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Fall as an extreme situation for people with mental disorders: a review

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Abstract

People with mental disorders are divided for categories based on aetiology of their disabilities. Intellectual disability is mostly born with neurodevelopmental disorder, while other mental disorders are acquired as a result of mental illness. Sometimes this both types mixed as result of one of another.

The aim of this study is generalization of knowledge about similarities between fall risk factors and motor behaviour of people with different type of mental disorders. Despite differences in classification and description in literature, individuals with those type of impairment have many common factors that can put them together in terms of fall risk analysis. From physiotherapist point of view, their cognitive and motor dysfunctions are mostly similar, which allows them to be put in the same high risk of fall group, despite separate analysis in literature. Alongside with common anti-psychotic drug treatment, which leaves extra-pyramidal side effects that affects motor functioning, people with mental disorders could be one of groups of the highest risk of injury or mortality caused by a fall, not to mention appearing of depressive symptoms and fear of falling.

Elderly with mental disorders could fall event more frequent that once a year. Necessity of hospitalization caused by a fall could take place up to 60% of population of people with intellectual disability. People with mental disorders under drug treatment are up to 70% more likely to fall.

Fall prevention programs could decrease fall risk and fall rates but effects of therapy are not everlasting and there is necessity to design good strategy for a life time for individuals with mental disorders to eliminate trauma from these extreme phenomena for them.

Key words: fall prevention • fall risk • mental disorder • mental illness • intellectual disability

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Introduction

On the most general level, fall can be defined as unintentional, sudden change from vertical to horizontal posture. Falling often lead to injury, that is why it is qualified in International Classification of Disease (ICD). Codes includes falls on the same or upper level, as well as others, unspecified falls. Falls results with collision with walls, furniture, ground or other objects or obstacles [1]. Although fall is commonly associated with an injury it does not necessarily leave physical trauma [2-4]. Even fairly safe fall, without any significant injury may lead to psychical trauma and cause fear of falling, with may decrease the quality of life for some people, especially for elders [5, 6].

For every person, there are circumstances, that may result in fall. Life cannot be predicted in every aspect, so even healthy adults may fall sometimes, although no one will put them in group of higher risk of injury caused by fall. From biomechanical point of view,

EFPA – "extreme form of physical activity are extreme sports, often classified according to the environment in which they are performed (water, land, air), extreme form of physical recreation as well as gainful activity or voluntary service, and all varieties of physical activity that meet at least one classification criterion of the feature associated either with extreme risk of injury or death, or extreme body burden with high level of effort, or extreme coordination difficulty" [36, p. 19].

Position – *noun* **1**.the place where a player is standing or playing **2.** the way in which a person's body is arranged [119].

Posture – *noun* the position in which a body is arranged, or the way a person usually holds his or her body when standing [119].

our center of gravity (COG) can shift beyond our plane of support to the point, where it is impossible to recover [7]. Differences between individuals lies in size of plane of support [8], ability to maintain centre of gravity in it [9] and recovering balance by returning COG into plane of support [10].

Falls could be caused by an external force like collision with object [11] or unexpected change of surface leading to tip or slip [12, 13]. There are also internal factors, that leads to impairment of motor abilities. Degenerative processes that comes with aging makes our musculoskeletal system weaker, making individuals loss their ability to recover after losing balance [14]. Impairment of nervous system causes locomotive disturbances. There is fair enough knowledge about falls and injuries for people without any impairment [15], which also gives enough knowledge about motor impairments, because it only changes biomechanics of an individual. Also there is significant and still increasing knowledge about acquired neurological diseases such as stroke [16, 17].

There are also comprehensive works about falls for people with different kinds of disabilities [18], but what lacks is comprehensive insight for people with mental impairment including both neurological and biomechanical approach.

Although term "mind disorder" does not exist in scientific literature, in terms of similarity cognition disorders connected with locomotion and motor aspects of that kind of disorders I put it as the highest level of generalization. Because at the beginning of every analysis intellectual disability is analysed separately from mental illness, no one puts in order similarities and differences of motor control of these two groups of the highest risk of injury caused by fall.

The main difference between those two categories of "mind disorders" is that intellectual disability is permanent and occurs since birthday. Mental illness is acquired, but there are many cases with both conditions occurs simultaneously [19].

According to World Health Organisation, intellectual disability or mental retardation is condition of arrested or incomplete development of the mind, which is especially characterized by impairment of skills manifested during the developmental period, which contribute to the overall level of intelligence, i.e. cognitive, language, motor, and social abilities [20]. Cognitive and motor dysfunctions are factors that puts people with this condition in the group of highest risk of injury caused by fall [21]. Mostly it is connected with lack of anticipation of consequences in situations, that may lead to a fall [22].

According to Diagnostic and Statistical Manual of Mental Disorder (DSM-IV), mental disorders or mental illness is a syndrome characterized by clinically significant disturbance in an individual's cognition, emotion regulation, or behaviour that reflects a dysfunction in the psychological, biological, or developmental processes underlying mental functioning [23].

The aim of this study is generalization of knowledge about similarities between fall risk factors and motor behaviour of people with different type of mental disorders.

Cognition dysfunctions and increased risk of a fall

Primary problem of people with mental retardation is inability to absorb new information or learn new skills in standard pace [24]. They are unable to understand some phenomena on certain level of complicity depending of extension of intellectual deficit [25]. Those deficits have origin in sensory and cognition dysfunctions. Inability to interpret correctly external stimulus or even receiving it correctly is the base of developmental disorders. Sensation, therefore cognition dysfunctions affects also vision of the world. Inability to be aware of danger that comes with certain actions or situations have two steps. Firstly, wrong or none sensory information about surroundings [26], and then inadequate interpretation of reality that leads to wrong choices of action [27]. During childhood people gather those information and skills from constant repatriations of different motor activities. During motor organization of a body, children fall a lot [28], but as motor skills and competition grows alongside with awareness of causes and consequences of a fall [10, 29] they develops sense of danger. Mental retardation prevents people from developing such competences [30].

People with mental illness without any intellectual deficit in a stable state have proper sense of danger. But during increased emotional reactions like mania in schizophrenia [31] or bipolar disorder and increased aggression during depression or anxiety disorder [32], they could perform dangerous actions without awareness of consequences because of bad or non-perception of reality, depending on stage of illness.

The third possibility is developing mental illness over intellectual disability. These phenomena can occur often [19], as people with intellectual disability have fragile mind and are more liable to stress [33]. This group is at highest risk a fall, as misinterpretation of reality is put on underdeveloped sense of danger and undertaking proper actions. Also during prolonged mental illness, intellectual abilities of a person could be decreased [34], disabling higher cognitive functions like abstract thinking, which puts them in a similar position in terms of being susceptible to fall as they have intellectual disability to begin with.

Cognitive deficits made people with mental disorders being prone to development fear of falling and revives greater trauma even when fall results with no injuries. Mental disability to handle emotions and stress during this situation is what qualified it as an extreme situation ("extreme situation" it is not a term eligible for, "extreme form of physical activity – EFFA" [35, 36], but contains common elements – see glossary).

Motor dysfunctions connected with mental disorder as a fall risk factor

Disturbances in neurodevelopment of a human is not only cognition and mental aspect, but also motor. Poor experiences and wrong organization of central nervous system leads to motor dysfunctions. Without proper feedback, motor learning is disabled in a same way as cognitive one. It diverse to two aspects. One is that without proper experiences which cause lies in inactivity or stereotype behaviour makes one's motor development narrow, without fully developed movements [37]. The reason of this phenomena lies in cognitive disorders. Lack of normal cognition abilities is connected with motor abilities [38]. People with mental disabilities often have problems with coordination. Bilateral or contralateral movement is limited. Also they have problems with crossing the middle line of the body with limbs or making circle movements [39]. Being unable to perform some movement voluntarily comes with limited possibilities of movement in extreme situation like a fall. They cannot defend themselves because the sensor-motor habit does not exist to begin with.

In terms of fall risk factors, more attention should be put on gait and balance. Main reason of fall caused by slip or tip is shortened step length and too wide plane of support with external rotation of lower limbs [40]. Short length of step is connected with inadequate rising of a foot in transition phase. It could cause a tip in a situation where healthy people will just omit obstacle. Also with sudden stepping on slippery ground to narrow step will make performing recovery step impossible. Poorly management of own balance is also connected with lower tension and strength of core muscles [41], so when centre of gravity is placed outside plane of support it is harder to maintain balance [42]. Sometimes even performing recovery step is not enough, and even taking some trials to maintain vertical position will result in fall [43]. The reason of that lies in worse than normal muscle activity level which is slower than normal [44]. So proper response from muscles will be delayed and they will not recover in time [45]. Lower muscle activity level goes with longer time of response and lower activation of motor units, so they cannot produce enough power from muscle in time or in general. Muscle will only have time to increase the tension but will not be flexible enough to make proper move [46]. It results in stiff fall, which is more dangerous than flabby or properly performed.

Poor coordination skills occur also in mental illness like schizophrenia, where changes in biochemical reactions in brain leads to dysfunction of motor skills. Sometimes slight changes in motor reactions and activity is even first sign of mental illness [47, 48]. Coordination problems is similar to those that was described above, so disturbances in contralateral and bilateral moves, and difficulties with crossing middle line of the body [49]. Bad representation of a body and movement makes difficulties in performing proper action as imaginary of movement in mind is different from reality [50]. So even proper cognition of a movement which should be adequate to situation could be not the one they want in reality [51, 52], so consequences could be fatal. After acute episode, when treatment started with medicaments, side effects of a drugs made normal movement difficult [53]. Pyramidal side effects make gait and movement Parkinson-like and impairs coordination, muscle activity level and even causes bradykinesia [54]. Those factors cause gait and balance disturbances which also causes shortening of step lengths and height of transition of step [55, 56]. The difference is that those side effects is reversible to some point, while gait and balance disturbances in intellectual disabilities can be decreased through physiotherapy but cannot be nullified. Physiotherapy and drugs withdrawal could be nullified to some point in mental illness as biochemistry disturbances in acute state

of mental illness could be reversed and regenerated partially [57]. But it can only occur when none of side effects of antipsychotic treatment will appear and that is very rare. Normally, throughout prolonged drug treatment, mind illness can be stabilized but motor side effect will be present and could be increased over time [58]. So the more time one person is mentally ill and takes drugs, the more is susceptible to motor and cognition side effects, as drugs is designed to calm nervous system with its activity, but it is not perfect [59]. So cognition aspect along with intellectual part is damaged as well [60]. Along with dyskinesia, some involuntary movements, stereotypical ones could appear in upper limbs [61]. It could be similar to movement of washing hands or clapping etc. It might have rigged conscious movement of upper limbs to defend from fall. Those side effects also affect time of muscle response [62], which is crucial factor of aligning the body to proper, safe body posture to absorb a damage caused by a fall.

Other mental illnesses like depression or anxiety disorders also leads to changes in cognition sphere [63]. It does not only affect mood, but changes in distribution of hormones in brain affects way of perception and motor skills [64]. Those two kinds of illnesses along with all similar varieties mainly leads to physical inactivity and sedentary lifestyle [65]. Prolonged inactivity weakens musculoskeletal system [66]. Changes in nervous system also decreased muscle activity level, which again delays time of response in extreme situations [32]. Also in case of those illnesses, drug treatment is necessary. Antidepressant drugs also may cause motor dysfunctions side effects which leads to similar consequences as those described in schizophrenia [67].

As well as in cognitive aspect, combination of mental illness with intellectual disability leads to the highest risk of injury cases. Not only there is no solid base of motor skills, but also mental illness made a necessity to apply medical treatment [68]. It causes underdeveloped motor system to be at risk of motor side effects of drugs, which cause more motor impairment despite improvement in mental sphere [19]. My place is not to judge any of this, just to make a point that current methods needs to be improved, because increasing mental performance for a period of time could result in fatal consequences when unpredictable situation as a fall might appear. Magnified motor impairment leads also to life inactivity which affects quality of life and as a result, making mental illness aspect worse [69].

Individuals with intellectual disability have increased difficulties with weight managements, which often leads to increased body mass or obesity [70]. Also anti-psychotic drug treatment often affects metabolism and leads to increased body mass [71]. Being overweight affect gait indicators and ability to perform motor actions as well as main disability, so it is increasing fall risk factor even more [27]. Also mental illnesses alone could cause increased body weight. Sedentary lifestyle and inactivity as a consequence of avoiding social interactions and normal daily activity causes slowness of metabolism and along with drug treatment may cause obesity [72].

The worse biomechanical profile of movement has elderly people with intellectual disabilities, mental illness or both [73]. Fragility, lower muscle mass and power, joint stiffness that comes with elder age for people who did not maintain proper physical activity [74].

Last factor of injuries during caused by fall is fragility of bones. It is caused by drug treatment [75]. Osteoporosis in elderly is common as result of a drug treatment. Along with other risk factors of a fall which eventually is unavoidable [76], fragility of bones made people more prone to injuries [77].

In terms of similarities in affecting cognitive and motor aspect of our life, “mind disability” in some cases could not be analysed separately. Dysfunctions, despite different aetiology leads to the same symptoms from physiotherapy point of view. Difficulties with learning and imitating movement for a therapist is similar. Differences lies in an extension of dysfunctions.

Epidemiology of falls and injuries among people with mental disorders

There are a few studies investigating falls among people with intellectual disability. Fallers ranging from 34% to 70% in their study populations [27, 77]. Other study has shown that adults with mild or moderate intellectual disability falls in 45% of cases and fall rate per one person is 1.00 a year [73], which on the other side, general elderly population have fall rate at a level from 0.45 to 0.65 per year [78-80]. Necessity of hospitalization due to injury caused by fall range from 20-60% for intellectual disability populations [81].

Studies involving people with depression are investigating falls among elderly. Elderly people with

depression falls at least once a year in a study population [82, 83]. There is high correlation between falls and depression [84, 85], as elder who falls cannot mentally recover for at least 5 months [86].

Studies about falls among individuals with anxiety disorders are commonly connected with depression and they are conducted on elderly population [87]. For people who suffered for anxiety disorder through at least once in his history, likelihood of occurring a fall is three times bigger than people without anxiety disorder history for male population [88].

There are almost none reports of fall related injuries for individuals with schizophrenia. At these group females are more prone to injuries and men are less in comparison to general population [89]. In general, risk of fractures due to a fall is increased among people who suffer from schizophrenia (5.54 for 1000 to 3.48 in control group) [75]. Some studies showed, that there is high association between schizophrenia and traumatic brain injury [90].

Many injuries due to a fall occurs during hospitalization as a consequence of acute state of illness. For hospitalized elderly with mental illness is above twice as big as in general population [91]. During different kind of daily activities during psychiatric hospitalization, individuals fall mostly when they get up, then walk or run, an at third place its bathroom-related falls [92]. So there is not even necessity to perform absurd motor action due to mental illness.

At the highest risk of fall are individuals with prolonged anti-psychotic drug treatment. Falls might occur in 78% of all individuals under drug therapy [93]. For individuals narcoleptic treatment, fall occurs more than three times often than in general population [94].

Polish scientist Roman Maciej Kalina designed *"the susceptibility test of the body injuries during the fall"* (STBIDF), which include three motor tasks [2, 4]. The results allows to predict which body parts are the most prone to injury during a backward fall. Although this test is not used as daily basic on the world yet, there were a few scientist who test different group of people to see level of susceptibility of body injury during a fall (SBIDF). Test score range from 0 to 14 points. There are four levels of SBIDF: low (0), average (1–3), high (4–8), very high (9–14).

Only practitioner martial arts showed average level of SBIDF, while less experienced showed high level [95] alongside groups of young teenagers (10-14 years old), teenagers with visual impairment [96, 97], adult amateur football players with amputation [98] and people with mental illness (mostly schizophrenia). Among tested groups, only people with intellectual disability showed very high SBIDF [99], which is empirical proof of theoretical basis presented in this paper.

Fall prevention programs for people with mental disorders

There are studies revealing effectiveness of fall prevention programs for peoples with intellectual disability. Mostly, interventions took place in fall clinics, where person is trained and taught about safe actions in a house and proper lifestyle combined with physical therapy and improvement in general health condition. This interdisciplinary approach could reduce fall rate by 23% in comparison to situation from before attending to fall clinic [100].

Most of fall prevention programs focus on improving strength, balance and gait parameters. A few weeks of intervention improves motor abilities of young people with intellectual disabilities [101]. For older adults with intellectual disabilities, physical fitness interventions could be beneficial in terms of reducing fall risk [102], but some scientists doubt that improvement of physical fitness is sufficient kind of intervention [103]. But all authors came to conclusion, that reduced value of fall risk last for about one year, and then it started to rise to initial level.

There are even less studies regarding fall prevention for people with depressive disorder. Studies have shown that fall prevention programs could reduce both fear of falling and fall rate [104]. There is correlation between reducing fall rates and depressive symptoms [105]. But psychological intervention did not eliminate fear of falling after dismiss ion form hospital [106]. Again, multifactorial approach proves to be the most effective.

Though searched databases, paper about fall prevention program for people with schizophrenia cannot be found. Fall prevention programs seems to be directed and elderly, and mental disorders are treated as co-occurring factor which needs to be taken to account, but it is not recognized as standalone problem [107, 108].

Last factor mentioned in previous part is anti-psychotic drug treatment. Proper changes of medicaments

could reduce fall rate up to 70% [109]. Other studies suggest that changes in vitamin D supplementation in older adults could not only improve bone density but also muscle strength and gait indicators, which may contribute to fall risk reduction [110].

Engineers also have found falls as important issue, so for other approach fall detection devices and fall prevention programs are designed for wearable devices [111] and smartphones [112]. But none of them have yet proven as a tool for reducing fall rates.

None of prevention program has proven to eliminate falls completely. So at some point, fall is inevitable for people who suffers for mental disorder, nor is for general population. Based on this paradigm, safe falls techniques based on martial arts was designed by Kalina [76]. Those techniques has been proven to be effective on population of young adults [113]. Moreover, it was proven, that elder person trained in safe falls techniques could behave better than young trained adult, whether there is a fall [114] or vertical collision [115] despite 40 years age difference. Other study shows that experienced adult judo athletes have significantly lower SBIDF indicator than non-practicing control group [116]. It indicates that safe fall training based on judo could greatly reduce risk of injuries during a fall in healthy adults. Although effectiveness of safe fall techniques for people with mental disorder is yet to be fully proven, there are some indicators that is might be effective [99]. Those techniques are based on teaching how to fall safely, so fall rate is not as important as to do not receive any injury or minimize it as a result of collision. That method is a part of concept of agonology (the science about struggle in preventive and therapeutic dimension [117]), which with actions by any ethical means leads one's to succeed in performed confrontation [118]. It fulfils the criteria of interdisciplinary approach to falls phenomena and it is promising concept of solving falls issue.

Conclusions

Injuries caused by fall affects people quality of life. The more risk factors occur, the more likely they would fall in some part of their life. Mental disorders, born with or acquired weakens one's defence system against injuries. In terms of fall phenomena all mental disorders are analysed separately, but analysis above points many common dysfunctions and problems with motor and cognitive abilities of all common mental disorders.

The biggest problems lie in finding the issue urgent to solve when it is too late to do so. Most of research is on elderly, with despite mental problems, have also body and health dysfunctions that's naturally comes with ageing process. Sometimes is hard to distinguish when the nature of motor impairment comes from. And above all, it is far too late to create a new habit, that will successfully protect individuals from harm caused by fall. Improvements in motor abilities gives temporary effects, but it is not everlasting. Proper medical intervention to optimize side effects or mental problems is necessary, but starting fall prevention alongside with teaching safe falls seems to be crucial.

Temporary effects of fall prevention therapy leads to conclusion, that individuals with high risk of fall and injury caused by it should be under constant stimulation that prevents such phenomena, so more awareness should be spread to governments, to create effective strategy alongside with physicians and fall prevention specialists to reduce cost of hospitalizations for this unnecessary phenomena that occurs far too often.

Conflict of interest

The author declares that has no conflict of interest.

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