Practical Applications of Aquatic Physical Activity, Swimming, and Therapy for People with Visual Impairment or Blindness

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Abstract

Studies show that aquatic physical activity is recommended and advantageous for people with visual impairment or blindness, which are both common disabilities. The Israeli legislation for Equal Rights for Persons with Disabilities (1998) strives to ensure equal opportunities for people with disabilities in all areas of life. Yet despite legislation, significant obstacles prevent the participation of this population in aquatic physical and therapeutic activities. This paper presents important principles and emphases for designing a suitable swimming-pool environment for people with visual impairment or blindness, as well as relevant accommodations. The implementation of the proposed adaptations by professionals who work in water will enable best practices when working with people with visual impairment or blindness.

Keywords: Visual impairment and blindness, aquatic therapy, adapted swimming, accessibility.

Visual impairment and blindness are common disabilities in Israel. According to data published by the Ministry of Labor, Social Affairs, and Social Services, approximately 23,000 people hold a certificate of blindness in Israel (Gleitman & Gozovsky, 2016). The definition of blindness in Israel is in line with that of the World Health Organization, whereby a person is eligible for a certificate of blindness if their impaired vision meets at least one of the following criteria: (a) complete lack of vision; (b) vision of less

than 3/60 after correction; and (c) visual field in the better eye with a possible correction of less than 20 degrees (Gleitman, 2014). It is important to note that in addition to these definitions, visual impairment is categorized according to complete blindness, visual acuity of less than 1/60, visual acuity of less than 3/60, visual field of less than 10 degrees, and visual field of less than 20 degrees (Ministry of Social Affairs and Social Services, no date).

The cause of visual impairment could stem from the person's central or peripheral nervous system. The damage could be congenital, due to a birth defect or genetic illness, or acquired, as the result of trauma, neurological injury (such as tumors), eye diseases (such as cataract, glaucoma, and retinal detachment), or systemic diseases (such as diabetes or hypertension) (Shulman & Shamir, 2015).

Studies point to a correlation between age and diseases that cause blindness, whereby blindness as an acquired impairment is more prevalent among the elderly; the dominant age of people with blindness is 65 years and older (Renaud & Bédard, 2013), compared to the rate of children with blindness in Israel, which is very low (Shulman & Shamir, 2015).

People with blindness participate less in social interactions and experience a greater sense of loneliness (Renaud & Bédard, 2013). Forming social connections is even more difficult in cases of congenital blindness (Dursin, 2012), possibly leading to emotional difficulties (Rees et al., 2010). Moreover, people with acquired blindness often suffer from grief-like responses (Papadopoulos et al., 2013), frustration, helplessness, and shame (Rees et al., 2010).

In addition to the definitions and categories of blindness and visual impairment presented above, the level of impairment is typically assessed in functional terms (Kadmon, 1997; Kaiser & Herzberg, 2017). A person's level of functional vision is dependent on several factors, including: (a) past experiences; (b) the level of familiarity with visual abilities and an understanding of the necessary sensory cues; (c) how well a person understands the actions that are necessary for making the most of sensory cues; and (d) the extent to which the environment is adapted to the person's needs, enabling them to optimally function and utilize their abilities.

Additional factors relating to functional vision relate to the personality, motivation, emotional support, and environment of the visually impaired or blind person who is making strides towards visual independence. A person with visual independence, someone with the motivation to improve their functioning, will implement both visual information and past visual experiences, while seeking new ones. To

achieve greater independence, these individuals need to have had a positive sense of self as children with a visual impairment, be willing to use visual aids near other people, and have a desire to be visually independent. They must also understand that it is sometimes possible to use non-visual methods or accept the help of others, in order to complete a task in a more efficient and comfortable manner (Corn, 2017).

Physical Activity in General, and Aquatic Physical Activity in Particular, for People with Visual Impairment or Blindness

Incorporating physical activity in the daily lives of people with visual impairment or blindness is important for two major reasons. First, an adequate level of physical fitness is necessary for performing everyday functions (Ayvazoglu et al., 2006); it has been found that people with visual impairment or blindness expend more energy on performing daily living activities (O'Connell et al., 2006). Second, infants and children with visual impairment or blindness experience delays in the development of their gross and fine motor skills (Auxter et al., 1997; Houwen et al., 2010; O'Connell et al., 2006). Children with visual impairment or blindness, yet with no other disabilities, have the same potential of reaching developmental milestones as that of children with typical development (O'Connell et al., 2006). Moreover, the participation of children with visual impairment or blindness in physical activity has been found to reduce the gap in their motor development (Houwen et al., 2009). Yet studies indicate low rates of participation in physical activities among this population (Lieberman et al., 2010).

Immersing in warm water has many positive physiological effects on the human body, including reducing pain and spasticity, decreasing activity of the sympathetic nervous system, improving venous return, and increasing the central blood volume (Becker, 1997; Becker, 2009). Yet there is little research on the effect of aquatic physical or therapeutic activity on people with visual impairment or blindness (Bellomo et al., 2012). This is surprising given that there are aquatic therapy centers in institutions that provide services to people with visual impairment or blindness (such as Eliya and Keren Or, Israel, and the Perkins School for the Blind, Massachusetts, USA). Studies that were conducted on this population indicate that rehabilitative and competitive swimming assists in improving endurance, muscle endurance, muscle strength, and flexibility (Lepore et al., 2007). Professional swimmers with visual impairment or blindness can improve their speed by reducing the water's resistance to their movements, through training and practicing effective swimming. Their ability to practice in the pool and realize their potential is therefore of the utmost importance (Oh et al., 2013).

Aquatic activity creates a sense of calm, freedom, and independence in this population, as they require no assistive equipment in the water, such as a cane (Lieberman, 2002). Furthermore, if the aquatic activity is a group activity, it could provide a unique opportunity for social interactions that will further enhance the participants' sense of success and capability (Lepore et al., 2007; Lieberman, 2011).

Therapeutic aquatic activity might be particularly helpful for people with acquired blindness who are experiencing a sense of grief and loss. In their book, Mayim ad Nafesh, Stein and Aronov (2017) describe the space of aquatic therapy as a 'beneficent womb' that embraces, accepts, and enables a person to feel the water's qualities – especially motion, propulsion, and flow. This space provides both physiological and emotional comfort, that helps reduce feelings of loneliness, while forming a bridge between the person's sense of self before their loss and their "new self" that contains the loss.

Accessibility and Barriers to Physical Activity for People with Disabilities

In 1998, the Israeli Knesset enacted a law for equal rights for people with disabilities (Equal Rights for Persons with Disabilities Law, 5758-1998). The law defines accessibility as "the ability to reach, be mobile, and be oriented within a place, to use and enjoy a service, to receive information that is given or produced in a place or a related service, make use of facilities, while participating in programs and activities that are taking place there – in an equal, dignified, independent, and safe manner." The law defines certified accessibility experts in two areas: Licensed Buildings, Infrastructure, and Environment Accessibility Experts, and Licensed Service Accessibility Experts. The role of the former is to provide input regarding accessibility and accommodations in a given building and infrastructure, to adapt them to suit people with disabilities in line with legal requirements. The role of the latter is to provide input and authorization regarding accommodations to services that will enable people with disabilities to use these services in an equal, dignified, independent, and safe manner. The object of this law is to ensure the rights of people with disabilities to equally and actively participate in society in all major spheres of life.

Despite existing legislation, there are certain gaps that pose barriers for enabling the comfortable and optimal participation of people with visual impairment or blindness in physical activity (Rimmerman et al., 2013). Some obstacles are related to the field of expertise of the Licensed Buildings, Infrastructure, and Environment Accessibility Experts, such as the structure of sports facilities, and the equipment and signage in these

facilities; others are related to the field of expertise of the Licensed Service Accessibility Experts, such as the policies, staff, and programs of the given facility (Lieberman et al., 2006; Rimmer et al., 2005).

Additional barriers to enabling the participation of people with visual impairment or blindness in physical activity include minimal advance preparation, lack of time (Lieberman et al., 2006), and lack of self-discipline and motivation to participate (Lee et al., 2014).

Recommendations for Accessibility and Adaptation of the Pool Structure and Environment for Aquatic Therapy, Bathing, and Swimming for People with Visual Impairment and Blindness

To ensure that all people with disabilities, including those with visual impairment or blindness, have suitable accessibility to a swimming pool facility, the Licensed Buildings, Infrastructure and Environment Accessibility Expert must be consulted as early as in the planning stages of the pool. Doing so could ensure that it is built in compliance with all relevant rules and regulations, and preferably also in line with universal design principles (Erin, 2014).

Entering the Swimming Pool

A sufficiently wide entrance into the actual swimming pool must be considered, namely one that allows two people to use it simultaneously, especially side by side. Contrasting colors should be used for the railings, ladders, and frames. It is also important to place an auditory aid that emits sounds at the entrance of the pool, so that people can orient themselves. If the entrance door is transparent (as seen in many indoor pools), details must be added to the door, in two contrasting tones (as per the Israeli Standard SI 1918, Section 4). Furthermore, it is important to add shade to the entrance area in such a manner as to moderate the changing levels of light, thereby making it easier to adjust to these changes when entering and exiting the swimming pool complex. In is important to note that extreme light changes could cause temporary blindness, thereby increasing the risk of accidents.

Tiling and Changes in Color and Texture in the Pool and the Pool Environment

The tiling in the swimming pool environment should be uniform, non-reflective, in a non-glossy shade, and with no decorative elements. The color of the skirting should be in contrast to the color of the walls, acting as a border between the tiling and the wall. To distinguish between areas in the pool environment, different tiling textures and colors can be used (Figure 1), to enable users with visual impairment or blindness to identify where they are at any given time. It is essential that areas that contain different heights and depth perceptions are clearly marked using contrasting colors. For example, for stairs, a visual contrast strip with a

rough texture should be placed at the beginning of the staircase and on the front edge of all steps (Figure 2). Another example for contrasting colors is a yellow rail at the entrance of the swimming pool, that is in clear contrast to the blue of the pool (Figure 3).

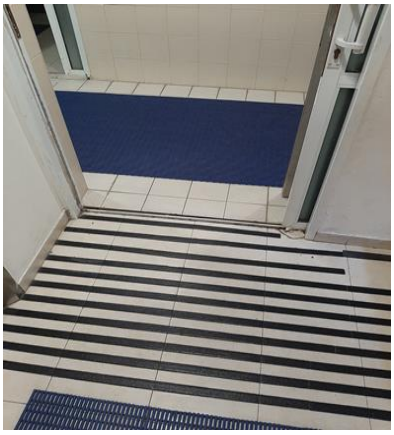

Figure 1. Different Textures and Colors in the Various Areas in

Figure 2. Pool Entry Steps

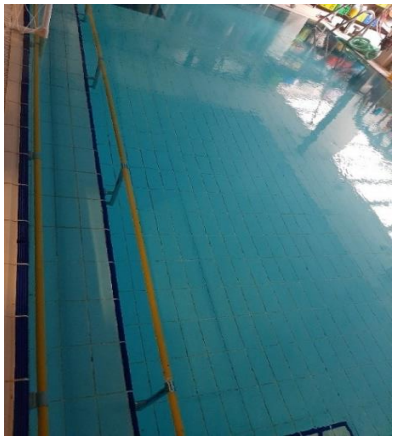

Figure 3. Yellow Rail.
Note. The rail is painted in yellow, which is a contrast color to blue; the rail in the photograph delineates the walking perimeter.

Recommendations for Accessibility and Adaptation of Services in the Swimming Pool and its Environment for Aquatic Therapy, Bathing, and Swimming for People with Visual Impairment and Blindness

To guarantee accessibility of the pool facility to people with a disability, including people with visual impairment or blindness, a Licensed Service Accessibility Expert must be consulted. Following are several basic principles that should be considered:

Signage Accessibility

To enable accessibility to the information on the signs in the pool environment, all signs must be placed in areas without equipment that could block the signs. The sign itself must also be adapted, using a unicolored and non-textured background. The text must appear in a color that contrasts that of the background, and in large, bold, and prominent print (Figure 4). Using a non-glossy color is preferable, to ensure that it does not reflect the light. Braille should also be used on such signs.

Figure 4. Example of an Accessible Sign

Taking Acoustics into Account

The sense of hearing is most dominant in people with visual impairment or blindness; as such, a quiet space is of the utmost importance in the swimming pool environment (Lieberman, 2011). Many swimming pools in Israel, especially therapeutic ones, are indoor pools. The roofing often creates problematic acoustics, enhancing background noises (such as other people's movements in the water, as well as their voices) and creating loud echoes. As such, lessons and therapy for this population should be scheduled at quieter times, when there are fewer people in the complex in general, and in the swimming pool in particular.

Accommodating the Lighting to the Needs of the Swimmer/Patient

To enable the adjusting of the lighting in the pool to the unique needs of people with visual impairment or blindness, shades and blinds should be available, to control the light from the outside. The instructor/therapist must also be aware of the angle at which the light hits the pool, in order to avoid placing people with visual impairment or blindness facing the source of light, and to prevent glare (Figure 5).

In addition, visual stimuli can be added, in the form of glowing waterproof light fixtures.

Figure 5. Example of Adapted Lighting and Awareness of the Angle at which Light Hits the Pool

Permanent Arrangement of the Swimming Pool Areas and Safe and Accessible Routes

To enhance orientation within the swimming pool environment, and to facilitate independence, equipment should be placed in a permanent spot, in both the pool area and the changing rooms. Furthermore, clear and walkable spaces must be ensured, to prevent people with visual impairment or blindness from bumping into objects. The height at which the equipment is placed should also be taken into consideration, so as not to restrict visitors' field of vision or pose an obstacle. Moreover, hanging objects on walls should be avoided, such as cabinets or wall-mounted diaper changing tables – as these will pose obstacles for people who walk with a cane.

Recommendations for Adapting Teaching Methods for Aquatic Physical or Therapeutic Activity for People with Visual Impairment and Blindness

Before Entering the Water

It is important to speak with the patients and/or their parents/carers prior to the first session in the swimming pool, in order to obtain information about their functional vision. The following three questions are especially important:

1. Is the disability acquired or congenital?
2. Is the patient blind or do they have a visual impairment? In the case of the latter, what distance can they see and what is the quality of their vision?
3. Is the patient affected by the glare of sunlight or bright lights?

The patient should become familiar with the pool area, including the entry and exit points of the swimming pool, where equipment is placed during the sessions, etc. They should also receive detailed explanations about the stairs into the swimming pool, the perimeters of the pool, and the use of agreed-upon tactile cues (for example, when teaching how to swim it is important to prevent the collision of the patient's head with the pool wall; it should therefore be agreed upon in advance that a light tap on the head by the instructor is a sign to stop).

The patient should also be given time to adjust to the smell and sounds of the space (Cordellos, 1976), and the teacher/instructor should work to create a personal, reliable, and safe relationship with the patient. This is especially important as the instructor/therapist's voice and touch will serve as tools for building this relationship. In the initial sessions, the time actually spent in the water should be brief, lasting only a few minutes, yet gradually increasing from session to session.

During the Session – Communication in the Water and in General

The methods for teaching swimming, or for conducting physical and therapeutic aquatic activity, must be adapted to people with visual impairment or blindness. This can be achieved through the following six methods:

1. Verbal Instruction – Verbal communication is the primary input channel for people with visual impairment or blindness. They might have difficulty making eye contact or noticing facial expressions or gestures, and they do not tend to visually imitate the movements of others as a learning method. Therefore, a simple, clear, and consistent description of the desired action is necessary, rather than long-winded descriptions that could put a strain on their attention and processing levels (Lieberman, 2011; Lieberman & Haibach, 2012).

During the session in the water, the instructor should call the patients by their names, so that it is clear that they are being addressed or referred to. Furthermore, verbal instructions must be given in an informed and adapted manner. Using concepts such as "like an arrow" or "in the shape of a star" could be problematic, due to discrepancies in the perceptions of such shapes, especially among people with visual impairment or with blindness.

If the patient is an infant, be sure to use sounds that stimulate them to move in the desired direction (e.g., using a bell ball). The therapist's voice or the sound of the bell could serve as an auditory anchor that "stimulates" movement.

2. Tactile Information Guidance – People with visual impairment or blindness usually rely on the sense of touch as a learning and communicative medium (Lieberman, 2011; Lieberman & Haibach, 2012). The hydrostatic pressure on a body immersed in water transmits information about the body's boundaries to the brain (Becker, 2009). Such sensory information can be convey by creating whirlpools around the various body parts. Furthermore, every movement in the water transmits more information to the brain about the location of the body part that has moved. When a body part that is immersed in water moves, the movement's speed is significant, as is the surface area of the body part (there is a difference in the hand's movement, for example, between open and closed fingers), and the depth of the water (hydrostatic pressure increases as the depth of the water increases) (Becker, 1997).

People with visual impairment or blindness should be allowed to explore and touch any piece of equipment that is to be used during the therapy, before this equipment is actually used. This exploration can take different forms, as some people may prefer tapping the equipment on the side of the pool or on the water's surface, while others might prefer feeling the equipment or even putting in their mouths. It is important to give them time to properly explore the equipment. It is then also advisable to complement such exploration with a verbal description of the equipment's' main characteristics. To facilitate independence in choosing aquatic games and activities, it is also important to clearly mark the boxes in which the equipment is stored, for example, by adhering part of the actual game to the outside of the box.

3. Physical Guidance – It is important to physically assist the student when performing new movements. The instructor/therapist must place the student/patient's body in the desired position, so that the student/patient achieves a feel, rhythm, or motion of the movement prior to performing it (O'Connell et al., 2006). Such physical guidance can also be combined with

verbal explanations or cues. It is important to understand that physical guidance can range from fully assisting the student throughout the movement to a mere gentle touch, and students should be encouraged to perform the movement as independently as possible (Figure 6). Furthermore, it is important to inform the student/patient that you are about to touch them, before actually doing so, and ask for their permission to touch them (O'Connell et al., 2006; Lieberman, 2011).

4. Tactile Modeling – With this method, another person or even a dummy performs the desired movement, while the student/patient touches them as they do so (Lieberman & Cowart, 2011). This method allows the student/patient to understand the required movement, as well as its speed and direction (O'Connell et al., 2006; Lieberman, 2011).

5. Co-Active Movement – In such movement, the student/patient is situated in such a way so that their body part that they are moving touches the same moving body part of the instructor/therapist (Lieberman & Haibach, 2012) (Figure 7). This method is similar to Tactile Modeling, yet in this method, the body part that is moving is controlled by the instructor/therapist, and the student/patient performs the motion at the same time as the instructor/therapist.

6. Demonstration – This method can be applied for working with people with residual vision. The instructor/therapist or the peer will demonstrate the movement, making sure that they remain within the student/patient's field of vision. The demonstration must incorporate verbal or tactile cues (Lieberman, 2011; Lieberman & Haibach, 2012). If the student/patient encounters difficulty in understanding the demonstrated movement, it can be repeated several times, and complex movements can be broken down into smaller components (Lieberman & Cowart, 2011). In general, it is necessary to plan the learning steps, in order to teach a new exercise or swimming motion (Mohanty et al., 2016).

Figure 6. Example of Physical Guidance

Figure 7. Examples of Co-Active Movement

It is important to keep in mind that transitions are especially challenging for people with visual impairment or blindness. For example, moving from the pool deck into the water, or climbing onto a pool air mattress. Each transition involves a change in position and in immersion depth. Since the ability to see the upcoming changes is limited or nonexistent, such transitions are a sensory stimulation that must be given time to process. Unlike sighted people, people with visual impairment or blindness are dependent on the instructor/therapist's guidance and instruction, and will not be able to prepare for the transition or change in the body's position unless the instructor/therapist explicitly says so. As such, exposure to transitions and changes must be longer than usual, and with many brief repetitions.

In aquatic activity, it is possible and even desirable to include a child with visual impairment or blindness in a peer group of sighted children (Hess, 2009) – in line with the child's abilities, and with some consideration of their chronological age. When working in a group, it is important to constantly state the children's names, so that the child with the disability feels confident, and to mediate between the child and their surroundings.

After the Session

It is important to achieve feedback from the student/patient, if possible – as a means for understanding what was helpful, which further adaptations they required, and what type of additional support could be beneficial.

Summary

For meaningful and effective learning to take place among people with visual impairment or blindness, instructors and therapists must carefully choose the methods that they apply, to suit the specific population (Lepore et al., 2007; Lieberman, 2011; O'Connell et al., 2006). Combined

with an adapted swimming pool environment, optimal learning and accessibility will be possible. It is also important to allow for accommodations and the use of suitable aids, in order to enhance visual efficiency and independence (Corn, 2017).

The purpose of this article was to offer practical/applicable tools for working in the water with people who have visual impairment or blindness. Practical tools include adaptation of both the pool environment and the learning method. This article presented existing research infrastructure; yet additional studies are necessary for understanding the unique/distinct obstacles that people with visual impairment or blindness encounter in the swimming pool environment, as well as the contribution of different aquatic learning and therapy approaches to improve functioning and orientation within this environment. Based on such studies, we will be able to develop and leverage various approaches to working in the water, while adapting them in an evidence-based manner to the patient and treatment.

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