

The Wheelchair

For sufferers of Duchenne Muscular
Dystrophy
(DMD)

Duchenne Muscular Dystrophy (DMD) is a global disease, one of the 9 unsparing, more common childhood forms of muscular dystrophy, affecting every 1 out of every 3,500 boys ("Muscular Dystrophy").

It is caused by the absence of a gene in the body, preventing the body from manufacturing a specific protein in the body by the name of Dystrophin, which keeps muscle cells intact, and maintains the muscles strength.

The gene for Dystrophin is on the X-chromosome, making it an X-linked recessive disease, affecting mainly males, who inherit it from their mothers. Females usually are carriers of the disease, but show no symptoms.

Dystrophin is part of the dystrophin- glycoprotein complex, which helps the body to anchor the structure of the human skeleton within the muscle cells, through the membrane of each muscle cell, to the tissue lining that surrounds each muscle cell. When any component is lacking in this system, any muscle contraction will lead to the disintegration of the membrane of the outer cells, therefore leading to the permanent weakening and perishing of the human muscles.

Symptoms become evident in early childhood (2-6 years old), when a child begins walking, as the pelvic muscles begin to weaken, and a wheelchair is required for the affected child when the child reaches the age of about 10-12 years.

Early symptoms will appear at varying degrees, including, the ability to walk, sit straight, breathe normally, and move the arms and hands freely. All these weaknesses will increase with age, and may also lead to other health problems.

Figure 1 below shows a sufferer of DMD:

"DMD sufferer"



Since DMD is a global disease, infecting children all over the world, all of them will of course need a wheelchair at some point, so the wheelchair will affect the lives of these children all over the world, to make them feel able. They can move around and not sit at home, and feel like normal human beings, but of course depending if society supports that with wheelchair accessibility everywhere.

Without wheelchairs, sufferers of DMD will most probably miss out on the short life they have, and feel inferior since they are children, and should be living life like normal children.

It is uncertain who invented the wheelchair, but history shows in 1595, "an invalid's chair" was designed for Phillip II of Spain, but it is unknown who the designer is. Later, in 1783, John Dawson Bath designed a wheelchair named after the town of Bath. This wheelchair was made up of two big wheels and one small one. In the late 1800's a more comfortable wheelchair was invented, since the Bath wheelchair was highly uncomfortable for the disabled. The wheelchair kept evolving with minor changes throughout the periods of time, to finally be the wheelchair we know and see today. Figure 2 and 3 below show the evolvement of the wheelchair, of how it was before and how it looks now.

Figure 2:
"The Old Wheelchair"



Figure 3:
"The Modern Wheelchair"



How the wheelchair works (its biomechanics and motion) can be understood by the physics-related laws of motion. A proper wheelchair has low friction and runs on the floor with low running friction. Since a wheelchair has low friction, very little force is required to keep it moving but more force is required to change the wheelchairs state of motion. Newton's first law and second law of motion are applied to the mechanics of a wheelchair. Newton's first law states that every object in a state of motion will stay in motion, unless acted upon by an external force. This is applied to the wheelchair by introducing mechanics to the equilibrium of a wheelchair (how the wheelchair stays in equilibrium and does not move unless pushed on by an external force.)

Newton's second law states the relationship between the force applied to the object in motion to its force and acceleration, where $\text{force} = \text{mass} \times \text{acceleration}$. Let us assume that there is a person pushing the wheelchair, so the assistant is producing a force (f). The mass of the wheelchair and the person in it is noted as (m), and the acceleration of the wheelchair will be noted as (a). According to Newton's first law, the wheelchair is in equilibrium, at acceleration 0. When the assistant pushes the wheelchair, the acceleration of the wheelchair, will be directly proportional to the applied force, as stated in Newton's second law.

The wheelchair has many advantages including its lightweight, where it is easier to push by the sufferer of DMD, and the person helping to push the person. So the assistant pushing the wheelchair will be at ease while pushing the wheelchair, and the sufferer of DMD will easily move around, and not tire his/her muscles, since they are already weakened by DMD in the first place.

Its cost is very cheap, less than other pieces of physical aid like electrical wheelchairs and scooters. Since it's a global disease, everyone all over the world, in developed countries or undeveloped will suffer from DMD, so all sufferers will be able to purchase wheelchairs.

It's easy to transport, and take to places, since it can be folded up easily and moved around, so the sufferer will be able to go virtually anywhere, with no difficulty.

Also, it can go virtually anywhere, so the sufferer does not have to worry if where they are going is too bumpy or too uneven.

It also allows physical activity for the sufferer of DMD as I mentioned before since they might feel inferior because of their disease, but the wheelchair allows these sufferers to take part in more activities such as basketball, so they can feel normal.

Controversy to this, the wheelchair also has disadvantages. One of the disadvantages is if the disabled human is pushing the wheelchair by himself, although it is lightweight, the sufferer's upper body through time is weakened by the disease, so one might not be able to move freely, since the hands might get tired, although it gives excellent exercise to the human's upper body, it can still lead to injury.

Also, the tires of the wheelchair must be inflated regularly, so this might cause trouble for the sufferer, especially the ones who live by themselves with no help since they would have to go every month or so to inflate the tires.

Wheelchairs interact mainly with sociality since when having a deadly disease as a child, you are cutback from the activities that unaffected children normally experience, so providing a wheelchair for DMD sufferers can of course not ensure total comfort for the sufferers, but can ensure a sense of it.

Also, society's reactions to sufferers may impact the sufferer, especially in adolescent sufferers, where they would for example be socially unaccepted because of their disability, and be socially excluded. An example is shown through a thirty-five year-old woman who was not permitted into a greeting card store because the owner claimed it was a fire hazard to have a wheelchair in the aisles ("Martens, Christine")

Wheelchairs also interact with cultural implications, since when any manufacturing company is designing a wheelchair; it has to be kept in mind about the culture in which the sufferer lives in, since DMD is a global disease. Things like the sufferers profile, his/her environment, his/her daily activities and social roles.

What can be done in order to insure that the wheelchair matches with the criteria of the sufferer is to take all his/her living circumstances in mind, and design an ideal wheelchair for that, although it might be costly.

The environment where the sufferer of DMD lives can impact the use of wheelchairs. Developed countries support wheelchair accessibility while undeveloped countries have unfriendly wheelchair access, where no ramps can be present to make the disabled feel normal, and enter specific buildings.

Wheelchairs can interact with economical implications, since this is a global disease, so some sufferers in poor countries will need a wheelchair, and it can be costly for them, since the little money they have will be spent on the essentials such as food and

medicine so they will live their lives physically unable to do anything or move around.

While the wheelchair is improving and developing, some moral and ethical considerations should be kept in mind, like keeping the original idea of the wheelchair in mind when creating all of the new gadgets and power buttons to create modernized wheelchairs, like TV installations and built in-phones, when all that is needed is a smooth-running wheelchair that can go anywhere. These gadgets that are being installed in modern wheelchairs I think, makes the disabled feel more impaired than they already are, since they can watch TV like normal people, and they can talk on the phone like normal people, and when all these gadgets are installed, the impaired will feel discriminated.

Without the wheelchair, the disabled would be physically unable to do anything, so they will spend their lives doing nothing when they can be accomplishing so much in the limited amount of time that DMD sufferers have.

Without the wheelchair, William Rinaldi, who was diagnosed with DMD, would not have become a successful teacher and Governmental Administrator. He was the first wheelchair user in the history of elementary, secondary, college and graduate school. Without the wheelchair, the disabled would have no rights to perform anything.

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