

RISK-TAKING BEHAVIOR IN RECOVERED COVID-19 PATIENTS

Aslı Egeli¹, Serkan Adıgüzel², Yaşar Kapıcı¹, Bulut Güc¹, Ayşegül Yetkin Tekin³ & Atilla Tekin¹

¹Psychiatry Department, Faculty of Medicine, Adiyaman University, Adiyaman, Turkey

²Psychology Department, Faculty of Art and Sciences, Haliç University, İstanbul, Turkey

³Private Psychological Counselor, Adiyaman, Turkey

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SUMMARY

Background: The aim of this study is to investigate risk-taking behavior and decision-making processes in recovered COVID-19 patients.

Subjects and methods: Twenty patients recovered from COVID-19 as confirmed by polymerase chain reaction (PCR) tests and twenty-one healthy individuals were recruited. A computerized version of the Iowa Gambling Test (IGT) for measuring risk-taking behavior tendencies as a decision-making process and State-Trait Anxiety Inventory (STAI), Beck Depression Inventory (BDI), and WMS-R Digit Span Forward Test (DSFT) for clinical assessments included. The assessments of the recovered patients were applied on the initial phase that the tests of the patients were negative and on the 4-week follow up phase.

Results: The results showed that the anxiety scores were significantly higher in the healthy control group than in the group of recovered patients. The IGT-Net 4 scores were significantly and IGT-Net total scores were marginally significantly lower in the group of recovered patients. In other words, recovered patients showed higher risk-taking behavior tendencies. This tendency difference is consistent with the anxiety levels of the groups. These IGT scores showed to be persistent in the 4-week follow up phase.

Conclusions: Our findings indicate that recovered patients show higher risk-taking behavior tendencies than healthy controls and this may be the result of overcoming the COVID-19 threat.

Key words: COVID-19 – Iowa gambling task - risk-taking behavior - decision-making

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INTRODUCTION

Corona Virus Disease 2019 (COVID-19) is a highly infectious disease and its effects are seen almost all over the world. From the time that the first case reported, numbers have reached huge amounts with almost 40 million cases and 1.1 million of deaths (World Health Organization 2020). Due to its high contagious and mortality risks, it became a public health emergency of international concern. These high-risk factors led this epidemic to have impacts on many different areas. To start with the social impacts, social distancing, working from home, and distance learning are new ways of living our lives while risk for agriculture and food, travel restrictions, and curfews are our new concerns. Regarding the economic impacts, we are facing employment shock, extreme fall in trade and commodity prices, manufacturing declines, and vulnerabilities in banking systems. When the impacts on health are considered, the primary effects of COVID-19 are obvious but not surprisingly mental health is also highly affected during this epidemic (International Labor Organization 2020).

The psychological impact of the epidemic is studied by several pieces of research. A research conducted by Yang and Ma (2020) showed that the epidemic led to a 74% drop in overall emotional well-being. Also, impacts on depressive and anxious symptoms (Haji Akhoundi et al. 2020, Li et al. 2020, Luo et al. 2020, Wang et al. 2020, Wang et al. 2020), severe stress levels (Wang et al. 2020) and decrease in positive emotions and life satisfaction (Li et al. 2020) have been reported. Reactive

psychosis and mood alterations due to neuroinflammation in patients with COVID-19 have been reported (Lazzari et al. 2020, Sinanovic et al. 2020, Valdés-Flórida et al. 2020, Van Rheeën et al. 2020). When we consider the cognitive effects, Haji Akhoundi et al. (2020) showed a cognitive dysfunction up to 70% in multiple sclerosis patients. A lower correct number and reaction time score in the Continuous Performance Test is also reported in COVID-19 patients (Zhou et al. 2020).

All in all, the epidemic has affected our lives in many ways. Decision-making strategies and risk-taking behavior may be one of them. Behaviors that increase the probability of developing a physical, social, and psychological problem as a result are called risk-taking behavior. Such behaviors can be sampling as smoking and drinking alcohol, insecure sexual relationship, reckless driving, and extreme sports (Byrnes 2003). Risk-taking behavior tendency shows differences according to gender (Bayar & Sayil 2005, Singh et al. 2020), age (Bayar & Sayil 2005), parents' attitude, and social connections (Uludağlı & Sayıl 2009). Another affecting factor is cognitive and emotional abnormalities which have strong empirical support (Güven 2012, Kusev et al. 2009). Accordingly, accessibility to decision-making contents and having emotion regulation strategies have an impact on risk preferences and tendencies.

In this context, the aim of this study is to investigate risk-taking behavior tendencies in recovered COVID-19 patients. Although a full neuropsychological evaluation is needful to reveal this tendency, the Iowa Gambling Test is shown to be a reliable tool (Bechara et al. 2005,

Giustiniani et al. 2019, Icelliglu 2015, Li et al. 2010, Miu et al. 2008). The importance of this study is to clarify the potential difference in recovered COVID-19 patients' risk-taking behavior tendencies via an objective measurement. In doing so, the experimental group consists of the patients unlike many other pieces of research in the literature. So, the cognitive impairment and behavioral changes that result from the epidemic would be able to be investigated.

SUBJECTS AND METHODS

Participants

Using a convenience sampling method, 20 recovered patients aged 19-56 who were formerly diagnosed with COVID-19 (38.3±12 years) and 21 healthy individuals aged 22-56 (37.4±9 years) were recruited from Adıyaman University Training and Research Hospital. All participants had full physical and mental health, were not addicted to any drugs and alcohol. Additionally, all participants were free of brain tumor, trauma, and surgery. All procedures performed in this study were conducted with the informed consent of the participants.

The research protocol was registered in the clinical trials registry of the Turkish Ministry of Health and the non-invasive clinical research ethics committee of Adıyaman University (Registration Number: 2020/5-7).

Experimental Tasks

State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI) is a likert type scale consisting of 40 questions and developed by Spielberger et al. (1970). This scale consists of two sections, each consisting of 20 questions, and these sections measure state and trait anxiety levels separately. While the State Anxiety Inventory (SAI) is sensitive to changes in the instantaneous anxiety level, the Trait Anxiety Inventory (TAI) is sensitive to changes in the general anxiety level. The total score for both sections varies between 20 and 80 scores. Higher scores indicate higher anxiety status. With the implementation of the STAI, it was aimed to evaluate the state anxiety levels of patients continuously and trait anxiety levels before the pandemic outcome and their possible overall effects on risk-taking behavior. The validity and reliability study of the Turkish form was conducted by Öner and Le Compte (1983).

Beck Depression Inventory

Beck Depression Inventory (BDI) is a likert type scale developed by Beck (1961) and consisting of 21 questions. These questions are prepared to include the symptoms seen in depression based on clinical observation. Each question is rated with values ranging from 0-3 scores. Accordingly, the scale score ranges from 0 to 63 scores. Higher scores indicate higher levels of depression. The purpose of applying BDI in the study

is to evaluate the depression levels of patients and their possible effects on risk-taking behavior. The validity and reliability study of the Turkish form was conducted by Hisli (1989).

WMS-R Digit Span Forward Test

The Digit Span Forward Test (DSFT) is a subtest of the Wechsler Memory Scale and is dedicated to measuring memory for digits (Wechsler 1939). There are two types of digit span tests as digit span forward and backward, and these tests can be applied both verbally and visually. In the digit span forward test, a series of random single digits are either read or shown to the participant and then expected to recall them in order. This test is used to examine participants' short-term memory capacities and attention abilities. The validity and reliability study of the Turkish form were conducted by Karakas and Yalin (1995).

The Iowa Gambling Task

Iowa Gambling Task (IGT) is a neuropsychological test designed to reveal decision-making skills or deficiencies (Bechara et al. 1994). The Turkish norm study of IGT was conducted by Icelliglu (2015). A computerized version of IGT is used in this study. Initially, the participants are given 2000 points and are asked to choose from four decks of cards. The purpose of these choices is to increase the money owned at the end of the game as much as possible. These decks are made up of two types, which have an extremely high risk of loss which yields a high gain but ultimately can lead to a net loss, also called as disadvantaged decks and a smaller risk of loss and low gain but ultimately can lead to a net gain, also called as advantageous decks. During the task, we expect the participants to notice this distinction in the decks and create a tendency in their preferences. Thus, we can obtain information of the risk-taking behavior of the participants. After the participant chooses 100 cards, the test is concluded and their scores are calculated. Lower scores indicate a high risk-taking tendency while higher scores indicate low.

Procedure

The study design had two phases as initial and follow up, and two groups as experimental and control. For the experimental group, all processes are carried out on the day that patients are free of COVID-19 diagnosis. Despite this, during the process, all the COVID-19 precautions are considered and the application room had been made suitable for experimentation. In the initial phase, participants for both groups are provided with written informed consent. Then, all the participants were controlled for exclusion criteria. The clinical measures of STAI, BDI, WMS-R Digit Span Forward Test were applied in order. After all, a computerized version of IGT, the main outcome assessment of this study, was carried out. In the follow-up phase, for the experimental group, all the assessments were reapplied 4 weeks after the initial assessment day.

Statistical Analyses

The SPSS software version 25.0 package program was used for statistical analyses of the present study. Normality distribution of the continuous variables was tested with their skewness and kurtosis values. The variables with skewness and kurtosis values between +1.5 and -1.5 were considered to fit the normal distribution. Comparisons of the categorical variables in patients and healthy controls were assessed with the Chi-Square and Fischer's Exact tests. Group comparisons of the variables that fitted normal distribution were evaluated with independent samples t-test. Group comparisons of the variables that do not show normal distribution were evaluated with the Mann-Whitney U test. Baseline and one-month follow-up tests and scales scores of the experimental group were compared with the Wilcoxon Signed Ranks test. The significance level was accepted as $p < 0.05$ for all tests.

RESULTS

Demographic characteristics

20 recovered patients who were formerly diagnosed with COVID-19 and 21 healthy controls included at the

initial phase of the current study. 4 of the recovered patients dropped out at the follow-up phase.

Group comparisons for sociodemographic features were presented at Table-1. There were no significant differences between groups on age ($t=0.261$, $p=0.795$), gender ($\chi^2=0.631$, $p=0.427$), education ($p=0.076$), occupation ($p=0.261$) and marital status ($\chi^2=0.013$, $p=0.910$).

Clinical Assessments

BDI, DSFT, STAI and IGT scores of groups were compared at Table-2. Accordingly, DSFT scores in the experimental group were higher than healthy controls ($t=-2.990$, $p=0.005$). State and trait anxiety scores of healthy controls were also higher than recovered patients' scores ($t=-2.652$, $p=0.012$ and $t=-3.025$, $p=0.004$, respectively). Mean rank of IGT-Net 4 scores in experimental group was higher compared to the healthy controls ($Z=-2.604$, $p=0.009$). There were no statistical differences between groups on BDI ($t=-1.943$, $p=0.059$), IGT-Net 1 ($Z=-0.978$, $p=0.328$), IGT-Net 2 ($Z=-0.762$, $p=0.446$), IGT-Net 3 ($Z=-0.866$, $p=0.387$), IGT-Net 5 ($Z=-0.760$, $p=0.447$) and IGT-Net Total scores ($Z=-1.963$, $p=0.05$).

Table-1. Comparison of sociodemographic features between recovered COVID-19 patients and healthy controls

Variable		COVID-19 (+) (n=20) M±SD or n (%)	COVID-19 (-) (n=21) M±SD or n (%)	t/χ ²	p
Age		38.3±12	37.4±9	0.261	0.795
Age Group	18-40	10 (50)	14 (66.7)	1.172	0.279
	>40	10 (50)	7 (33.3)		
Gender (Female)		8 (40)	11 (52.4)	0.631	0.427
Education (University)		7 (35)	14 (66.7)		0.076*
Occupation (Working)		10 (50)	16 (76.2)		0.261*
Marital Status (Married)		13 (65)	14 (66.7)	0.013	0.910

Abbreviations and Symbols: M: mean; SD: standart deviation; n: number; %: percent; t: t score for indepent sample t test; χ²: Pearson Chi-Square value; *: Fischer's Exact test

Table-2. Comparison of BDI, Digit Span Test, STAI and IOWA scores between recovered COVID-19 patients and healthy controls

Test or Scale	COVID-19 (+) (n=20) M±SD or MR (SoR)	COVID-19 (-) (n=21) M±SD or MR (SoR)	t/Z	p
BDI	8.7±7.6	13.1±7.1	-1.943	0.059
Digit Span Test	5.6±1.4	6.9±1.3	-2.990	0.005
STAI- (State Anxiety)	32.8±10.1	40.4±8.1	-2.652	0.012
STAI- (Trait Anxiety)	38.5±6.7	45.3±7.8	-3.025	0.004
IGT-Net 1	22.85 (457)	19.24 (404)	-0.978	0.328
IGT-Net 2	19.60 (392)	22.33 (469)	-0.762	0.446
IGT-Net 3	19.38 (387.5)	22.55 (473.5)	-0.866	0.387
IGT-Net 4	16.15 (323)	25.62 (538)	-2.604	0.009
IGT-Net 5	19.60 (392)	22.33 (469)	-0.760	0.447
IGT-Net Total	17.25 (345)	24.57 (516)	-1.963	0.050

Abbreviations and Symbols: M: mean; SD: standart deviation; MR: mean rank; SoR: sum of ranks; t: t value for indepent sample t test; Z: Z value for Mann-Whitney U test

Table-3. Comparison of initial and one-month follow-up BDI, Digit Span Test, STAI and IOWA test scores in recovered COVID-19 patients

Test or Scale		MR	SoR	Z	p
BDI	Negative Ranks (N=7)	6.50	45.5	-0.513	0.608
	Positive Ranks (N=5)	6.50	32.5		
STAI (State)	Negative Ranks (N=8)	8.06	64.5	-0.181	0.856
	Positive Ranks (N=8)	8.94	71.5		
STAI (Trait)	Negative Ranks (N=11)	8.05	88.5	-1.061	0.289
	Positive Ranks (N=5)	9.50	47.5		
Digit Span Test	Negative Ranks (N=3)	8.83	26.5	-1.016	0.310
	Positive Ranks (N=9)	5.72	51.5		
IGT-Net 1	Negative Ranks (N=6)	6.33	38.0	-0.529	0.597
	Positive Ranks (N=7)	7.57	53.0		
IGT-Net 2	Negative Ranks (N=6)	6.92	41.5	-0.290	0.771
	Positive Ranks (N=7)	7.07	49.5		
IGT-Net 3	Negative Ranks (N=5)	6.40	32.0	-0.553	0.580
	Positive Ranks (N=7)	6.57	46.0		
IGT-Net 4	Negative Ranks (N=5)	6.20	31.0	-0.365	0.715
	Positive Ranks (N=5)	4.80	24.0		
IGT-Net 5	Negative Ranks (N=6)	6.00	36.0	-0.269	0.788
	Positive Ranks (N=5)	6.00	30.0		
IGT-Net Total	Negative Ranks (N=6)	8.42	50.5	-0.543	0.587
	Positive Ranks (N=9)	7.72	69.5		

Abbreviations and Symbols: MR: mean rank; SoR: sum of ranks ; Z: Z value for Wilcoxon Signed Ranks Test

Table-4. Comparison of BDI, Digit Span Test, STAI and IOWA scores between in participants aged 18-40 and over the age of 40 with and without COVID-19

Test or Scale	COVID-19 (+) (n=10) M±SD or MR (SoR)	COVID-19 (-) (n=14) M±SD or MR (SoR)	t/Z	p
Aged 18-39				
BDI	9.1±7.9	12±7.3	-0.915	0.372
Digit Span Test	6.2±1.3	7.1±1.1	-1.724	0.103
STAI- (Stait Anxiety)	36.1±11.1	40.1±8.8	-0.960	0.351
STAI- (Trait Anxiety)	39.6±8.6	44.1±7.1	-1.370	0.189
IGT-Net 1	13.35 (133.5)	11.89 (166.5)	-0.504	0.615
IGT-Net 2	10.6 (106)	13.86 (194)	-1.162	0.245
IGT-Net 3	12.7 (127)	12.36 (173)	-0.119	0.905
IGT-Net 4	9.9 (99)	14.36 (201)	-1.547	0.122
IGT-Net 5	10.25 (102.5)	14.11 (197.5)	-1.357	0.175
IGT-Net Total	9.95 (99.5)	14.32 (200.5)	-1.499	0.134
Over the age of 40				
BDI	8.3±7.6	15.4±6.5	-2.078	0.056
Digit Span Test	5.1±1.2	6.4±1.5	-1.938	0.079
STAI- (Stait Anxiety)	29.4±8.4	40.9±7.2	-3.019	0.009
STAI- (Trait Anxiety)	37.3±4.1	47.6±9.2	-2.777	0.025
IGT-Net 1	10.15 (101.5)	7.36 (51.5)	-1.141	0.254
IGT-Net 2	9.4 (94)	8.43 (59)	-0.407	0.684
IGT-Net 3	7.6 (76)	11 (77)	-1.402	0.193
IGT-Net 4	6.95 (69.5)	11.93 (83.5)	-2.133	0.033
IGT-Net 5	9.85 (98.5)	7.79 (54.5)	-0.878	0.380
IGT-Net Total	7.95 (79.5)	10.5 (73.5)	-1.032	0.315

Abbreviations and Symbols: M: mean; SD: standart deviation; MR: mean rank; SoR: sum of ranks; t: t value for indepent sample t test; Z: Z value for Mann-Whitney U test

BDI, DSFT, STAI and IGT scores of the recovered patients, which were measured at the initial and follow up phase, were compared in Table 3. There were no statistical differences between initial and one-month follow-up scores of the recovered patients.

The BDI, DSFT, STAI and IGT scores of the two groups are also compared by the participants' ages. In doing so, participants are distinguished into two groups as relatively young (aged 18 to 39) and relatively elder (aged 40 to 56). These age thresholds are determined by the Turkish IGT norm study (Icelliglu 2015). There were no significant differences in BDI, DSFT, STAI and IGT scores between relatively young participants of the recovered COVID-19 patients and healthy controls. On the other hand, state and trait anxiety scores and IGT-Net 4 scores of the healthy controls were higher than of the recovered COVID-19 patients (respectively; $t=-3.019$, $p=0.009$; $t=-2.777$, $p=0.025$; $Z=-2.133$, $p=0.033$) (Table-4).

DISCUSSION

To the best of our knowledge, this is one of the very few studies on cognitive and mental health aspects of COVID-19 sampling diagnosed patients. This research contributes to the literature by exploring how the pandemic influences psychological well-being and risk-taking behavior tendencies. Specifically, our results suggest that recovered patients show high risk-taking behavior tendencies compared to healthy individuals. To support this, IGT-Net 4 scores show the significant difference and IGT-Net total scores were found to be marginally significant. Accordingly, the control group has higher state and trait anxiety levels than the recovered patients. The IGT scores were found to be similar in the 4-week follow up phase.

When we compare our findings with the Turkish norm study's data (Icelliglu 2015), recovered patients' IGT score was found to be similar to the normative data. Namely, the recovered patients' risk-taking behaviors may have been normalized because they overcome the COVID-19 threat. On the other hand, healthy controls seem to have a low tendency of choosing high-risk decks. This may be the result of continuing high COVID-19 threat for this group. Additionally, post COVID-19 neuropsychological deficits such as fatigue, cognitive disturbances may have affected the test performances of the recovered COVID-19 patients (Stam et al. 2020).

Many studies have reported that decision-making strategies are affected by anxiety levels. The effect of trait anxiety on IGT performance is indicated in the results of many researches (Maner et al. 2007, Miu et al. 2008, Peters & Slovic 2000). Hereunder, the inverse relationship between anxiety level and high-risk decks was found out. This also may explain recovered patients' tendency of high risk-taking behaviors via their respectively lower level of anxiety. The underlying

reason for these anxiety level differences may be the experience of overcoming the COVID-19 threat. Moreover, some studies have shown recovered patients produce antibodies and this may lead them to a favorable position in a reinfection circumstance (Ni et al. 2020, Seydoux et al. 2020).

An interesting finding of the present study was both state and trait anxiety levels and IGT-Net 4 score found to be higher in relatively elders of healthy controls. On the other hand, anxiety levels and IGT scores did not differ in relatively younger individuals between the groups. Although COVID-19 can cause poor prognosis and mortality in younger people, higher complication or mortality rates of COVID-19 have been reported on elderly people (Guan et al. 2020, Ioannidis et al. 2020), and this may lead this kind of higher anxiety levels. Due to this high anxiety level and high risk of mortality, elderly healthy controls seem to have low risk-taking behavior tendencies.

Anxiety as a strong predictor of IGT performance shares this effect on people with HIV. These people with high anxiety levels show decision-making and IGT performance dysfunctions (Golub et al. 2016, Thames et al. 2012, Wardle et al. 2010). IGT is a highly valuable task in emphasizing brain structures for decision-making (Levy 2017, Li et al. 2020). These studies concurrently show a neural circuitry involving the dorsolateral prefrontal cortex, the insula and ventromedial prefrontal cortex, and any dysfunction of these regions show an effect on IGT performance. So, the epidemic may lead to these kinds of dysfunctions in the brain.

The present study is a descriptive experimental study which assessed the risk-taking behavior tendencies in recovered COVID-19 patients. These findings could inform other researchers seeking to understand the role of the COVID-19 epidemic on patients' decision-making abilities. However, the following limitations should be taken into account when interpreting our findings. Firstly, the sample size was relatively small, thus we might not have adequate support claims of having achieved valid conclusions. Secondly, the maximum age was relatively low in our sample when we consider the commonly specified high-risk age range for COVID-19 so we lack from this analysis. Thirdly, neuroimaging analysis needs to be done to specify the potential functional dysfunctions. Finally, we could not determine the anxiety levels and IGT performances throughout the disease. Therefore, longitudinal observations on the potential changes in these scores are suggested to be explored further.

CONCLUSION

In conclusion, our findings indicate that individuals who formerly diagnosed with COVID-19 are a more likely tendency to higher risk-taking behaviors. This can affect the recovered COVID-19 patients' behaviors such as wearing masks, respecting social (or physical) distance, and providing hygiene.

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Contribution of individual authors:

Aslı Egeli, Serkan Adıgüzel, Ayşegül Yetkin Tekin & Atilla Tekin conception and design of the study.

Aslı Egeli, Yaşar Kapıcı & Bulut Güc: data collection.

Serkan Adıgüzel & Ayşegül Yetkin Tekin: statistical analyses of data.

Serkan Adıgüzel & Atilla Tekin: drafting of manuscript.

All authors approved the final manuscript.

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Correspondence:

Atilla Tekin, MD
Psychiatry Department, Faculty of Medicine, Adıyaman University
Adıyaman, Turkey
E-mail: md.atillatekin@gmail.com