Injury Prevention and Management of the Consequences of Falls in the School Environment and in Daily Life

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Abstract

School is one of the environments where many accidents occur, as children spend a very large part of their day there and come into contact with many other kids of the same age as well as with groups of different age. Individual self-protection, through educating minors to manage their bodies in such a way that in the event of a fall potential injuries are minimized upon landing, is imperative. However, whether children could be trained-through physical education classes—to know how to prevent a fall, to use the appropriate equipment each time, and to know how to fall safely, has not been the subject of scientific research (despite the fact that thorough studies on the use of safe fall techniques from judo in middle-aged and elderly people, without prior experience in combat sports, provide tangible evidence). Nevertheless, learning how to fall safely, so as to reduce accidents caused by falls in everyday school life as much as possible (both during physical education lessons and during recess in the schoolyard), is not an unachievable goal, but rather a feasible reality through specific teaching methodologies of falling techniques in combat sports (judo – pankration).

***Keywords:** fall, accident, combat sports, judo, pankration, physical education, physical education curriculum*

1. Introduction

Fall is defined as "a sudden, unintentional descent, with or without injury to the individual, leading the person to the floor, onto or against another surface, another person, or an object" (Benning & Webb, 2019). Falls are one of the main causes of injury-related hospitalizations and emergency department visits among children aged 0 to 18 years (Wang et al., 2017).

Falls can lead to a number of serious consequences for children, such as fractures (according to epidemiological data among youth aged 0 to 14 years, fractures of the lower limbs are mostly due to falls or slips), while others take place due to collisions, falls from height, or traffic accidents. Regarding the location where fractures occur, the most frequently recorded place is home, followed by the street and the school (Liu et al., 2018).

One of the places where many accidents are recorded is the school. This is natural, as a child spends a large part of the day there and comes into contact with many other children of the same or different age groups (Orton et al., 2016). According to data from the Center for Research and Prevention of Childhood Accidents (CEREPRI), during the six-year period 1996–2001, there were 23,000 school accidents in children aged 5–14 within the school premises, of which 60% concerned the age group of 10–14 years, while 66% involved boys. The majority of injuries (92%) occurred during school hours. The areas where they took place were the schoolyard (70% of injuries), the classroom (10%) and the stairs (7%). Injuries were mainly caused by falls (56%). Twenty percent of such events led to fractures, while regarding the outcome, 46% required treatment and re-examination, and 4% resulted in hospitalization (Karagianni, 2019). In a similar study on school accidents in 12 secondary schools during 2002–2003, 123 mishaps were recorded, 66.67% of which were due to falls and 11.38% to blows. In this study, the schoolyard was considered the most dangerous place (56%), followed by classrooms and stairs (11%). The most frequent incident occurred during recess (60%) and physical education (10.6%) (Syrou, 2014).

For the prevention of accidents in general (including those caused by falls), the solutions proposed so far mainly (and justifiably) concern the school infrastructure: school spaces, courtyards, staircases, gyms, common areas and classroom, which must meet all safety standards in order to reduce the objective risk factors for accidents among children. Indeed, infrastructure is very important and constitutes one of the causes of accidents, even serious ones, that occur during breaks or even during lessons, especially in physical education classes (Karagianni, 2019). Research data shows that the age group 12–14 (middle school students) is the most vulnerable to injuries due to rapid musculoskeletal development. Other possible causes for this include: lack of safety measures, poor floor surfaces, inappropriate mats, footwear, as well as exercises that place high mechanical stress on the body (Tamoutsidis, 2014).

However, there is no discussion as to whether students could be trained, through physical education, to prevent falls, to use the appropriate equipment each time, and to fall safely. Nevertheless, learning how to do so, in order to reduce accidents from falls that occur in daily school life (both in physical education classes and during recess in the schoolyard), is not an unattainable goal but a feasible reality through specific teaching methodologies that helped avoid similar problems in combat sports (judo – pankration).

2. Methodology

For teaching forward, backward, and sideways falls, what can be used is the teaching methodology of falls in judo (Kudo, 1979) – pankration. For safer forward and backward falls and rolls, the initial methodology comes from artistic gymnastics (floor exercises – forward and backward rolls), followed by the methodology of diagonal rolling (with landing on the floor and rising) from judo – pankration (Savvidis, 2013). Practice is carried out on gym mats in an indoor hall (indoor gymnasium) at the initial stage and is completed with the performance of falling techniques under real conditions (shock-absorbing floor – wooden parquet or elastic mat).

3. Exercises and Key points

The methodology followed for teaching the backward, forward, side fall and backward, forward roll without and with jump includes practice with floor exercises (forward roll – backward roll) from artistic gymnastics (Kaimakamis, 1994), which in essence are nothing more than a loss of balance from the standing position, resulting in a fall – roll forward or backward, and returning to standing. In other words, the floor exercises of artistic gymnastics could be described as successive alternations between phases of flight – suspension and phases of support – landing. The utilization of fall techniques from combat sports (judo, pankration et.), through their "modified" application for teaching students the above techniques for safe fall has its basis in the floor exercises of artistic gymnastics (primarily forward roll – backward roll – dive roll, etc.), which are basically used in a differentiated form.

3.1 Backward fall

The most important point of attention is to prevent the back of the head from hitting the ground. Other parts of the body that must be protected from violent impact with the floor are the back and the hip bones (pelvis – hip joint).

Key points during a backward fall:

1. The eyes look at the abdominal area (the spot where the trouser belt buckle is).
2. The neck is flexed with the chin approaching the chest.

3. The shoulder blades (upper back) tilt forward. The back is in a flexed (curved) position.

Fall first on the buttocks (glutes), then on the rest of the hips, and finally on the back, so that no part of the body hits the floor violently.

Vigorous placement of both arms (or one arm in the case of a diagonal-backward fall) along their full length (at an angle of 30–40 degrees from the torso – not too close, not too far from the body). At an initial stage (or at younger ages, e.g., elementary school or early middle school students), the arms can be placed behind the head for protection and to support cervical flexion.

3.2 Pre-exercises (rolling practice)

Forward-backward rolling in a tucked position, holding the legs with the hands.

Initially, the exercise is performed with the legs lower than the seat (facilitated conditions). Then the pre-exercise is repeated with the legs at the same level as the seat.

Forward-backward rolling in a tucked position, holding one knee with the hands.

Initially, the pre-exercise is performed with the legs lower than the seat (facilitated conditions). Then the pre-exercise is repeated with the legs at the same level as the seat.

From supine position (Kudo, 1979)

Starting position: Lying on the back with both arms extended forward (at shoulder height), chin on the chest, neck flexed, eyes looking at the waist (at belt level).

Action – Final position: Vigorous placement of both arms (or one in the case of a diagonal-backward fall) simultaneously on the floor with palms leading, along their full length.

From sitting position (Kudo, 1979)

Starting position: Legs stretched out in front on the floor and arms extended forward at shoulder height.

Action: As the body "falls" backward, raise the legs at a right angle (hip flexion) relative to the torso, chin on the chest, neck flexed, eyes looking at the waist (at belt level).

Final position**:** Same as the 1st pre-exercise (leg lift at right angle/hip flexion relative to torso).

The arms may initially be placed behind the head for protection and to support neck flexion (Toronjo-Hornillo et al., 2018).

From squat with one leg projected forward (left and right) (Kudo, 1979)

Starting position: Squatting with one leg projected forward and arms extended at shoulder height.

Action: "Slide" with the glutes very close to the heel and fall backward, raising the legs at a right angle (hip flexion) relative to the torso, while simultaneously placing both arms (or one arm in the case of a diagonal-backward fall) vigorously on the floor. Chin on the chest, neck flexed, eyes looking at the waist (at belt level).

Final position: Same as the 2nd pre-exercise.

From a squat (bent knees) with the feet parallel to the ground (Kudo, 1979)

Starting position: Squat with bent knees and arms extended forward at shoulder height.

Action – Final position: Deep squat (full knee flexion) and fall as in the 3rd preparatory exercise. The pre-exercise can also be performed with the help of a partner who holds the hands (see related photo in the article by Toronjo-Hornillo et al., 2018), or with a partner providing assistance by holding a fabric belt, e.g., a judo belt.

The methodology followed for teaching the backward fall in the above article does not include practice with floor exercises (forward roll – backward roll) from artistic gymnastics, which in essence are nothing more than a loss of balance from the standing position, resulting in a fall – roll forward or backward, and return to standing. The same is repeated also in Safe Fall-Safe Schools (SFSS) Level I. Research protocol (DelCastillo-Andres et al., 2024). The key points of attention for the position of the head (cervical flexion), the body (tucking – rounding the spine in a curved shape), and the legs (hip and knee flexion) in the backward roll do not differ from the points of attention indicated for the execution of the backward fall according to the Safe Fall Programme (Toronjo-Hornillo et al., 2018)) discussed in the article. In real conditions, however, where children fall during movements while walking or jogging in various directions, or due to another mechanical cause (e.g. being pushed, pulled by another person, etc.), the falls occur with acquired momentum, which may vary in each case. It is possible, if the hands are not placed vigorously on the ground, as indicated in the exercise of falling backwards (from standing position) that we analyze below, that an involuntary backward roll over the neck will follow, with a complete rotation of the body, exerting dangerous mechanical pressures capable of causing injury to the cervical spine and the head (if the fall backwards is not followed by a diagonal roll backwards).The fact that children do not have fully developed reflex and balance abilities—since the motor skills that

strengthen balance develop mainly between the ages of 5 and 10 years (DelCastillo-Andres et al., 2019)—makes floor exercises and artistic gymnastics in general the foundation for building the necessary flexibility, strength, static and dynamic balance. These are physical attributes that are a prerequisite for the execution of backward falls and preparatory drills.

The utilization of fall techniques from combat sports (judo in this case), through their "modified" application for teaching students the backward fall is based on the floor exercises of artistic gymnastics (primarily forward roll – backward roll – dive roll, etc.), which are basically used in a differentiated form.

At a competitive level, artistic gymnastics serves as a foundational sport for combat disciplines (due to the technical similarities of wrestling - judo throws – falls with gymnastic exercises, but also because it trains basic physical attributes required for learning the aforementioned techniques). Consequently, engaging children from an early age with artistic gymnastics - and especially with floor exercises - should not be overlooked as a foundation both in terms of physical conditioning and technical development (positive transfer of learning) for learning safe falling techniques in all directions (forward, backward, sideways, with forward or backward rolling).

3.3 Exercises

From standing position (Kudo, 1979)

Preparatory exercise: From a standing position, rolling forward–backward with simultaneous arm movement and rising.

Starting position: Standing upright, feet parallel, with arms extended forward at shoulder height. Action – Final position: Deep squat (full knee flexion) with arms extended forward at shoulder height, "sliding" the buttocks very close to the heels and falling backward. Lifting the legs to a right angle (hip flexion) relative to the torso, while simultaneously slapping the floor energetically with both hands (or with one hand in the case of a lateral-backward fall). Chin to the chest, neck in flexion, eyes looking at the waist (belt line).

From standing position with 2 or 3 backward steps

Take 2 or 3 steps backward (walking or slow jogging) and fall as in the previous exercise.

From standing position with a partner

In pairs or groups (pairs arranged in two lines), one partner pushes the other in a controlled manner, and the pushed partner performs the backward fall.

3.4 Forward Fall

The most important point of attention is to protect the face, chest, and abdominal area.

Key points during the fall

The hands turn inward with fingers kept together (elbows apart and hands close together, positioned in a triangle shape).

Support is on the arms (from elbows to palms) and on the toes.

Fall prone so that the face (the head is turned to the side)**,** chest, and abdominal area do not hit the floor.

Pre-exercises

Support the body in the "plank" position (full extension of the torso with support points on the palms: elbow flexion position and palms, elbows, and toes.

Head in line with the torso, the whole body stretched straight and maintain this position for 10'' to 30''.

Side plank support, first on one arm (palm–elbow) and then on the palm with the elbow extended (performed bilaterally).

From support with the knees on the floor (thighs parallel) (Kudo, 1979)

Starting position**:** support on the knees.

Action**:** let the upper part of the body "fall" forward, placing the hands so that they touch the floor directly under the face.

Final position**:** support on 4 points (palms – knees).

From squat with support on the feet (Kudo, 1979)

Starting position: deep squat with the torso upright.

Action**:** let the upper part of the body "fall" forward, extend the knees, and place the hands so that they touch the floor directly under the face.

Final position: support on 4 points (palms – feet).

From half-squat, fall forward.

3.5 Exercises

Fall from standing position forward.

From standing position with 2 or 3 steps forward (walk or slow jog and then fall as in the previous exercise).

From standing position with a partner (one pushes the other in a controlled way, who then performs a backward fall) – in pairs or with pairs arranged in two lines.

3.6 Side Fall

Preparatory Exercises

From a sitting position (Kudo, 1979)

Starting position**:** Sitting position with feet parallel.

Action – Final position: Fall backwards and turn slightly to the right. Place the right hand vigorously at a 30–40 degree angle from the torso (not too close, not too far from the body). Chin tucked in. The exercise is also performed to the left.

From a half-squat (Kudo, 1979)

Starting position: Half-squat.

Action – Final position: Raise the right hand sideways to the right, tilt the body to the right, and place the left hand on the left knee. Move the right leg sliding close to the floor forward and sideways to the left, turn the body to the right, and fall with vigorous placement of the hand, breaking the energy–speed of the fall (the legs do not lift very high). The same is performed to the left.

Exercise

Side fall exercise from standing position (Kudo, 1979)

Starting position**:** Standing position.

Action – Final position**:** Step with the left foot to the side, "slide" the right foot in front of the left, turn the torso to the right, fall on the right side with vigorous placement of the hand, breaking the energy–speed of the fall (the legs do not lift very high). The same is performed to the left.

3.7 Forward Roll – Forward Roll with Jump

The forward roll without and with jump is a modified version of the somersault exercise. It is taught using methodology from artistic gymnastics. It is completed diagonally, with a landing on the floor and a return to the initial upright position.

Prerequisites – Basic Somersault Exercises

Somersault from an inclined plane

Somersault from a horizontal plane

Jumping somersault

Preparatory Exercises

From a tucked position *(Kudo, 1979)*

Starting position: Tucked stance with the right foot in front.

Action – Final position:

Place the left hand at the "top" of a triangle whose base is the line connecting the two feet.

Place the right hand on the right knee.

From a "low hips" position, extend the knees and lift hips and heels (tiptoe position).

Place the right hand close to the left.

Roll forward: sequential floor contact with elbows, back, hips, legs.

Break the fall by energetically placing the left hand.

Attention: do not cross legs, do not strike heels on the floor.

From a half-squat (Kudo, 1979)

Starting position: Half-squat stance.

Action – Final position: Same as in exercise 1.

Exercises

From a standing position *(Kudo, 1979)*

Starting position: Upright stance.

Action – Final position:
Take a large diagonal step forward with the right foot.
Place the right hand on the floor about 10–15 cm in front of the right foot.
Perform a forward roll as in exercise 2.
Forward roll from standing After 2–3 steps of walking or light running.
Forward roll in pairs after a controlled push from a partner.
Forward roll after jumping over a stable object (hoop, cardboard box) or a partner (in tucked position on the floor).

3.8 Backward Roll (Diagonal Backward Rolling)

It is a modified execution of the backward roll. The roll is taught with the methodology of artistic gymnastics. It is completed diagonally with landing on the floor and returning to the initial standing position.

Before practicing the diagonal backward rolls, the preparatory exercises of falling backward are performed. All exercises are carried out on gymnastics mats.

Preparatory exercises
Rolling on the back with free arms – placing them on the floor and returning to standing.
Backward roll on an inclined surface.
Backward roll on a flat surface.
Execution of the backward roll from a sitting position with one leg forward, with diagonal rolling and standing up
A. Starting position: Tucked position with the right leg in front.

Action – Final position**:** Deep squat (full flexion of the back left knee, half flexion of the front right knee) with arms approximately at shoulder height. Slide the hips close to the heels (especially of the back left leg) and fall backward, lifting the legs at a right angle (hip flexion) relative to the trunk, while actively placing both hands. Perform a diagonal backward rotation – roll with the head and trunk directed to the left. The sequence of contact with the floor is: hips, pelvis, lower back, back, shoulders, elbows, right leg, left leg. Do not cross the legs, do not hit the heels on the floor.

B. Starting position: Tucked position with the left leg in front.

Action – Final position**:** Deep squat (full flexion of the back right knee, half flexion of the front left knee) with arms approximately at shoulder height. Slide the hips close to the heels (especially of the back right leg) and fall backward, lifting the legs at a right angle (hip flexion) relative to the trunk, while actively placing both hands. Perform a diagonal backward rotation – roll with the head and trunk directed to the right. The sequence of contact with the floor is: hips, pelvis, lower back, back, shoulders, elbows, left leg, right leg. Do not cross the legs, do not hit the heels on the floor.

Execution of the backward roll from a sitting position with bent knees (feet parallel), with diagonal rolling and standing up

Starting position: Tucked position (feet parallel).

Action – Final position: Deep squat (full knee flexion) with arms approximately at shoulder height. Slide the hips close to the heels and fall backward, lifting the legs at a right angle (hip flexion) relative to the trunk, while actively placing both hands. Perform a diagonal backward rotation – roll with the head and trunk directed to the right or to the left – to the "comfortable" side. The sequence of contact with the floor is: hips, pelvis, lower back, back, shoulders, elbows. Do not cross the legs, do not hit the heels on the floor.

Exercises
Diagonal backward roll from standing position with standing up.
Diagonal backward roll after 2–3 backward steps and light running.
Diagonal backward roll after controlled pushing by a partner (initially on gymnastics mats, then on sprung floor – elastic carpet or parquet).

4. Conclusions – Suggestions

The scientifically applied didactic and training methodology of the Olympic sport of judo (Nasioudis, et al., 2025), as well as of other combat sports such as pankration, which sets as a prerequisite the training in falling techniques before the practice of throwing techniques is vital. It provides strong evidence that the teaching of safe landing, especially for those participating in sports that involve a risk of falling (Fall Safety Training for Equestrian Athletes), but also more generally for other populations (Jadczak et al., 2023; Arkkukangas et al., 2021; Blach et al., 2021; Ortiz et al., 2025; Chan et al., 2023), including students, is not a utopia.

However, whether children could be trained through physical education classes to prevent falls, to use the appropriate equipment each time, and to be instructed in how to fall and land safely by applying the scientifically validated methodology of artistic gymnastics (forward – backward roll) and the methodology of combat sports (judo, wrestling, pankration), is not explicitly mentioned in the objectives of the physical education curricula across school levels or in scientific research in Greece. This is despite the fact that scientific studies on the use of judo safe falling techniques in middle-aged and older adults without prior combat sport experience (Chan et al., 2023), as well as in minors abroad (Toronjo-Hornillo et al., 2018; DelCastillo- Andrés et al., 2019; Kerner et al., 2021; DelCastillo-Andrés et al, 2018), provide tangible evidence in support of this.

The fact that many serious accidents occur within the school environment makes it imperative to cultivate personal self-protection through the training of students in managing their bodies in such a way that, in the event of a fall, potential injuries are minimized upon landing. Therefore, initiating scientific research on the application of the didactic methodology of falling techniques from combat sports, beyond the narrow training and competitive context, to broader populations of minors as well as adults (Kontogiannis et al., 2023) in Greece is considered necessary. It is also positive that, as previous researches has shown (Melistas, 2016; Lamprou, 2012), it is possible, through various teaching subjects in Greek Departments of Physical Education and Sports Sciences, to integrate and/or emphasize the teaching methodologies presented and proposed in this study, with the main objectives the injury prevention and management of the consequences of falls in the school environment and in daily life.

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