

## Schizophrenia and vehicle driving: a systematic literature review

### Esquizofrenia e direção veicular: uma revisão sistemática da literatura

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**ABSTRACT: Introduction:** The diagnosis of schizophrenia has, over the years, gone through a historical process of transformation under the eyes of society. In this context, schizophrenia is seen as a degenerative disease, characterized by progressive dementia, with global impairment of the patient's functions and cognitive decline, generating, very commonly, a life marked by prejudice and exclusion, including in the area of mobility with respect to vehicle driving. Concomitant to these data, there is a shortage of research on traffic accidents involving drivers with schizophrenia, although some studies point to a higher potential risk factor. **Objective:** The objective of this review was to collect information from the studies in the literature about the patient with schizophrenia and vehicle driving, seeking to answer if they may or may not be allowed to drive from the results of mental / psychological examination. **Methodology:** A systematic review of the scientific literature on the relationship between schizophrenia and vehicle driving was carried out. **Results:** There are studies that suggest a greater number of traffic infractions and traffic accidents in schizophrenic patients, but these data are not observed by other authors. These contradictory findings may be due to different research designs. There was a greater tendency for distortion of visual feedback among the patients in relation to the general population, in addition to sensory processing errors. Schizophrenics who drove were better at mental state examination than schizophrenic non-drivers. The accident rates found were very similar in the groups of patients with psychotic disorders and control group. In addition, their injury rates can be equated with the general population. **Conclusion:** With the data presented, the relationship between schizophrenia and cognitive impairment becomes evident. However, the studies traced did not allow the solid assessment of these mental losses, neither to demonstrate their impact on vehicle driving. In short, a more accurate investigation of these patients is shown to be of extreme importance, so they are not unduly impeded from exercising the act of driving. As more studies appear, the Traffic Medicine professionals will have more theoretical basis in their mental evaluation.

**KEY WORDS:** Schizophrenia; Automobile driving.

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## INTRODUCTION

The diagnosis of schizophrenia has, throughout the years, gone through a historical process of transformations under the eyes of society. Its description was introduced at the end of the 19<sup>th</sup> century, when Emil Kraepelin noticed some patients presented a syndrome with common manifestations, similar to dementia, and named this entity “dementia praecox”. Later, Bleuler (1857-1939) presented the term “schizophrenia” (schizo = division, phrenia = mind), and, through specific symptoms such as hallucinations, delusions, loose associations, ambivalence, autism, and affective alterations, gave way for many others to trail an obscure and doubt-filled path regarding its causes, prognosis, and treatment<sup>1</sup>.

As a result of many scientific studies, the DSM-V was described and delineated to visualize the great human issues with a dimensional rather than a classificatory approach, applying a widely comprehensive view to schizophrenia. In this sense, this disorder includes patients with alterations in one or more of the following domains: delusions, hallucinations, disorganized thought, grossly disorganized or abnormal motor behavior (including catatonia), and negative symptoms, such as anhedonia, apathy, social withdrawal, and affective blunting. The previously presented subtypes (paranoid, hebephrenic, residual, indifferent, and catatonic) were eliminated in this new version of the DSM, since they presented little limitation of the diagnosis, with low reliability and without significant differences in response to treatment or change in the course of treatment.<sup>2</sup>

Exactly because the condition is so heterogeneous, one may find patients in varying degrees of functional impairment, for example in work, interpersonal relations, self-care, and the academic field. Schizophrenia is currently seen as a degenerative disease, presenting progressive dementia, with global functional impairment and cognitive decline, very frequently producing a life marked by prejudice and exclusion<sup>3</sup>.

Factors that are known to contribute to such a bad prognosis are: early age of onset, diverse hospitalizations, prevalence of negative symptoms, and low social level<sup>4</sup>.

Seemingly, the prevalence of schizophrenia is between 0.3 and 1%, and may vary among countries. The peak age of onset for males is between 18-25 years, and, for women, between 25-35 years; the onset before puberty and after 50 years of age is rare<sup>5</sup>.

It is verified that schizophrenia brings a potential decline in cognition, altering to a greater or lesser extent psychopathological instances, especially voluntary and spontaneous attention, psychomotricity, sense perception, and judgment of reality. Another aggravating factor is that it is a chronic and progressive disease that generally affects people from youth, when they were

supposed to represent the productive machinery of the social economy, and who are frequently deprived of their own generation's activities and interests, for example, going to college, socializing in parties, having a career and driving independence.

These people in the schizophrenia spectrum may present cognitive and behavioral alterations in varied degrees, depending on the nature of the disease, its characteristics, duration, the severity of the symptoms, use of psychotropic medication, clinic and psychiatric comorbidities, and social environment of belonging. These variables tend to compromise, in a permanent manner, their driving performance<sup>6</sup>.

In the activity of driving a vehicle, one must use their perception of external stimuli, interpretation of situations, rapid decisions, planning and execution, speed of feedback processing, attention, visual-perceptive-spatial dominium, work memory, among others<sup>7</sup>.

Concomitant to these data, there is a shortage of studies investigating automobile accidents involving schizophrenic drivers, although some studies suggest a greater potential risk factor<sup>8</sup>.

Besides the disorder's significantly heterogeneous clinical conditions, which alone may make the standardization of the risk at vehicle driving more difficult, there are other variables that increase the complexity of this clinical universe. It is important to remember that psychotropic consumption, especially if regular and prolonged, may secondarily impair driving performance. It becomes extremely difficult to differentiate the impact of the illness from the effects of the drug<sup>9</sup>.

There are also clinical and therefore cognitive differences between the moments of crisis in schizophrenia and the periods of stability. Some patients recover almost completely, and once out of the psychotic break resume their routinely activities, having regained their capabilities. Others, conversely, carry these impairments for persistent periods of time<sup>10</sup>.

However, some studies suggest that there is a greater number of car accidents and traffic infractions involving schizophrenic patients in comparison to the non-psychiatric population<sup>11,12</sup>.

In this sense, the psychological evaluation is seen as essential, since it verifies the cognitive processes, as well as the candidate's behavior, through the analysis of traits of personality, emotional control, impulsiveness, self-reliance, tolerance to frustrations, auditory and visual memories, control of aggressiveness, interpersonal relationship, fluency of thought, phobic signals, among others<sup>13</sup>.

In spite of this, according to the most recent Resolution of CONTRAN No. 425 (National Traffic Council), the psychological evaluation is only required for acquiring the learner's permit, an addition and/or change of category, and in the occasion of renewal of the

national driver's license for the conductor that has a paid economic activity involving vehicle driving<sup>14</sup>.

In this context, the medical evaluation by a non-specialist, exclusively, has empirically proven itself insufficiently sensitive and specific for the mental exam, whose techniques have not been conclusive with respect to driving capability, perhaps due to the lack of expertise and education in the specific field.

In many situations, help is sought from specialists' reports and/or from medical and psychological boards in order to answer these questions. However, the number of evaluations requested is significantly smaller in comparison to the proportion of people with psychiatric disorders, denoting a great number of patients not identified by the examiners<sup>15</sup>.

Even if the act of driving is considered something complex, multifactorial, that demands cognitive abilities and experience from the driver, the fact is that around 43% of middle-aged and older schizophrenics have a driver's license and actively drive<sup>16</sup>.

The permission to drive has an important role in collective mobility, with respect to health, well-being, participation in the community, social networks, work, source of income; inserting man into society<sup>17</sup>.

In this way, a more profound understanding of schizophrenic patients is needed in their mental/psychological evaluations in order to allow them to drive, and thus improve their social inclusion, but in a grounded, secure manner, minimizing the risks for themselves and others involved in the traffic.

The goal of this bibliographical review was to

collect studies in the literature that bring information about schizophrenic patients and vehicular driving, aiming to answer if they may or may not be allowed to drive from the results of the mental/psychological exam. The aim is to contribute to the physical and mental aptitude exam for drivers and candidates for obtaining a driver's license.

## METHODOLOGY

A systematic review of the scientific literature on schizophrenia and vehicular driving was performed. The present review was based on research in the following databases: PubMed, BVS (Virtual Library in Health), and Scielo (Scientific Electronic Library Online). There was no restriction as to the period of publication.

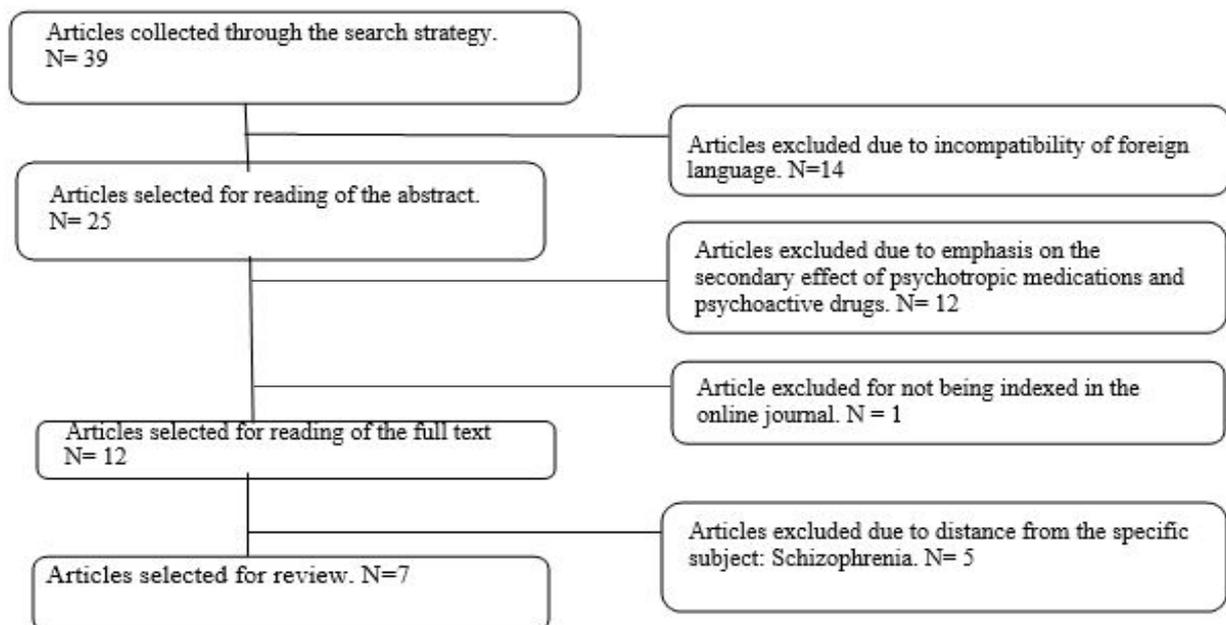
The following subject descriptors were used: *automobile driving; schizophrenia*, according to the Mesh terms (Medical Subject Headings).

The criteria for selection of the studies included: 1. Original and empirical studies. 2. Studies in scientific periodicals. 3. Studies in English, Portuguese, and Spanish.

The following criteria for exclusion were established: 1. Studies that gave greater emphasis to the secondary effect of psychotropic medications and psychoactive drugs. 2. Researches that were not focused on the elected psychiatric disorder (Schizophrenia).

There was no search for non-published studies. Only one author decided on the articles to be included/excluded, read them, and analyzed the data.

### Strategy for Search and Selection of Articles



## RESULTS

### Methodology for comparison of the selected studies

With the selected articles, it was verified that most of them consisted of observational studies (6), being 1 a review and the other 5 cross-sectional studies. Only 1 study proposed an experimental measure. Thus, in their majority, it becomes impossible to determine the causal proof. They supply, however, a good source of hypotheses.

Besides this, they have samples with a variable N, not always reflecting the real population.

### Objectives of the researches found in the literature

In their totality, the researches tried to establish relations between schizophrenia and driving capacity/performance. Once a correlation was found, they attempted to analyze some discovered aspect.

There were studies that investigated the issue of the functional status, exploring other domains such as labor activities, personal independence, and individual mobility<sup>16,18</sup>.

Two other articles had as their main objective the specific evaluation of some mental attributions involved in the act of driving, for example, visual perception, mental state, memory, visual organization, motor response, and recognition of reality through sense perception<sup>19,20</sup>.

The present literature review has the purpose of illustrating how psychological tests and evaluations may translate and give aid in the choice of which schizophrenic patients may have the right to drive automobiles<sup>15</sup>.

### Epidemiology of the schizophrenic patient

A study found that the greater the number of psychiatric hospitalizations, years of illness and consequently greater decrease in the patient's global functioning, the smaller their chances of active vehicle driving. In spite of this information, 32% of the patients answered having driven motor vehicles in the last 12 months. 64% had a driver's license. Another relevant data found was that only 31.3% had a car, in contrast with the general population (50.6%). Moreover, the motorized patients answered driving a mean 4,160km/year and the general population 14,200km/year, showing there is a social limitation involved<sup>18</sup>.

Another research shows that 43% of patients with psychotic disorders had a license to drive. There was also a smaller number of people who drove with their license suspended, in comparison with the general population<sup>19</sup>.

### Impact of Schizophrenia on Driving

In Ferreira e Simões' study<sup>15</sup>, the most representative

errors observed among schizophrenic patients were a greater difficulty in lateral control of the vehicle and in speed regulation. Moreover, the authors mention that some studies suggest a greater number of traffic infractions and road accidents among schizophrenic patients, although this difference was not observed elsewhere. This leads to the conclusion that systematic studies between neuropsychological tests and driving capacity are needed, seeing there is divergence between the studies.

With respect to the studies that evaluated cognitive and global functioning, the patients showed a tendency to distort visual feedback in relation to the general population, as well as mistakes in sensorial processing<sup>20</sup>.

With the classic neuropsychological test ROCF (Rey-Osterrieth Complex Figure Test), it was verified that healthy individuals performed significantly better, however schizophrenic drivers were better in the mental state exam than schizophrenics who did not drive. The results demonstrated that impairment in the visual abilities does not impede schizophrenics driving, and emphasizes the importance of the general cognitive state for everyday complex chores such as driving a vehicle. Thus, the study reinforces the need for more studies to reach conclusions and recommends Minimental as a general cognition test<sup>19</sup>.

When submitted to driving simulators, the patients exceeded the limits of the white line that separates the lanes ( $p < 0.05$ ) and presented a greater tendency to cross the central line with a frequency greater than the general population ( $p = 0.06$ ). Additionally, patients presented 2.5 times greater chances of involvement in collisions ( $p = 0.09$ ). On the other hand, patients with schizophrenia drove at significantly lower speeds ( $p < 0.05$ ), possibly as a means of compensating for cognitive impairments. Considering  $p$  statistically significant when  $< 0.05$  and that it was not clear if a driving simulator supplied real data on human driving ability, the small sample of patients did not lead to an appropriate conclusion, being thus suggested at the end further studies<sup>22</sup>.

It is important to note that the rates of accidents were almost identical in the groups of patients with psychiatric disorders and in the control groups, and furthermore that the rates of accidents with injuries involving drivers with psychiatric disorders can be equated with those of the general population. No patient with schizophrenia showed attempt to escape with their vehicle after collision, denoting ethical behavior<sup>21</sup>.

### Schizophrenia X Other Psychiatric Diseases

Other psychiatric disorders have a more expressive impact on bad driving behavior in comparison to Schizophrenia. Among these mental disorders, the Anxious (former neurotics) and Personality disorders have rates of accidents 49-114% higher than the control population. In relation to traffic infractions, the patients with anxiety disorders contribute with 135% and those with personality

disorders with 167% more than the general drivers. Conversely, schizophrenics have a rate of infractions 59% higher than the control group<sup>22</sup>.

It is worth noting that patients with personality/ anxiety disorders can be, in their majority, functional, have a good socio-economical position and, from the psychopathological point of view, many times pass unnoticed in a medical or even psychological exam.

In the case of the anxiety disorders, these may be expressed in the form of crises, which will not necessarily be present during contact with the examiner. The personality disorders may come with psychotic breaks, aggressive outbursts, anger, and explosive behavior, which are frequently found in situations of frustration regarding interpersonal relations. These are situational symptoms, that may also be absent at the moment of the physical and mental aptitude exam for obtaining the National Driver's License.

**Schizophrenia X Clinical comorbidities**

A study evaluated that, with respect to deaths

during driving, 44 to 88% are caused by arterial coronary disease. In the necropsy of patients who died driving, two thirds presented at least one coronary artery with a lesion of 75%. This reinforces sudden death as one of the main causes of fatal accidents in traffic<sup>23</sup>.

In a multi-centered study performed in four Brazilian capitals (Salvador, Recife, Curitiba, and Brasília) in emergency services (1169 victims) and in legal medical institutes (45 fatal victims), among the patients who had been involved in traffic accidents, 63.5% of the men had positive blood alcohol content and, of these, 33.5% had alcohol content superior to 0.6 g/l, and 53.7% of the women showed positive blood alcohol content, 9.6% of which above the limit established by the Brazilian Traffic Code<sup>24</sup>.

Despite the lack of consistent data on the prevalence of serious and fatal accidents related to schizophrenic patients in the literature, the studies show they are equated to those of the general population. Their dimensions are much less relevant in comparison to other morbidities such as sudden death, acute coronary disease, epilepsy, and use of alcohol and driving.

**Table 1.** Collected studies on Schizophrenia X Vehicle Driving and their main findings

Sources	Country of origin	Study design	Objectives	N of the study	Main Findings
Steinert et al., 2015	Germany	Cross-sectional	To explore individual mobility patterns and predictors of motor vehicle use in a representative population sample with schizophrenia in urban/ rural area.	N=150 (hospitalized and ambulatory patients)	-The lower the social functioning and greater the No. of hospitalizations and past history of driving under the effect of alcohol and drugs, the smaller the chances of active driving. -People with schizophrenia do not seem to represent a relevant portion of the road accidents.
Palmer et al., 2000	USA	Cross-sectional	To explore three domains of the functional status of schizophrenic middle-aged and older patients who live in therapeutic communities: labor life since the onset of the disease, current independence, and driving status.	N=83 schizophrenics N=46 control group	-Patients had a smaller propensity to drive and to have a driver's license; they had a worse neuropsychological performance and functional capacity. -Among the schizophrenics, the drivers were predominantly of the paranoid subtype. -The negative symptoms were connected to greater severity in relation to the functional status.

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Sources	Country of origin	Study design	Objectives	N of the study	Main Findings
Ferreira, et al., 2015.	Portugal	Literature Review	To document empirical investigation data concerning psychological tests for prediction of driving activity in people with neurological or psychiatric diseases and to contribute to raising awareness, among physicians, about the utility of a differentiated psychological evaluation in the clinical examination of drivers.	36 articles	<ul style="list-style-type: none"> <li>-There is a lack of empirical data on the relation between psychiatric diseases and driving capability.</li> <li>-Difficulties in the control of the variables of confusion.</li> <li>-Some studies suggest a greater No. of traffic infractions and accidents among schizophrenic patients in comparison to the general population, although this difference was not observed by the other authors.</li> <li>-Systematic studies on the relation between neuropsychological tests and driving capability in people with psychiatric diseases are needed.</li> </ul>
Velikovskiy et al., 2012	Israel	Cross-sectional	To know if visual perception, mental state, and memory affect driving aptitude in people with schizophrenia in the same way as in other populations.	N=60	<ul style="list-style-type: none"> <li>-ROCF (classical neuropsychological test) revealed that the abilities of healthy individuals were better than those of schizophrenic patients.</li> <li>-Impairment of visual abilities do not impede schizophrenics from driving; emphasizes the importance of the general cognitive state for driving.</li> <li>-More in-depth studies are needed on the subject.</li> <li>-A general cognition test is recommended (Minimental) as a driving aptitude test.</li> </ul>
Posada et al., 2006	France	Cross-sectional	To evaluate the recognition and attribution of actions for differentiating the real from the virtual, in the sense of evaluating driving impairment in schizophrenia.	N=30	<ul style="list-style-type: none"> <li>-An impaired processing of the basic aspects of a visual stimulus was observed among the schizophrenic patients, expressed by their difficulty in discriminating their own movements from other movement stimuli-Complementary studies are needed.</li> </ul>

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Sources	Country of origin	Study design	Objectives	N of the study	Main Findings
Germain, et al., 2005	USA	Case-control	Answering about driving capability in schizophrenia, seeing that the majority of the population with schizophrenia lives and possibly drives in the community.	N=12schizophrenics N=25controlgroup	-In spite the small sample and lack of real data, the patients exceeded the limits of the white line on the lane more than the control population (p<0.05) and tended to cross the central line with greater frequency (p=0.06). -Patients showed 2.5 times higher chances of getting involved in collisions (p=0.09). -Individuals with schizophrenia drove in lower speeds (p<0.05), probably to compensate for their cognitive impairments. - More complementary studies are needed in the field.
Crancer, et al., 1969	USA	Cross-sectional	To determine if there is any correlation between mental disorders and driving performance, and to analyze the nature of the correlation, once it is found.	N=271 psychiatric patients, being 97 with psychotic disorder	-Of the patients with a psychotic disorder, 43% had a driver's license. -Accident rates were almost identical in the groups with psychotic disorders and in the control population. -Infraction rates were a little higher among patients with psychotic disorders than in the general population. -Accidents with injuries were equated to the rates of the general population. -More studies are needed.

## DISCUSSION

The patients show extremely heterogeneous clinical conditions, in addition to their comorbidities, which exert distinct influences on cognitive and psychomotor functioning, leading to different possibilities in driving behavior.

Beside the complexity per se of Schizophrenia in its symptomatic spectrum, it is worth remembering the impact of psychotropic medications, and associated use of alcohol and illicit drugs, very commonly found in mental disorders in general.

Considering the important role of mobility in

health, well-being and social participation, it would be of extreme importance to perform in-depth studies on this subject, systematized, with bigger population samples and more tests applied.

In the practical scenery, the physical and mental aptitude exam works as a “stamp” identifying “schizophrenic”, and this individual is immediately labeled as inapt. In this sense, improvements on stratification of the severity of the psychotic disorder and its neuropsychomotor impact on driving are necessary.

There is a false idea that every schizophrenic patient is criminally unimputable before the law; such a fact would be in disaccord with law No. 9,503, article

140 of the Brazilian Traffic Code, in which it is stated that the candidate must be criminally imputable to have the right to drive a motor vehicle<sup>25</sup>.

In this manner, the need is denoted for more accurate clinical examination and investigation at the moment of the physical and mental exam of the candidate in question. For this it is suggested:

- 1) The patient who declares having schizophrenia in the questionnaire for obtaining or renewing the driver's license must present complementary exams with a report and favorable evaluation from a specialist, in this case from the psychiatrist who assists in the person's treatment;
- 2) A standardized report could be made for use by the psychiatrist, with relevant questions such as age of onset of the disease, number of psychotic breaks, previous hospitalizations, presence of negative symptoms, use of psychotropic medication, exam of mental state, cognitive and social impairment;
- 3) The performance of neuropsychological tests is suggested for patients with psychotic disorders, in order to estimate psychic impairment;
- 4) As in the case of physical deficiencies, the presence of a technical medical board accompanying these patients in practical driving

situations would be of the utmost importance, in order to scale out their capacities in diverse scenarios.

5) Ultimately, in the case of aptitude for driving, the expiration date for the national driver's license could be reduced, for example, to one year, for periodical evaluations and to thus establish an idea of the evolution and progression of the disease.

6) Driving simulators could be used in these cases as a complementary instrument for cognitive evaluation.

## CONCLUSION

Considering the exposed data, the relation between Schizophrenia and cognitive impairment becomes evident. However, the reviewed studies did not allow the solid assessment of these mental losses, neither the demonstration of their impact on vehicle driving. In short, a more accurate investigation of these patients is shown to be of extreme importance, so they are not unduly impeded from exercising the act of driving. As more studies appear, the Traffic Medicine professionals will have more theoretical basis for their mental evaluation.

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**RESUMO: Introdução:** O diagnóstico de esquizofrenia vem, ao longo dos anos, carregado de um processo histórico de transformações sob o olhar da sociedade. Nesse âmbito, a esquizofrenia é vista atualmente como doença degenerativa, de caráter demencial progressivo, com prejuízo global de suas funções e declínio cognitivo, gerando muito comumente, uma vida marcada por preconceito e exclusão, inclusive no âmbito de mobilidade no que se diz respeito à direção veicular. Concomitante a esses dados, existe uma escassez de trabalhos de investigação sobre acidentes de automóveis em condutores portadores de esquizofrenia, apesar de alguns estudos apontarem no sentido de maior potencial fator de risco. **Objetivo:** O objetivo desta revisão bibliográfica foi levantar estudos na literatura que tragam informações acerca do paciente portador de esquizofrenia e direção veicular, buscando responder se podem ou não ser liberados através do exame mental/psicológico. **Método:** Realizou-se uma revisão sistemática da literatura científica sobre a relação entre esquizofrenia e direção veicular. **Resultados:** Existem estudos que sugerem um maior número de infrações às regras de trânsito e acidentes de viação em pacientes esquizofrênicos, porém esta diferença não fora observada por outros autores. Houve uma tendência de distorção de feedback visual nos pacientes em relação à população geral, além de erros de processamento sensorial. Esquizofrênicos que dirigiam apresentaram-se melhores no exame do estado mental que esquizofrênicos não motoristas. As taxas de acidente encontradas foram quase idênticas nos grupos de pacientes com transtornos psicóticos e controle, e que além disso, taxas de acidentes com lesões podem ser equiparadas com as da população geral. **Conclusão:** Diante dos dados expostos, fica evidente a relação entre esquizofrenia e prejuízo cognitivo. Porém os estudos traçados não permitiram exercer com solidez a aferição destas perdas mentais, e tampouco demonstrar o impacto na direção veicular. Em suma, torna-se de extrema importância investigação mais apurada destes pacientes, para que não sejam indevidamente impedidos de exercer o ato da direção veicular. À medida que mais estudos surgirem, os profissionais da Medicina de Tráfego obterão mais embasamento teórico em sua avaliação mental.

**PALAVRAS-CHAVE:** Esquizofrenia; Condução de Veículo.

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