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Özgün araştırma

İnmeli Bireylerin Araba Kullanma Tehdit Algılarının İncelenmesi

Orkun Tahir ARAN [1], Zeynep BAHADIR AĞCE [2]

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Öz

Amaç: Bu çalışmada, inmeli bireylerin trafik tehlike algı düzeylerinin araştırılması ve kognitif becerileri ile ilişkilerini incelemek amaçlandı.
Gereç ve Yöntem: Çalışmaya en az 1 yıl ince inme geçirmiş bireyler dahil edildi. Tehlike Algılama Testi (TAT) ve İz Sürme Testi Bölüm B (TMT B), katılımcıların sürüş tehlikesi algısını ve kognitif becerilerini analiz etmek için kullanıldı. Tehlike algısı ile bilişsel işlevler arasındaki ilişkiyi araştırmak için Spearman korelasyon testi kullanıldı. Ayrıca, TMT B test sonuçlarının 106,7 saniye kesme skorundan farklı olup olmadığını belirlemek için tek örneklem T testi kullanıldı.
Bulgular: Çalışmaya yaş ortalaması 59,42 ± 11,07 yıl olan 21 katılımcı (2 kadın, 19 erkek) katıldı. Katılımcıların TAT ortalama skoları 30,52 ± 18,2 (min: 6, maks: 65) ve TMT B ortalama skorları 165,38 ± 89,94 saniye (min: 65, maks: 347) olarak bulundu. Testler arasında istatistiksel olarak anlamlı, negative yönde, mükemmel korelasyon (p <,05, r: ,89) olduğu bulundu. Tek örnek T testi TMT-B skorlarının 106,7 saniyelik kesme skorundan daha yüksek olduğunu gösterdi (p <,05).
Sonuç: Katılımcıların tehlikeli durumlara tepki verme sürelerinde sürelerinde gecikme olduğu ve yürütücü işlevler, görsel-algısal ve görsel-motor takip gibi kognitif becerilerinde kısıtlılıkları olduğu bulundu. Tehlike algısı doğrudan kaza riskleriyle ilgili en önemli becerilerden biridir. Klinisyenler ve araştırmacılar inmeli bireylerin görsel algılama becerilerini ve tehlike algılarını eğitmeyi düşünmelidir; çünkü tehlike algısı sadece araba kullanan bireyleri değil, aynı zamanda yayaları da etkilemektedir.

Anahtar kelimler: *Otomobil sürme, inme, risk değerlendirmesi, ergoterapi*

[1]**Orkun Tahir ARAN (Sorumlu Yazar).** (Hacettepe Üniversitesi, Sağlık Bilimleri Fakültesi Ergoterapi Bölümü, 0312 305 2560/120, orkunaran@gmail.com.
[2] **Zeynep BAHADIR AĞCE,** (Atlas Üniversitesi, Sağlık Bilimleri Fakültesi Ergoterapi Bölümü, (0216) 400 2222 4063, fztzeynepbahadir@gmail.com

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Original Research

Investigation of Driving Hazard Perception of Stroke Survivors

Orkun Tahir ARAN [1], Zeynep BAHADIR AĞCE [2]

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Abstract

Objective: It was aimed to investigate the level of hazard perception and its relation to cognitive skills of stroke survivors.
Material and Methods: Participants who had a stroke at least 1 year before were included in this study. Hazard Perception Test (HPT) and Trail Making Test Part B (Trails B) were used to analyze participants' driving hazard perception and cognitive skills related to driving. Spearman correlation test was used to investigate the relationship between hazard perception and cognitive functions. Additionally, one sample T test was used to determine whether or not the Trails B test results differ from the 106.7 seconds cut-off score.
Results: Twenty-one participants (2 females, 19 males) with mean age 59.42 ± 11.07 years participated to the study. Participants had 30.52 ± 18,2 (min: 6, max: 65) mean scores from HPT and 165,38 ± 89,94 seconds (min: 65, max: 347) from Trails B. Bivariate correlations indicated HPT and Trails B had statistically significant negative excellent correlation ($p<.05$, r: .89). Additionally, one sample T test indicated Trail B scores were statistically different and higher from 106.7 seconds cut-off score ($p<.05$).
Conclusion: It was found that participants had late responses to potential driving hazards and limited executive functions, visual-perceptual and visual-motor tracking. Hazard perception, on the other hand, is one of the most crucial skills that directly related to crash risks. Clinicians and researchers should consider training visual perception skills and hazard perceptions of stroke patients; because hazard perception does not only be related to driving but also pedestrian safety.

Keywords: *Automobile driving, stroke, risk assessment, occupational therapy*

[1]Orkun Tahir ARAN (Corresponding Author). (Hacettepe Üniversitesi, Sağlık Bilimleri Fakültesi Ergoterapi Bölümü, 0312 305 2560/120, orkunaran@gmail.com.
[2] Zeynep BAHADIR AĞCE, (Atlas Üniversitesi, Sağlık Bilimleri Fakültesi Ergoterapi Bölümü, (0216) 400 2222 4063, fztzeynepbahadir@gmail.com

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Introduction

Stroke is one of the main causes of chronic disability world-wide which approximately 16 million annually and 62 million survivors live with its consequences (Mukherjee & Patil, 2011). It causes disability that affects an individual in many different aspects like motor, cognitive function and daily functioning and social participation (Mercier, Audet, Hébert, Rochette, & Dubois, 2001; Warlow, 1998). These disabilities, on the other hand, may be the one of the important factors causing vehicle accidents. Thus, identifying factors associated with stroke may prevent vehicle accidents and/or provide significant information to prevent disability related accidents (Sasaki, Nogawa, Yamada, Kojima, & Kanaya, 2019).

Driving hazard perception (DHP) is one of the factors that might affect safe driving. DHP is the ability to determine and identify hazardous incidents while driving (Borowsky, Shinar, & Oron-Gilad, 2010; Wetton, Hill, & Horswill, 2011). Horswill and McKenna discussed that hazard perception is the most crucial component related to vehicle accident beyond many other driving related components (Horswill & McKenna, 2004). While DHP is too important for vehicle accidents, DHP is assessed while the examinee watching videos which were filmed on the road including several hazardous incidents, and points out these hazardous incidents. The one other way to assess DHP is to use driving simulations and observe the examinee while driving in a simulated environment (Wetton et al., 2011).

It was shown that hazard perception and training to anticipate hazards improve the performance of experienced drivers. Additionally, individuals with brain injuries have been found to have reduced hazard perception skills (Dimech-Betancourt, Ross, Ponsford, Charlton, & Stolwyk, 2020). However, the relation between cognitive skills and driving hazard perception knowledge is limited in the literature. A stroke may affect individuals in many different ways, and these effects might include motor, cognitive and affective skills. On the other hand, the affection of these areas might affect driving negatively which is a complex activity. Therefore, in this study, it was aimed to investigate the DHP of stroke survivors' and its relation to cognitive skills of who was still driving after stroke.

Material and Methods

Participants

Twenty-one participants with stroke were included to this study. All participants were informed about the study, and written and signed consent form was obtained from all participants. *World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects"* was followed in this study, and ethical board

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approval was received from local university non-conventional ethics board (Üsküdar University Non-Conventional Ethical board approval number: 61351342/ 2020-685). Participants who was older than 18 years old, had at least 23 minimum score from Mini Mental State Test, was literate, had a stroke at least one year before the initial assessments, and continued to drive his/her own vehicle after stroke were included to the study. Participants with vision problems, additional neurological diagnosis, no driver license, had spasticity above 2 according to Modified Ashworth Scale in biceps brachii and wrist/finger flexors, and who was not driving at least one year, were excluded from the study.

Assessments

A sociodemographic information form including age, gender, stroke onset, active driving period and number of accidents, was used to gather descriptive information of the participants. After obtaining socio-demographic information Hazard Perception Test (Theory Teaching, 2002), Trail Making Test Part B *(Trails B)* (Reitan, 1958) and Clock Drawing test were used.

Hazard Perception Test (HPT) is an online test which includes different traffic occasions to evaluate the examinee's perception of hazard and risk while driving (Theory Teaching, 2002). HPT includes 14 different video clips and each clip has 15 developing hazards for examinee to find. Each video clip lasts 1 minute in order to complete. Video clips in the HPT includes 13 common hazard types which are zebra crossings, pedestrians (young and children), pedestrians (elderly), pedestrians (adults), cyclists and motorcyclists, animals, vehicles (moving off and pulling up), vehicles (meeting), vehicles (emerging), vehicles (about to turn), vehicles (reversing and U-turns), larger vehicles and vehicles with flashing lights. For each video clip, examinee requires to click with a mouse on the hazardous occasion. Scoring of the test is being calculated via online test tool; a higher score is obtained when the examinee reacts in the first segment (just as the potential hazard starts) and the score gets lower if the examinee reacts slower and/or clicks on the wrong occasion. For each video clip 5 is the higher score while 0 is the lowest.

Trail making Test B (Trails B) is a cognitive assessment test which assess executive functions, visual-perceptual and visual-motor tracking (Reitan, 1958). The trail making test consists of two parts; Part A and Part B. Part A requires examinee to draw lines between consecutive numbers between 1 and 21; Trails B requires examinee to connect a series of numbered and lettered circles, alternating between one number and one letter (1-A, 2-B and so on). Trails B recently is being used for off-road assessments of driver evaluations and related

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studies and its sensitivity to determine risk of driving was evaluated by Classen et al (Classen et al., 2008; Classen, Wang, Crizzle, Winter, & Lanford, 2013). Classen stated that Trails B is an accurate screening test to predict on-road assessment outcomes. The cut-point for Trails B of 106.7 seconds showed 76% sensitivity and 67% specificity. Turkish validation and reliability of the test was found excellent (Dugbartey, Townes, & Mahurin, 2000).

Statistical Analysis

SPSS 23.00 software was used to analyze data. Quantitative data were described with mean ± standard deviation (X±SD), qualitative data were described with percent (%) values. Normality of data was evaluated with visual (histogram and stem-leaf plots) and analytic (Kolmogorov-Smirnov/Shapiro-Wilk tests) methods. Significance was set an alpha level of 0.05. Bivariate correlations test was used to investigate the relation between hazard perception and cognitive functions (correlation coefficients were ranged between; 0.20-0.39: poor correlation, 0.40-0.59: moderate correlation, 0.60- 0.79: strong correlation, 0.80 and above: excellent correlation). Additionally, one sample T test was used to determine whether or not the Trails B test results differ from the 106.7 seconds cut-off score.

Results

Twenty-one participants (2 females, 19 males) with stroke participated to the study. The mean age of the participants was 59.42 ± 11.07 years. Of the 21 participants 19 had an wrist flexor spasticity (1+), 16 had biceps brachii spasticity (1), and all of the participants had spasticity at finger flexors (1+). Demographic information of the participants was represented in Table 1.

Participants had 30.52 ± 18,2 (min: 6, max: 65) mean scores from HPT in which higher scores indicated better hazard perception. Also, Trails B mean values were 165,38 ± 89,94 (min: 65, max: 347) seconds. Bivariate correlations indicated HPT and Trails B had statistically significant negative excellent correlation ($p<.05$, r: .89). Additionally, one sample T test indicated Trail B scores were statistically different and higher from 106.7 seconds cut-off score ($p<.05$).

Table 1. Socio-demographic characteristics of participants, Trails B and HPT scores

Gender (n(%))	2 female (9%) 19 male (91%)
Age (mean ± SD)	59.42 ± 11.07 years
Dominant extremity	21 right sided (%100)
Hemiplegic side (n(%))	14 left side (66%) 7 right side (34%)
Time after stroke onset (mean ± SD)	54.7 ± 8.7 months
Driving license availability (mean ± SD)	24.6 ± 4.3 years
Total number of car accidents (mean ± SD)	0.8 ± 0.6
Trails B (mean ± SD)	165.38 ± 89.94 seconds
HTP (mean ± SD)	30.52 ± 18.2

SD: Standard deviation, Trails B: Trail Making Test Part B, HTP: Hazard Perception Test

Discussion

This study investigated driving hazard perceptions and its relation to executive functions, visual-perceptual and visual-motor tracking. In this study, participants had late responses to potential driving hazards and executive functions, visual-perceptual and visual-motor tracking.

Hazard perception is one of the crucial skills related to the crash risk (Horswill, Hill, & Jackson, 2020; Horswill & McKenna, 2004; Sagberg & Bjørnskau, 2006; Sasaki et al., 2019). Nagayama et al. suggested that 50% of the all collusions in road traffic arise from missing or delayed hazard perception (Nagayama, 1978). Horswill and McKenna stated that hazard perception required higher level of cognitive functioning (Horswill & McKenna, 2004). Stroke is a condition has many consequences as cognitive, social, motor etc., and these consequences were known to alter driving skills (Mukherjee & Patil, 2011). Xue and Wen found significant correlations between significant traffic risks and driving hazard perception in stroke survivors (Xue & Wen, 2020). Cho et al. examined perceived and actual driving hazards are related with each other, the research results indicate that higher actual crash risk increases perceived driving hazards, while higher perceived crash risk is negatively associated with actual crash rates (Cho, Rodríguez, & Khattak, 2009). One study found that road types also affect the hazard perception of the stroke survivors; in which roads with horizontal curves and narrow lines associated with over-rated risks, while intersections and roadside hazards correlated with high perceived risk (Xue & Wen, 2020). The test environment used in this study included city areas, which included

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sudden pedestrian movement, traffic lights, inappropriate parked cars etc. These conditions might lead the participants to fail or delay responses. Aslo, our findings were similar with current literature findings; hazard perception of the participants delayed because of the consequences of the stroke. We believe that cognitive function and visual function related to cognition might be the result of the late responses of our participants.

One of the general consensuses on cognitive ability after stroke is that cognitive dysfunction decline seen in stroke patients was alteration of visual information processing speed and capacity, which of those were found related to safe driving skills (Dawson, Anderson, Uc, Dastrup, & Rizzo, 2009; Hurford, Charidimou, Fox, Cipolotti, & Werring, 2013; Su, Wuang, Lin, & Su, 2015). Lodha et al showed that decreased cognitive functions and motor functions also negatively affect break time and driving safety (Lodha, Patel, Shad, Casamento-Moran, & Christou, 2021); in addition to that Kwak and Yoo showed that cognitive functions is a good predictor for driving of stroke patients (Kwak & Yoo, 2020). Trails B is a test that assess executive functions, visual-perceptual and visual-motor tracking (Reitan, 1958) which was high for the participants of this study (above 106.7 seconds (Classen et al., 2013)) . Also, it was found that Trails B scores and HPT scores were correlated. This result was an expected result regarding previous literature and we also contributed supportive data for the literature. We believe, visual perception skills should be implemented into intervention strategies to increase the perceptions of drivers with stroke for hazardous enrollments.

This study has several limitations. First of all, driving hazard perception was evaluated in simulated/computerized environment. The current literature still discusses the positive and negative aspects of assessments in simulated environment. It is known that simulated environments can provide safe assessment environments. On the other hand, the findings of simulated assessments may not be generalized and may not reflect real life situations. The second limitation is the distribution of the participants. We included participants with decent motor and cognitive functions. However, it is suggested to include participants with significant cognitive and motor dysfunctions, and analyze the effects of these dysfunctions on driving ability and hazard perception.

The number of traffic incidents in Turkey is above 1 million incidents per year (Turkey Statistical Institute, 2020), and it is much higher than developed countries, which indicates driving is riskier than other countries in Turkey. In addition to that having a disability such as hemiplegia, might increase the risk of traffic crashes. We believe that determining the cognitive, motor skills of disabled drivers are important. In addition to that, the examiners should keep in

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mind that hazard perception is also negatively affects safe driving. Hazard perception is one of the most crucial skills that directly related to the crash risks. Clinicians and researchers should consider training visual perception skills and hazard perceptions of stroke patients; because hazard perception should not only be related to driving but also related to pedestrian and community safety.

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Declaration of Interests

None declared.

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