Educazione al Movimento Funzionale: lo Swing

Functional movement education: the Swing

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ABSTRACT
Movement education is effective when sport-specific skills are successfully achieved. The variety of theoretical frameworks, of individual teaching and learning styles, lay the foundations to identify new practical teaching strategies, improve the mastery of motor skills, promote self-esteem, foster self-efficacy and positive self-image. The experimental educational and training strategy, proposed in this contribution, facilitates new motor experiences precisely through the ballistic action with the Kettlebell: the Swing. This movement develops and improves not only the conditional skills, but also the coordination ones. A didactic programming supports innovative and inclusive paths, and includes a new and innovative motor education based on functional movements, as a necessary strategy for developing learning processes. The knowledge development process will be transactional, within a reality in which the final product will be the relationship between subject and environment expressed through the body. For this reason, the movement holds the whole truth, made up not only of objective and subjective reality, external world and body, but more comprehensively, of relationships, emotions, symbols and meanings, all necessarily useful to build a knowledge of the vision of reality, of the real world.

L'educazione al movimento è efficace quando le abilità specifiche di uno sport vengono raggiunte con successo. La varietà di quadri teorici, di stili individuali di insegnamento e apprendimento rappresentano la base per individuare nuove strategie pratiche di insegnamento, per migliorare la padronanza delle abilità motorie, per promuovere l'autostima, per favorire l'autoefficacia e l'immagine positiva di sé. La strategia educativa e formativa sperimentale, proposta in questo contributo, agevola nuove esperienze motorie proprio attraverso l'azione balistica con il Kettlebell: lo Swing. Questo movimento sviluppa e migliora non solo le capacità condizionali, ma anche quelle coordinative. Una programmazione didattica, a favore dei percorsi innovativi ed inclusivi che considera l'educazione motoria, nuova ed innovativa basata sui movimenti funzionali, strategia necessaria per lo sviluppo dei processi formativi di apprendimento. Il processo di sviluppo della conoscenza sarà transazionale, all'interno di una realtà il cui prodotto finale sarà

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costituito dal rapporto tra soggetto e ambiente attraverso il corpo. Per questo motivo, nel movimento c'è tutta la verità, fatta non solo dalla realtà oggettiva e soggettiva, esterno e corpo, ma, più complessivamente, dalle relazioni, dalle emozioni, dai simboli, dai significati, tutto necessariamente utile a costruire una conoscenza della visione della realtà, del reale.

KEYWORDS
Education, functional movement, learning, motor education, kettlebell, swing, sports performance, training, health, mental and physical well-being. Educazione, movimento funzionale, apprendimento, educazione motoria, kettlebell, swing, performance sportiva, formazione, salute, benessere psicofisico.

Introduction

Bernard C., a physiologist (Saint-Julien 1813 - Paris 1878), marked an important step in medicine, from general physiology to the experimental method, also called "physiological autopsy" or "selective vivisection", thanks to which it was possible to deepen the study of many concepts, such as internal secretion, local circulation, internal environment, and reciprocal innervation. By applying this method, in 1848, B. discovered the hepatic glycogenesis, demonstrating that animals, like plants, have the ability to form polysaccharides regardless of the nature of the food. What is fundamental about B.'s method is that it strengthens the concept according to which critical doubt is the basis of any discovery; we should not think we know everything, but we should continuously seek to refine our knowledge. What may seem to be a natural and involuntary act such as breathing, if exercised instead in a conscious way and through a conscious practice, can bring benefits not only to the breathing action itself, but also to the physical exercise related to it. Teaching the correct way to breathe is fundamental to develop and improve the respiratory action itself, as well as to control and strengthen the stabilizing muscles of the trunk. In fact, among all the skeletal muscles of the human body, the most important muscle for breathing is the diaphragm (Merrell, & Kardon, 2013). It is a dome-shaped muscle that separates the chest cavity from the abdominal one, and is crucial for breathing. This study also includes experiences made over the years, and is an attempt to make a useful and comprehensive guide to the use of a fundamental exercise, namely the kettlebell swing (Lake, & Lauder, 2012). Our body and the external environment interact through the movement. The latter constitutes a two-way relationship, which not only allows our body to act in the environment, but also to modify itself by "learning" from stimuli, especially from new ones that come from it. This result can be obtained by training both conditional and coordination skills. The human body is a highly complex structure, and furthermore, presents a strong redundancy in the execution of movements. A given action, in fact, can be performed according to different rotations in space, so the joints allow for seven degrees of freedom in the arm (in addition to the possibilities provided by the finger joints). In addition, the same rotations can occur through different muscle activations. The coordination of a

movement consists of a motor skill process of the redundant degrees of freedom of the organ in movement, thus representing the organization of the musculoskeletal system control. To date, functional motor activity with the Kettlebell represents the transition from the use of isotonic machines to effective and specific workouts to work in the best way possible and reduce injuries (Jay K. et al., 2011). The function or purpose of this tool is to preserve and improve health, from athletes to performers, through specific movements for the development and improvement of basic and specific skills. Therefore, the use of the Kettlebell and the Swing leads its practitioners to focus as much as possible on multi-joint and polyaxial movements, unlike all other single-joint, isolated movements that work mainly on one specific muscle, and especially in recovery conditions, since they are separated from the others. For this reason, all movements performed with kettlebells are carried out always while keeping the body in contact with the floor, or in a standing position, when kneeling or lying on the ground. This is to ensure the intentional management of the overload, through the position and weight of the body, embedding the control of the stability of the body itself in the movements. All movements, whether ballistic or slow lifting, continuously stimulate balance and proprioception, so the muscles are always searching for tension, connection, balance and stability. In fact, the motor control of stability can be improved and prompted through rotational movements, where the support of the feet on the floor is asymmetrical and unstable. In conclusion, using the Kettlebell and the swing (if performed while moving) is a continuous learning of one's body weight management at all levels of movement. It is therefore important, for the reasons outlined above, to train the movements and not the muscles. The connection with the tool, the right tension in the set-up, the static and dynamic stability of the body in action, and finally the arthromuscular balance, are the key principles to be taken into account in order to develop an educational and training action in favor of the person's motor development, and not just of strength in itself. These priority goals of functional training, through the use of the kettlebells and especially of the Swing, can be proposed in various contexts and not only in traditional individual or team sports, such as in ballet (Grignoletto et al., 2020). In fact, in this study, starting from the considerations that ballet is a physically demanding artistic expression and used mainly in performances (Koutedakis & Jamurtas, 2004), there is also a growing interest in physiological features (Rodrigues et al., 2015), while for specific strength training (ST) is still rejected by the Academies and is still little studied in the scientific literature (Rafferty, & Wyon, 2010). This is because there are still traditionally negative thoughts about ST, and therefore it is not considered important for dancers, whereas a study by Welsh et al. (1998) shows that specific ST on the back muscles can reduce the risk of low back pain and injury, and can improve the aesthetics of arabesque in dancers. In addition, the idea that ST is to be related to the certain increased transverse section of the muscles, disturbing both the aesthetics of the body and the grace of the movements, is unfounded (Stracciolini et al., 2016). Fitt S. (1981), who showed that ST could improve dance performance without increasing muscle mass, already rejected this theoretical thinking in the early 1980s. These findings are consistent with the physiological basis of muscle growth (Gonzalez et al., 2016). Indeed, in order to optimize muscle hypertrophy, it needs to manipulate many variables of physical exercise, as well as food habits (Morton et al., 2015; Paoli & Bianco, 2012; Witard et al., 2016). Therefore, lifting a weight without proper programming will not be significant for muscle development, and it will not support hypertrophic muscle gain. Furthermore, there are many variables in ST that can

be changed for the purpose of improving both strength and muscle power outcomes, thus avoiding unwanted muscle growth: an example of this is represented by explosive movements (Bemben & Murphy, 2001).

1. Education and Movement

Educating the body through movement is fundamental to gaining perception of ourselves and our relationship with the world around us. In fact, through the movement, the body becomes a means for structuring the self and the learning processes, providing also the possibility of redesigning the educational and inclusive paths, as well as those of the individual's development, discovery and knowledge. Therefore, the theoretical perspective of cognitivist matrix acts as a beacon for interpreting the body-in-relationship and the movement in a multilanguage pedagogical key. For this reason, a didactic programming that favors innovative paths that consider the use of motor education should include new and innovative functional movements, such as the Swing with the use of the Kettlebell, as a necessary strategy for the development of learning processes. This is mainly because the formative processes of human beings are due both to the biological dimension of the body, and to the cultural one. In the former lie the elements of constraint of the experience, while in the latter are those related to the tools for interpreting and organizing reality (Bruner, & Sherwood, 1997). Everything will depend, on the one hand, on the set of genetic dispositions and internal evolutionary and developmental processes, and on the other, on the exclusive construction based on the interpretation of contexts and modes of thought that are strictly individual. The two dimensions will develop the training and learning actions (Lo Presti, 2005). This will be possible thanks to the mechanisms of exchange with the environment, but, without question, the whole development of the cognitive and intellectual apparatus of human abilities is closely interconnected to motor skills, to the point of determining the cultural and social component. In light of the above, it is clear that the knowledge development process will be transactional, within a reality in which the final product will be the relationship between the subject and the environment expressed through the body. For this reason, the movement holds the whole truth, made up not only of objective and subjective reality, external world and body, but more comprehensively, of relationships, emotions, symbols and meanings, all necessarily useful to build a knowledge of the vision of reality, of the real world. "What we go through and experience, what we know and are aware of, necessarily arises from our construction elements, and can be explained only by the way we constructed it all" (Von Glasersfeld, 1988, p. 33). Within reality, there are individuals whose relationships and interactions actively contribute to shaping and organizing the experience and the world in which they live through strategies and rules. In conclusion, these are the dynamics that create the mediations between the body and the external reality through relationships, the social and cultural context, the exchange of codes, languages, behaviors, and innovations of free and creative movement; all at the foundations of society and of both individual and collective reality. In fact, already the studies carried out by Piaget J. (1936) regarding the child's cognitive development, as well as subsequently those carried out by Neisser U. (1976), Bruner J. (1976) and Stern D. N. (1988), proved the active ability of human beings, starting from their first years of life, to acquire useful and necessary information to build patterns of orientation through the body and movement. This representation of reality within the mind

occurs internally, thanks to the continuous interaction with the physical environment, by means of actions and interactions with it. The object thus becomes a perceived-object, and thanks to the movement, it is then possible to interpret and include it in the system of representation and interpretation of the environment. The body and movement education will be the keys to build the patterns of reality through information. Through the actions and interactions of exploration, the movement will create visions of development of reality itself, up to allow for the development of learning skills. Therefore, the experience will be built and organized by means of a moving body; everything will be "inhabitable" and recognizable only through the exploratory and constructive actions of our body (Neisser, 1976). This psycho-pedagogical observation axis will upgrade movement education to the objective, universal and necessary condition of structuring knowledge, being it no longer only focused on a body that moves in a space thanks to its natural bio-mechanical predisposition, with respect to which only the technical-training educational road is useful – according to what traditional theory claims. The latter system is therefore deeply incorrect and limiting with respect to the complex nature of motor processes and movement knowledge construction. This will mean above all "thinking and feeling", indispensable prerequisites that will allow imagining and visualizing any kind of action; a motor organism intertwined with knowledge and in connection with the various contexts and meanings of reality (Contini, Fabbri, Manuzzi, 2006). For these reasons, the whole learning and knowledge development process is strictly interconnected with the neural morphology, with its synapses and with the whole CNS. The evolution, the growth of the brain (first six years of life) is directly proportional to the flow of experiences through the bodily, cognitive, rational and emotional interchange, against the background of the social context and cultural system of reference. As Contini M. G. (1992) affirmed: "*the sensory and emotional experience of corporeality guides cognitive processes as much as social and relational processes do*". In the same way, the perceived reality will be made stable through perception, attention and motor memory. All thanks to the individual experience that each subject makes, up to the complex structuring of stable representative patterns of reality, always thanks to the activities of mind and body working in harmony. Considering these observations, the organism must be considered as body-in-action. The body, through the movement, will help form the hippocampus, specifically the area devoted to procedural memory, a fundamental component defined by Damasio A. R. (2000) as corporeal, biological and material situatedness. This shows that we are our body; we are characterized by a materiality, a biological specificity, made up of and bounded by a fundamental condition of constraint, to which all our possibilities are related (Damasio, 2000). In conclusion, the body represents the primary environment through which the subject interacts with others and relates to them; ultimately, the subject is self-situated in his/her own individual body biology. It is in the body that the construction of knowledge and the processes of interaction and action lie. Through the environment, movement and exploration it will be possible to select all the information coming from outside through the movement. Ultimately, it is a circular process of reconfiguration and adaptation, whereby motor practice is the possible condition through which individuals will be able to respond to the different conditions arising (Nicoletti, & Borghi, 2007), in order to rebuild space-time maps (Neisser, 1976), continuously rewrite the movement patterns, and exchange cognitive information between internal and external reality by means of it (De Mennato, 2007). Therefore, knowledge will represent a structure containing anticipation patterns, which, if applied, will improve the individual's ability to ex-

plore; in this way, the cognitive structures of recognition and anticipation will be improved (Neisser, 1976). This pragmatic aspect of corporeality, already present in systematic social relationships, supported by the mutual symbiosis of systems of shared expectations (Habermas, 1997), will be the source of orientation for each individual in the search for and acquisition of all socio-cognitive, grammatical, syntactic and phonological skills. The latter, in fact, provide the models of expectation and shared action on which to structure the meanings of things, the use of language, the management of codes or signs and their interactions.

2. Kettlebell

The Kettlebell (KB) is an ancient tool, which origins date back to at least 1703 in Russia (Tsatsouline, 2013); it is made of a cast iron weight, very similar to a cannonball, with a handle on it. The design of the KB offers some ergonomic and unique advantages in both dynamic exercises, and progressive and slow actions. Unlike a barbell or a heavy dumbbell, it can be safely moved between the lower limbs either by swinging it or snatching it quickly, thus making it possible to move the load safely even in eccentric ballistic movements. The exercises that can be performed with the KB concern motor actions where movements are both controlled (since they are intended for large overloads) and also ballistic, and the main feature is the quickness and explosiveness of the gesture. The first ones include slow lifts, which are mainly used to develop basic strength. In fact, thanks to the handle, it is possible to use the false grip, allowing the wrist to get stuck in the tool itself. This grip makes the fingers free to manage the connection or the hold with the KB, and being also offset, the unloading position of the weight is directly on the carpal bones. This predisposes to the use of greater and greater weights, which will be such as the subject's strength increases. Military press, Squat, Deadlift, Turkish Get-Up and Bent Press are part of this order of movements. For ballistic exercises, however, the continuous swinging movement applied to the weight is due to the flexion-extension of the hips, which allows the KB to continue the movement by inertia in the direction of the strength push and until gravity acts, opposing the movement itself and counterbalancing the strength in movement in the opposite direction. These ballistic movements involve the activation of the main muscle kinetic chains, and their performance is characterized by rapid and synergistic contractions, which allow for the improvement of explosive power, reactivity, coordination power, proprioception and balance. Swing, Clean, Snatch and jerk belong to this group of movements (Tafuri & Marzullo, 2021).

3. Swing

The Swing (SW) with the KB shows that this functional movement is effective on the back and hip muscles (Edinborough et al., 2016; McGill, 2012). In fact, improved postural coordination and jump-based performance have also been proven (Jay et al., 2013b), thus increasing power and strength performance (Manocchia et al., 2013) and cardiovascular conditioning (Falatic et al., 2015; Fortner et al., 2014; Jay et al., 2011; Williams & Kraemer, 2015), as well as sympathovagal balance (Wong et al., 2017). More specifically, the SW with the KB is an explosive movement and its performance requires coordinated and powerful contractions of the lower body and trunk muscles, as well as highly demanding eccentric muscle actions (Jay et

al., 2011). In fact, Jay et al. (2011) showed that the SW has an acceleration phase similar to Olympic weightlifting, improving strength in the trunk extensors. In addition, previous studies had already shown improvements in jump performance and strength after 6 and 8 weeks of KB swing use, compared to traditional weightlifting exercises (Otto et al., 2012). In conclusion, the SW with the KB is the ballistic movement par excellence. Its movement mechanics intensely and simultaneously involve the posterior and anterior muscle chains, thereby strengthening core muscles, improving hip flexibility and mobility, and increasing muscular and cardiovascular conditioning. There are countless variations, progressions and regressions of these exercises, to make the SW adaptable to any type of athlete or anyone who wants to try it for the first time; few exercises can guarantee such a significant positive transfer in countless physical qualities, to the point of improving athletic performance in many sports. Being able to correctly perform the different variants of the SW is the prerequisite for correctly interpreting all the main exercises with the KB. In order to perform the SW it is necessary to stand in an upright position, with feet placed at a distance slightly greater than the width of the shoulders and tips pointing outwards, and with arms stretched along the sides. The KB is positioned in front of the performer, and not between his/her legs as in the Deadlift, thus forming an equilateral triangle with the malleoli of the feet, and the eyes looking straight ahead. The descent phase is the same as in the Deadlift, with a deep inhalation, a first movement of the hips with the knees flexing in a second moment; arms must be stretched out until they reach the KB and then grip it, and by using hands as a hook. Subsequently, the KB must be bent towards the lower limbs, so that its handle and body become the extension of the forearm, causing the arms to rotate outwards, arching the lumbar region and pushing the shoulders towards the pelvis, away from the head. After that, it will be necessary to throw it hard backwards, between the adductors, without changing the position of the body, so that the KB handle goes up more than the knees. This kind of movement brings the arms to press against the rib cage, the forearms to press against the adductors, and the body of the KB to tilt upwards with respect to the handle. This is the moment when the ascent phase begins, with an explosive movement thanks to the push of the feet against the floor and the forceful extension of the hips and knees, with an immediate contraction of the glutei and quadriceps. The KB will be lifted forwards and upwards until approximately chest height and with arms relaxed, which will have the task of transferring the energy provided by the extension of the hips to the KB, without being involved in the lifting. At the end of the ascent, arms, forearms and body of the KB should be perfectly aligned. The subsequent phase concerns the descent of the KB; in fact, once the KB has reached the peak of the ascent, it should be left floating in midair for a split second, and only when the KB begins to fall back down, will it be necessary to lead it backwards again. All this for almost all the descent phase, at least until the hands will have reached the height of the navel, the moment in which it needs to keep the abdomen, the buttocks and the quadriceps erect but contracted, while knees and hips will be fully extended. Only in the final moment, when the hands are above the navel, the hips must flex until reaching the low position of the movement, and then it needs to bring the KB back to the starting position.

Conclusions

In this work, it was highlighted that scientific literature supports the positive effects resulting from KB training. Nevertheless, like other training tools, there are no authorized guidelines or recommendations for its use (Meigh, 2019), especially in primary care medical settings. The aim was to summarize the key concepts of movement education, and especially to identify the advantages of using the KB in functional training and the SW as an innovative motor resource, the practice of which is definitely in favor of the person's harmonic development, as well as his/her prevention, health and psychophysical well-being. In addition, the axis of psycho-pedagogical observation in the movement will upgrade motor education to the objective, universal and necessary condition of structuring knowledge, being it no longer only focused on a body that moves in a space thanks to its natural bio-mechanical predisposition, with respect to which only the technical-training educational road is useful. Therefore, it follows that the educational process in various training contexts must consider movement as a valid solution to support social inclusion. The new educational strategies for functional movement, useful for mediations between the body and the external reality through relationships, the social and cultural context, the exchange of codes, languages, behaviors, and innovations of free and creative movement, will be the foundations of society and of both individual and collective reality.

References

Bemben M. G., & Murphy R.E. (2001). Age related neural adaptation following short term resistance training in women. *J Sports Med Phys Fitness*, 41, 291–299.

Bruner, J. (1980). *Under five in Britain*. London: Grant McIntyre Ltd.

Bruner, J., & Sherwood, V. (1997). Pensiero, linguaggio ed interazione nell'infanzia. In V. Ugazio, *La costruzione della conoscenza*. L'approccio europeo alla cognizione del sociale. Milano: Franco Angeli.

Contini, M.G. (1992). *Per una pedagogia delle emozioni*. Firenze: La Nuova Italia.

Contini, M.G., Fabbri, M., & Manuzzi, P. (2006*). Non di solo cervello. Educare alle connessioni corpo mente significati contesti*. Milano: Raffaello Cortina.

Damasio, A.R. (2000). *Emozione e coscienza*. Milano: Adelphi.

de Mennato, P. (2007*). Per una cultura educativa del corpo. Una epistemologia costruttivista delle scienze motorie*. Lecce: Pensa MultiMedia.

Edinborough, L., Fisher, J.P., & Steele, J. A. (2016). Comparison of the Effect of Kettlebell Swings and Isolated Lumbar Extension Training on Acute Torque Production of the Lumbar Extensors. *J Strength Cond Res*, 30, 1189–1195.

Falatic, J. A., Plato, P. A., Holder, C., Finch, D., Han, K., & Cisar, C.J. (2015). Effects of Kettlebell Training on Aerobic Capacity. *J Strength Cond Res*, 29, 1943–1947.

Fitt S. (1981). *Conditioning for dancers: investigating some assumptions*. Dance Res J, 1981; 14: 32–38.

Fortner, H. A., Salgado, J. M., Holmstrup, A. M., & Holmstrup, M. E. (2014). Cardiovascular and Metabolic Demands of the Kettlebell Swing using Tabata Interval versus a Traditional Resistance Protocol. *Int J Exerc Sci*, 7, 179–185.

Gonzalez, A. M., Hoffman, J. R., Stout, J. R., Fukuda, D.H., & Willoughby, D.S. (2016). Intramuscular Anabolic Signaling and Endocrine Response Following Resistance Exercise: Implications for Muscle Hypertrophy. *Sports Med*, 46(5), 671-85.

Grigoletto, D., Marcolin, G., Borgatti, E., Zonin, F., Steele, J., Gentil, P., Galvão, L., & Paoli, A.

(2020). Kettlebell Training for Female Ballet Dancers: Effects on Lower Limb Power and Body Balance. *Journal of Human Kinetics*, 74, 15-22 DOI: 10.2478/hukin-2020-0010.
Habermas, J. (1997). *Teoria dell'agire comunicativo*. Vol. I. Bologna: il Mulino.
Jay, K., Frisch, D., Hansen, K., Zebis, M. K., Andersen, C. H., & Mortensen, O. S. (2011). Kettlebell training for musculoskeletal and cardiovascular health: a randomized controlled trial. *Scand J Work Environ Health*, 37(3), 196-203 doi:10.5271/sjweh.3136.
Jay, K., Jakobsen, M.D., Sundstrup, E., Skotte, J.H., Jørgensen, M.B., Andersen, C.H., Pedersen, M.T., & Andersen, L.L. (2013a). Effects of kettlebell training on postural coordination and jump performance: A randomized controlled trial. *J Strength Cond Res*, 27, 1202–1209.
Jay, K., Jakobsen, M.D., Sundstrup, E., Skotte, J.H., Jørgensen, M.B., Andersen, C.H., Pedersen, M.T. & Andersen, L.L. (2013a). Effects of Kettlebell Training on Postural Coordination and Jump Performance. *J Strength Cond Res*, 27, 1202–1209.
Koutedakis, Y., & Jamurtas, A. (2004). The dancer as a performing athlete: Physiological considerations. *Sports Med*, 34(10), 651-66.
Lake, J. P., & Lauder, M. A. (2012). Mechanical demands of kettlebell swing exercise. *Journal of Strength and Conditioning Research*, 26(12), 3209–3216.
Lo Presti, F. (2005). *Il senso del sé. Percorsi autoriflessivi nella formazione*. Lecce: Pensa Multimedia.
Manocchia, P., Spierer, D. K., Lufkin, A. K., Minichiello, J., & Castro, J. (2013). Transference of kettlebell training to strength, power, and endurance. *J Strength Cond Res*, 27, 477–484.
Meigh, N. J., Keogh, J. W. L., Ben Schram, B., Wayne, A, & Hing, W. A. (2019). Kettlebell training in clinical practice: a scoping review. *BMC Sports Sci Med Rehabil*, 3, 11:19. doi: 10.1186/s13102-019-0130-z.
Mcgill, S.M., & Marshall, L.W. (2012). Kettlebell swing, snatch, and bottoms-up carry: Back and hip muscle activation, motion, and low back loads. *J Strength Cond Res*, 26, 16–27.
Merrell, A. J., & Kardon, G. (2013). Development of the diaphragm, a skeletal muscle essential for mammalian respiration. *NIH P-A*, https://doi.org/10.1111/febs.12274.
Morton, R. W., Mcglory, C., & Phillips, S. M. (2015). Nutritional interventions to augment resistance training-induced skeletal muscle hypertrophy. *Front Physiol*, 6, 245.
Neisser, U. (1976). *Conoscenza e realtà*. Bologna: il Mulino.
Nicoletti, R., & Borghi, A.M. (2007). *Il controllo motorio*. Bologna: il Mulino.
Otto W. H., Coburn J. W., Brown L. E., & Spiering B.A. (2012). Effects of Weightlifting vs. Kettlebell Training on Vertical Jump, Strength, and Body Composition. *J Strength Cond Res*, 26, 1199–1202.
Piaget, J. (1936). *La construction du réel chez l'enfant*. Neuchâtel: Delachaux et Niestlé.
Paoli, A., & Bianco, A. (2012). Not all exercises are created equal. *Am J Cardiol*, 109, 305.
Rafferty, S. (2010). Considerations for integrating fitness into dance training. *J Dance Med Sci*, 14, 45–49.
Rodrigues-Krause, J., Krause, M.,& Reischak-Oliveira, Á. (2015). Cardiorespiratory Considerations in Dance: From Classes to Performances. *J Dance Med Sci*, 19, 91–102.
Stracciolini, A., Hanson, E., Kiefer, A.W., Myer, G.D., & Faigenbaum, A.D. (2016). Resistance Training for Pediatric Female Dancers. *J Dance Med Sci*, 20, 64–71.
Stern, D. N. (1998). *Le interazioni madre-bambino. Nello sviluppo e nella clinica*. Milano: Raffaello Cortina.
Tafuri, D. & Marzullo, N. (2021). *Il Kettlebell Attività Tecnico Pratica*. Article N. Thirty-three - Multidisciplinary Series of Arts and Sciences edited by Francesco Peluso Cassese. Universitarie Romane Editions.
Tsatsouline, P. (2013). *Kettlebell: Simple & Sinister*. Reno, NV, Strong First Inc.
Von Glasersfeld, E. (1988). *Introduzione al costruttivismo radicale. In Watzlavick, P., La realtà inventata. Contributi al costruttivismo*. Milano: Feltrinelli.
Welsh, T. M., Jones, G. P., Lucker, K. D., & Weaver, B. C. (1988). Back Strengthening for Dancers A Within-Subject Experimental Analysis. *J Dance Med Sci*, 2, 141–148.
Williams, B. M., & Kraemer, R. R. (2015). Comparison of Cardiorespiratory and Metabolic

Responses in Kettlebell High- Intensity Interval Training Versus Sprint Interval Cycling. *J Strength Cond Res*, 29, 3317–3325.
Witard, O. C., Wardle, S. L, Macnaughton, L. S., Hodgson, A. B., & Tipton, K. D. (2016). Protein considerations for optimising skeletal muscle mass in healthy young and older adults. *Nutrients*, 8, 181.
Wong, A., Nordvall, M., Walters-Edwards, M., Lastova, K., Francavillo, G., Summerfield, L., & Sanchez-Gonzalez, M. (2017). Cardiac Autonomic and Blood Pressure Responses to an Acute Bout of Kettlebell Exercise. *J Strength Cond Res*, 2017 Oct 7 [Epub ahead of print].
Wyon, M. (2010). Preparing to perform periodization and dance. *J Dance Med Sci*, 14, 67.