

Relationship between Delayed Breast Cancer Diagnosis and Behavioral Economic Factors and Personality Characteristics

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Abstract

Background: Delays in breast cancer diagnosis can allow the disease to progress to an incurable stage. However, factors that cause patients to delay seeking treatment are unclear. In this study, we aimed to identify behavioral economic factors and personality characteristics of patients with breast cancer who had a delayed diagnosis. **Methods:** We analyzed questionnaires completed by 41 patients with breast cancer. A delayed diagnosis was defined if the time between the first symptom and the medical visit was more than 6 months. **Results:** We found 11 patients who had a delayed diagnosis. The significant characteristics associated with patients with breast cancer who had delayed diagnosis were: (i) less experience with breast cancer screening; (ii) progressive disease stage; and (iii) low time and future time preference. We found no significant behavioral economic factors other than time preference, and personality that differed between patients with breast cancer who did and did not have a delayed diagnosis. **Conclusion:** Low time preference rate is a characteristic of patients with breast cancer who had a delayed diagnosis.

Keywords: Breast cancer- behavioral economics- diagnostic delay

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Introduction

Breast cancer is the most common cancer in females worldwide, and the leading cause of cancer death among women (WHO, 2020). A frequent breast cancer symptom is a breast lump. Some patients ignore symptoms, which can lead to a delayed diagnosis. Such delays can allow the disease to progress to an incurable stage (Dianatinasab et al., 2016). In 2015, 5.8% of all newly diagnosed patients with breast cancer in Japan were diagnosed with stage IV breast cancer (“The deitorial board of the cancer statics in Japan.: CANCER STATISTICS IN JAPAN 2022. 2022.”). To prevent delays in diagnosis, it is important to understand why patients may delay seeking treatment. However, multiple factors can contribute to the likelihood of delayed diagnosis and the situations surrounding treatment delays are heterogeneous and unclear (Sobri et al., 2021).

Behavioral economics is a branch of economics that challenges the fundamental assumption that humans behave as fully informed and rational actors (Barnes et al., 2016). Seeing a patient as a nonrational actor who has predictable biases could make it easier to understand why individuals might fail to act in ways that are in their best interest (van Dalen and Henkens, 2014; Zimmerman, 2009). Behavioral economics may also be useful in understanding the behavior of patients with breast cancer who have delayed medical consultation. In this study, we aimed to identify behavioral economic factors and personality characteristics in patients with breast cancer who had a delayed diagnosis.

Materials and Methods

A total of 41 patients with breast cancer who agreed to complete questionnaires (Additional file) were enrolled

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in this study. The questionnaires comprised sections concerning personality characteristics and behavioral economic factors such as time preference, future time preference for a 90-day timeframe, present bias, risk preference and naiveness. To evaluate time preference, we used the multiple price list (MPL) method (Collar and Williams, 1999) in which patients were asked to choose between receiving 3,000 yen (at 100 yen per US dollar, \$30) now (option A) or waiting 7 days to receive an amount that increased from 2,500 (\$25) to 10,000 yen (\$100) (option B) (Additional file question 1). To evaluate future time preference over a 90-day timeframe, patients were asked to choose between receiving 3,000 yen (\$30) in 90 days (option A) or receiving a larger amount that increased from 2,500 (\$25) to 10,000 yen (\$100) in 97 days (option B) (Additional file question 2). In this study, we set the cut off and divided patients into a high or low group, rather than calculating the delay discounting rate. Present bias was determined to be present when the time preference was higher than the future time preference for a 90-day timeframe. Risk preference was measured using a question concerning purchase of a lottery ticket. The question had 8 different scenarios for how much study participants would be willing to pay for a ticket for a lottery for which they had a 50% chance of winning 100,000 yen (\$1000). The ticket price increased from 10 (10 cents) to 50,000 yen (\$500) (Additional file question 3), and participants were divided into two groups based on a cut-off value. The higher the amount they were willing to pay for a ticket, the higher their risk preference was. Naiveness was defined as a delay in execution rather than planning and was measured by two questions about completion of homework assignments made during childhood vacations (Additional file question 4 and 5). The first question asked about when the homework was done and the second asked when the homework was attempted. The difference in responses for the two questions was used as a measure of naiveness.

Personality was analyzed using a ten-item personality inventory (TIPI) (Gosling et al., 2003) (Additional file question 6). The TIPI is a simple psychometric instrument that has a certain degree of reliability and validity for capturing personality characteristics in five broad frameworks: extraversion, agreeableness, conscientiousness, neuroticism and openness. For this study we used the Japanese TIPI (J-TIPI) (Oshiro et al., 2012). For each item, patients rated themselves on a 7-point scale as to whether their characteristics applied to the question.

All answers were evaluated as ordinal categorical data, and divided into two groups using cut off values. The association between the characteristics and whether or not the participant had a delayed breast cancer diagnosis was assessed. Patients had a delayed diagnosis if there were 6 or more months between the first symptom and when the patient made a medical visit.

Differences between groups were evaluated with the Wilcoxon test and Pearson chi-square test for continuous and categorical variables, respectively. Statistical analysis was performed using JMP Pro, version 16.1.0 for Mac OS (SAS Institute Japan Ltd., Tokyo, Japan). P values ≤ 0.05

were considered statistically significant.

Results

The clinical characteristics of enrolled patients with breast cancer are shown in Table 1. The median age at diagnosis of breast cancer patients is 55. Questionnaires were completed while the patient was undergoing treatment, and the median time of completion was 5 years after diagnosis. Patients with various stage, T factor and N factor were included in this study. Excluding those patients who had no symptoms, the median time between the first symptom and the medical visit was 3 months. Defining diagnostic delay as patients seen more than 6 months after the first symptom or screening mammogram, we found 11 patients with diagnostic delay. A total of 28 patients had a history of mammography screening and 9 patients did not (Table 1).

Comparing patients with and without diagnostic delay, significant characteristics of patients with breast cancer who had diagnostic delay were less experience with breast cancer screening and disease stage. As for behavioral economic factors, patients with diagnostic delay had significantly low time preference and low future time preference, but there was no significant difference in present bias, risk preference and naiveness. The groups with and without diagnostic delay showed no significant difference in personality characteristics such as extroversion, cooperativeness, diligence, neuroticism and openness (Table 2).

Discussion

In this study, we examined whether behavioral economic factors and personality characteristics were associated with diagnostic delay of patients with breast cancer.

Table 1. Characteristics of Enrolled Patients

Age at diagnosis	median (range)	55 (38-83)
Stage	0	5
	I	16
	II	7
	III	5
	IV	9
T factor	is	5
	1	16
	2	13
	3	1
	4	6
N factor	positive (%)	16 (39%)
Time to diagnosis from symptom	median (month, range)	3 (0-96)
Time to questionnaire from diagnosis	median (year, range)	5(1-18)
Diagnostic delay	present/none	11/30
experience with breast cancer screening	present/none	28/9

Table 2. Characteristics of Patients with or without Diagnostic Delay

		Diagnostic delay		p-value
		Present N=11	None N=30	
Age at diagnosis	Median	61	51	0.68
experience of breast cancer screening	present(%)	2(20)	25(83)	<0.0001
stage	0-III/IV	5/6	28/2	0.0006
Behavioral economical factor				
Time preference	high/low	2/6	19/6	0.0091
Future time preference	high/low	3/6	17/7	0.05
Present bias	high/low	1/7	10/17	0.19
Risk preference	high/low	2/8	13/14	0.12
Naiveness	high/low	5/5	14/14	1
TIPI-J				
Extroversion	high/low	6/4	18/11	0.91
Cooperativeness	high/low	5/5	13/16	0.78
Diligence	high/low	8/2	15/14	0.11
Neuroticism	high/low	4/6	14/14	0.59
Openness	high/low	6/4	17/12	0.94

Delays in breast cancer diagnosis were shown to increase the rate of progression to advanced breast cancer. To decrease the risk of disease progression, it is important to understand why delays in seeking treatment occur. Factors associated with delayed diagnosis can be divided into clinicopathological, social, and psychological factors. For clinicopathologic characteristics, histology other than ductal carcinoma and lack of palpable mass were associated with delayed diagnosis (Dianatinasab et al., 2016). For social factors, low educational attainment, rural residence, and lack of knowledge contributed to delays in diagnosis (Dianatinasab et al., 2016; Sobri et al., 2021), as did the psychological and personality factors low fear and tendency not to consult others (Burgess et al., 1998). However, to the best of our knowledge, no studies have examined the relationship between behavioral economic factors as psychological traits that can affect diagnostic delay of breast cancer.

Behavioral economics combines fundamentals of economic theory with insights from psychology to describe common biases that can influence decision making, and is used to understand decision-making as a process that has predictable biases (SC, 2008). In this study, we examined behavioral economic characteristics such as time preference, future time preference in a 90-day timeframe, present bias, risk preference and naiveness. Among those factors, patients with breast cancer who had a delayed diagnosis had a significantly lower time preference than those who did not have a delayed diagnosis. In general, people with a higher time preference rate tend to perceive a lower present value of future reward, and thus engage in risk behaviors (Frederick and O'Donoghue, 2002). People with lower time preference rates are more patient and engage in preferred behaviors for the future, such as avoiding smoking and undertaking active self-care behaviors (Barlow et al., 2017; Madsen et al., 2019). For example, Chapman showed that time

preference is related to addictive behaviors such as smoking, but not to other preventive health behaviors such as vaccination (Chapman, 2005). In general, high time preference correlates with unhealthy choice (Story et al., 2014). On the other hand, there is a U-shaped relationship between self-reported health and time preference, it is supposed to be difficult to establish a simple causal relationship between time preference and health (Chao et al., 2009). Although our results do not appear to be consistent with general trends, a study of neuropathic anorexia nervosa (AN) showed that patients with AN had lower time preference rates compared to healthy controls (Steinglass et al., 2012), suggesting that excessive self-regulation may be involved in the pathological process, and could explain the characteristics of patients with breast cancer who had delayed diagnosis in this study. Excessive self-regulation, as expressed by time preference rates, does not necessarily lead to health-oriented behavior, and may in fact be harmful to patients' health.

As another matter, it is debatable whether time preference is an invariant individual characteristic (Story et al., 2014). We found no significant behavioral economic factors other than time preference, and personality that differed between patients with breast cancer who did and did not have a delayed diagnosis. Since the relationship between temperament and medical behavior is complex (Adachi et al., 2012; Magai et al., 2007), the simple personality analysis used in this study may not have identified temperamental characteristics associated with delayed diagnosis of breast cancer and thus a more detailed personality analysis is needed in future studies. And we have not been able to determine in this study whether time preference is a cause or a consequence of the association between time preference and advanced breast cancer found in this study. Moreover, this study involved a small number of outpatients. A larger study population might reveal other personality characteristics that may be

associated with the likelihood that a symptomatic patient would delay seeking treatment.

In conclusion, we found that breast cancer patients with delayed diagnosis are characterized by low time preference in behavioral economic characteristics. Further analysis of a large number of cases with detailed personality analysis is needed.

Author Contribution Statement

YS and KK analyzed the data and wrote the manuscript. H Yoshinaka, T Owaki, MN and T Ohtsuka provided guidance and supervision of the research. NH, YN, AN, YE, H Yano, HS, AN, KM, TH, KS and AT and treated patients or advised them on their treatment plan.

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Ethical statement

This study was approved by the institutional review board of Kagoshima University Hospital. And for this type of study formal consent is not required.

Conflict of interest:

There is no conflict of interest.

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