in Taiwan [5]. Nevertheless, molecular diagnostics and DNA sequencing would be the mainstream in the future [6].

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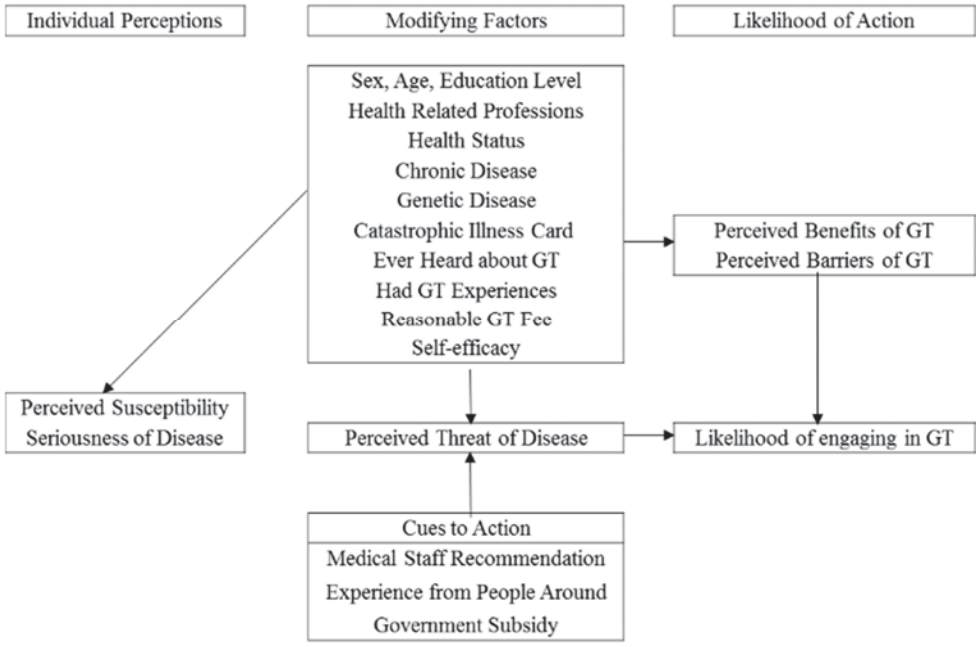


Fig. 1 Framework in this study

According to Chen and Hsieh's study, about 80% of Taiwanese were not equipped with knowledge of modern genetic technology [7]. However, most people in Taiwan perceived that the benefits of genetic technology were greater than its risks [8]. Since very few empirical studies had actually investigated Taiwanese's attitudes towards genetic testing, this study was designed to gain more insight into this particular issue.

### *B. The Effectiveness of the HBM in Genetic Testing*

The HBM was by far one of the most widely used conceptual frameworks in health education and health promotion [9]. The HBM served as an organizing framework to contain several primary concepts that predicted why people would take action to prevent, to screen for, or to control illness conditions. The main constructs included: perceived susceptibility, perceived severity, benefits and barriers to a behavior, cues to action, and self-efficacy.

The HBM had been widely applied to the analysis of health promotion behavior [10], health education [11], psychotherapy [12], consumer behavior [13], and driving habits [14].

In Taiwan, an investigation was based on the sample of 205 pregnant women and the main purpose was to explore their acceptance of fragile X carrier screening. The results indicated that under the framework of the HBM, perceived barriers and susceptibility were the two major predictors for acceptance of fragile X carrier screening [15].

Another research used the HBM to examine 175 nurses' cancer screening intentions [16]. The results revealed that cues to action and the intention to have cancer screening were positively correlated. In addition, higher levels of perceived barriers were negatively associated with intentions to perform screening mammography.

Unfortunately, very few studies used the HBM to investigate the general population in Taiwan about their intentions to engage in genetic testing; therefore, by means of the HBM, the present study could make some contributions towards preventive medicine.

## III. Methods

### *A. Participants*

The population of this study was comprised by all Taiwanese aged 20 and above. The participants were recruited by means of convenience sampling. A pilot study was conducted on 249 Taiwanese in 2017 to test the feasibility of the self-developed instrument. Schedule of formal data gathering was from July 2 to September 30, 2017. A total of 542 participants were recruited and the valid participants were 535 (98.70%) people in Taiwan between the ages of 20 – 86 in this study, the average age of the valid participants was 44 ($SD$ = 13.59).

There were more female (282, 52.71%) than male (253, 47.29%) Taiwanese in this study. The majority of participants obtained a bachelor's degree (228, 42.62%). About 30% of participants' academic majors were health-related fields (154, 28.79%). The majority of participants (445, 83.18%) perceived their health status as "good or very good". About 25.85% of participants reported to have chronic diseases ($n$ = 138). And 12.15% of participants ($n$ = 65) reported to have genetic diseases. Only 29 people (5.42%) possessed Catastrophic Illness Cards. Most people in this study had heard about genetic testing (392, 73.27%) and they thought that the reasonable genetic testing fee should be under NT$10000 (53.27%). However, only 32 people (6%) had actually completed genetic tests.

The participants expressed somewhat positive levels of intention in perusing genetic testing ($M_{item}$ = 5.05, $SD_{item}$ = 1.13) and perceived more benefits in genetic testing ($M_{item}$ = 5.55,

$SD_{item}$ = 1.09).

### B. Instrument

In order to conduct an in-depth study of Taiwanese's intention to pursue genetic testing, a self-developed questionnaire was designed based on the HBM. Thus, there were eight components to the overall analytic approach: perceived susceptibility, perceived severity, perceived benefits of genetic testing, perceived barriers of genetic testing, perceived threat of disease, cues to action, self-efficacy, and the intension to pursue genetic testing. Each component was measured on a 7-point Likert scale (1= strongly disagree, 7= strongly agree), with higher mean scores indicating higher levels of the characteristic. The pilot study covered a total of 249 Taiwanese and the sample was used to establish the questionnaire's validity and reliability.

Item analysis, item-to-total correlations, and the exploratory factor analysis (EFA) were used to examine each component's construct validity. Content validity index and Cronbach's alpha coefficients were used to examine their reliability. Six experts performed content validity. The content validity index (CVI) was .99. The results indicated that this self-developed questionnaire was a rigorous and well-developed instrument. Table I illustrated summary of the validity and reliability of this questionnaire.

## IV. Results

One-way ANOVA was conducted to evaluate group differences (people with and without the experience of genetic testing) in "intention to pursue genetic testing" and "self-efficacy in genetic testing", respectively. In addition, the independent chi-square test (two-way contingency table analysis) was used to determine if there was a significant relationship between two categorical variables. The results revealed that people with the experience of genetic testing had higher self-efficacy in genetic testing and greater intention to pursue genetic testing than those who never had the experience. Besides, for Taiwanese who had actually completed genetic testing compared to the rest who did not, many more of them had academic majors in health-related fields, had chronic and genetic diseases, possessed Catastrophic Illness Cards, and everyone had heard about genetic testing. Table II illustrated summary of the above figures. Because only 6% of Taiwanese in this study reported to have the genetic testing experience, the follow-up analyses were mainly focused on those who never had the genetic testing experience.

Pearson's correlations were used to test associations among the target research continuous variables (the 8 components of the HBM). In general, the results from Pearson correlation analysis indicated that "intention to purpose genetic testing" was significantly and positively associated with cues to action ($r$ = .71), perceived benefits ($r$ = .67), self-efficacy ($r$ = .53), perceived threat of disease ($r$ = .19), and perceived susceptibility ($r$ = .16), respectively. In addition, "intention to purpose genetic testing" was significantly and negatively associated with perceived barriers ($r$ = - .11). (as shown in Fig. 2).

TABLE I
MEANS, STANDARD DEVIATIONS, AND CRONBACH'S ALPHAS FOR COMPONENTS OF THE HBM QUESTIONNAIRE

| HBM component | # | # of Items to Delete | $M_{item}$ | $SD_{item}$ | Alpha | Total Variance Explained |
|---|---|---|---|---|---|---|
| intension to pursue GT | 5 | 0 | 4.32 | 1.47 | 0.90 | 72.14% |
| cues to action | 5 | 0 | 4.86 | 1.31 | 0.85 | 62.18% |
| perceived benefits | 5 | 0 | 5.10 | 1.21 | 0.91 | 74.41% |
| self-efficacy | 6 | 0 | 4.92 | 1.43 | 0.91 | 69.57% |
| perceived threat of disease | 5 | 0 | 5.45 | 1.38 | 0.91 | 63.45% |
| perceived susceptibility | 5 | 0 | 6.01 | 1.07 | 0.90 | 70.89% |
| perceived barriers | 4 | 1 | 4.02 | 1.43 | 0.79 | 61.76% |
| perceived severity | 4 | 1 | 5.97 | 1.14 | 0.83 | 66.26% |

TABLE II
MEANS AND STANDARD DEVIATIONS FOR GENETIC TESTING EXPERIENCE (YES/NO) AND THE RELATED VARIABLES

| Variables | | Genetic Tests YES $n$ = 32 | NO $n$ = 503 | Total $n$ = 535 | F/Pearson chi-square |
|---|---|---|---|---|---|
| self-efficacy | *M* | 5.8 | 5.11 | 5.15 | 13.28** |
| | *SD* | 0.97 | 1.05 | 1.06 | |
| intension to pursue GT | *M* | 5.53 | 5.02 | 5.05 | 6.31* |
| | *SD* | 0.87 | 1.13 | 1.13 | |
| health-related fields YES | Observed | 19 | 135 | 154 | 15.54** |
| | Expected | 9.2 | 144.8 | | |
| | A.R. | 3.9 | -3.9 | | |
| health-related fields NO | Observed | 13 | 368 | 381 | |
| | Expected | 22.8 | 358.2 | | |
| | A.R. | -3.9 | 3.9 | | |
| Chronic Disease YES | Observed | 17 | 121 | 138 | 13.28** |
| | Expected | 8.3 | 129.7 | | |
| | A.R. | 3.6 | -3.6 | | |
| Chronic Disease NO | Observed | 15 | 382 | 397 | |
| | Expected | 23.7 | 373.3 | | |
| | A.R. | -3.6 | 3.6 | | |
| Genetic Disease YES | Observed | 8 | 57 | 65 | 5.27* |
| | Expected | 3.9 | 61.1 | | |
| | A.R. | 2.3 | -2.3 | | |
| Genetic Disease NO | Observed | 24 | 446 | 470 | |
| | Expected | 28.1 | 441.9 | | |
| | A.R. | -2.3 | 2.3 | | |
| Catastrophic Illness Card - YES | Observed | 8 | 21 | 29 | 25.45** |
| | Expected | 1.7 | 27.3 | | |
| | A.R. | 5 | -5 | | |
| Catastrophic Illness Card - NO | Observed | 24 | 482 | 506 | |
| | Expected | 30.3 | 475.7 | | |
| | A.R. | -5 | 5 | | |
| Ever Heard about GT YES | Observed | 32 | 360 | 392 | 12.42** |
| | Expected | 23.4 | 368.6 | | |
| | A.R. | 3.5 | -3.5 | | |
| Ever Heard about GT NO | Observed | 0 | 143 | 143 | |
| | Expected | 8.6 | 134.4 | | |
| | A.R. | -3.5 | 3.5 | | |

A stepwise multiple regression analysis was applied to determine which variables were the best predictors of Taiwanese's "intention to purpose genetic testing". The overall model was significant, $F$ (3, 531) = 222.42, R = .75, adjusted $R^2$ = .55, $p$ < .01. The three variables that best predicted "intention to purpose genetic testing" were cues to action ($\beta$ = .46), self-efficacy ($\beta$ = .19), and perceived benefits ($\beta$ = .19). In other words, for Taiwanese who had never performed genetic tests, the facilitating factors were mostly linked to external cues to engage in genetic testing, belief in one's ability to undergo genetic testing, and one's perception of the effectiveness of genetic testing to reduce the threat of illness. See Fig. 3.

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| intension to pursue GT (1) | — | .71** | .67** | .53** | .19** | .16** | -.11* | -0.08 |
| cues to action (2) | | — | .80** | .51** | .27** | .18** | -0.08 | .14** |
| perceived benefits (3) | | | — | .55** | .25** | .24** | -0.08 | .20** |
| self-efficacy (4) | | | | — | .26** | .33** | -0.03 | .26** |
| perceived threat of disease (5) | | | | | — | .33** | -0.16 | .57** |
| perceived susceptibility (6) | | | | | | — | -0.03 | .51** |
| perceived barriers (7) | | | | | | | — | -.10* |
| perceived severity (8) | | | | | | | | — |

Fig. 2 Pearson's correlation coefficient for the main variables

| Sources | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients β | t | F | R | $R^2$ | $R_{adj}^2$ | VIF |
|---|---|---|---|---|---|---|---|---|---|
| Model | | | | | 222.42** | .75 | .56 | .55 | |
| Constant | 0.31 | 0.19 | | 1.61 | | | | | |
| cues to action | 0.50 | 0.05 | 0.46 | 9.54** | | | | | 2.85 |
| self-efficacy | 0.20 | 0.04 | 0.19 | 5.35** | | | | | 1.46 |
| perceived benefits | 0.20 | 0.05 | 0.19 | 3.80** | | | | | 3.02 |

Dependent Variable: intention to pursue GT

Fig. 3 Stepwise multiple regression analysis of the HBM components on people's intention to pursue GT

## V. Discussion and Suggestions

### A. Future Trends in Genetic Testing in Taiwan

Genetic testing in Taiwan was still an emerging market, comparable to only a few people reported to have the GT experience in this study. However, for those who had actually completed genetic tests and led to a higher evaluation of it, this meant that genetic testing healthcare market in Taiwan had established some positive reputations, which could help boost the credibility of this business.

The results in this study also showed that most people would accept the medical staff's advice to pursue genetic tests (cues to action). Thus, genetic counseling should be impartial and nondirective. Besides, the government must ensure that there should be well-defined criteria for genetic testing and consumers should be properly informed on the pros and cons of performing genetic tests.

It was obvious that genetic testing has been playing a growing role in healthcare delivery and has been providing information that could be the basis for profound life decisions. There was a need for the government of Taiwan to provide accurate knowledge education and supportive resources concerning genetic testing.

### B. The Effectiveness of the HBM in Genetic Testing

Even though most people in this study felt they were in good health, by means of the HBM, the results revealed that perceived benefits, self-efficacy, and cues to action were significant predictors of pursuing genetic testing. The HBM had been one of the most widely used conceptual frameworks in health behavior research, both to explain behavior change and maintenance of health-related behavior, and as a guiding framework for health behavior interventions. The present study also demonstrated that the HBM could be effective in designing and identifying the needs and priorities of the target population in the issue of genetic testing.

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