RECENT DISCOVERIES IN PERSONAL PROTECTIVE EQUIPMENTS

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ABSTRACT:

In the Human sphere of life, Protection is defined as any measure taken to guard or protect an object or a human against any kind of Physical, Chemical and Biological hazards. Personal protective equipments are the equipments that offer complete protection against these kinds of hazards.They are designed in such a way that they ensure one's safety to the fullest. The hazards addressed by protective equipments include physical, electrical, heat, chemicals, Bio hazard and airborne particulate.They are routinely used by Health care Professionals for preliminary protection. They enhance Occupational safety and also impose a barrier between the user and the environment. A Tremendous number of personal protective equipments had been invented in the last two decades. This review article has studied more than 55 articles on Personal protective Equipments. The article discusses such equipments that are needed for self protection of mankind which includes Face protective, Eye protective, Head protective, Ear protective, Ballistic protective and Foot protective equipments.

KEYWORDS: Anti ballistics, Canal caps, Goggles, N95 respirators, Personal Protective Equipments.

INTRODUCTION:

Protection is defined as any measure taken to guard a thing against any kind of damage that is caused by physical objects, Biological organisms, toxic chemicals, and all other intangible things like civil and political wars(Hassan et al. 2017)(Mp, Brundha, and Nallaswamy 2019) In the Human sphere of life, the concept of protection has been extended against non living objects, including technological systems, intellectual properties, Beliefs and Economic systems(Kaur 2017)(Brundha and Pathmashri 2019)(Prashaanthi and Brundha 2018). Personal protective equipments are the equipments that offer safety and protection from all sorts of physical, chemical and biological hazards. They are designed in such a way that they ensure one's safety to the fullest. The hazards addressed by protective equipments include physical, electrical, heat, chemicals, Bio hazard and airborne particulate(Haritha and Brundha 2019) matter. The personal protective equipments are used in order to reduce exposure to hazards when Engineering and Administrative controls are not Feasible or not at a level of acceptance(Kumar, Ashok Kumar, and Brundha 2016).Occupational safety and health administration mandates that these PPE in specified circumstances reduces the risk of exposure to blood borne pathogens(Hannah et al. 2019).They are routinely used by Health care Professionals for preliminary protection. They impose a barrier between the user and the Environment. They also reduce the risk of accidents (As'ady, Supangat, and Indreswari

2019). We have got a plenty of Personal protective Equipments designed to serve their own purposes. They are Face protective, Eye protective, Head protective, Ear protective, Ballistic protective and Foot protective equipment (Preethikaa and Brundha 2018). The Hierarchy of Hazard controls and various interventions to mitigate workplace hazards provide a policy framework which ranks the types of Hazard controls in terms of absolute risk reduction(N Aguwa 2013). Personal protective equipments are of tremendous utility that they protect us from various kinds of hazards. Measures should also be taken to reduce the mechanism of control of hazards(Shreya and Brundha 2017). Various Researchers have worked tirelessly in order to protect mankind from all sorts of impending danger(Subramaniyan et al. 2019). Tremendous number of Personal protective equipments had been invented in the last two decades. This study discusses some of the most important Personal protective Equipments. So, The aim of the study is to discuss all sorts of Protection and various recently discovered Personal protective equipments elaborately.

MATERIALS AND METHOD:

Articles by various Researchers all over the world had been used in constructing this article. More than 55 articles had been used for this purpose. The articles were retrieved using various search engines like Google scholar, Pubmed, Cochrane, Biorxiv and Chemrxiv. No approval for publication of the article was not required as it is a Review article.

FACE PROTECTIVE EQUIPMENTS:

Face protective equipments offer protection from various kinds of infections, air borne particulates and various other hazards(Dickson and Gudgin Dickson 2012). Face protective Equipments come first in our list because of the current ongoing dreadful Coronavirus Pandemic. Face masks become inevitable in controlling the rapid transmission of this deadly infection . Here we discuss the various kinds of Personal protective Equipments that not only offer protection against infections but also against many kinds of other protections related to Fire and Physical hazards. Basic cloth face mask is a standard, every day version of a face mask. They are soft, breathable, single ply spandex blend similar to a stretchy T - shirt. They have got a contoured shape and two sets of Ear holes(Kalaiselvi and Brundha 2016). They help in slowing down the spread of infection and preserve Medical grade gear for healthcare professionals but these kinds of masks do not protect us from exposure to hazardous liquids and High intensity heat sources or inflammable gases. Surgical face masks are FDA approved face masks(Harvey 2020) . They are made from a thin and disposable material. They are intended to be used by Healthcare professionals during Health care treatments. Surgical masks are often labeled according to their usage as Surgical masks, Medical or Dental procedure masks and isolation masks. Surgical masks greatly reduce the infection risk(Swetha and Brundha 2017).

Then comes the N95 respirator. N95 respirators are protective devices that have got a very close facial fit. They can efficiently filter the airborne particles(Mehedi, Amzad, and Akhtar n.d.). They are known for their fluid resistance, Filtration efficiency. Flammability and Bio compatibility. They are disposable.Filtering Facepiece respirators are devices that reduce the inhalational exposure to particulate contaminants(Polkinghorne and Branley 2020). They are used to decrease exposure to particulates like Wood dust, Animal dander and Pollens. They are used by workers working in sewing Industries (Fischer et al. 2020). The next one in the list is Self contained breathing apparatus. It is the type of face mask used by Fire freighters and Police personnels. They are used for providing breathable air in an immediately dangerous life or health atmosphere.

Full face respirators provide respiratory protection from hazardous vapours and gases. They are light weighed and balanced. They have got a face seal made up of silicon rubbers and hard coated lens providing a wide field of vision(Shenoy and Brundha 2016). P100 respirators/Gas masks rates highest for Personal respiratory protection.They are effective at blocking 99.99% of oil based particulates. They also

provide protection against dust, Fumes, Mist, Heavy metals like lead, arsenic and cadmium(Polashek 2014).

EYE PROTECTIVE EQUIPMENTS:

Eye protective equipments provide a protection gear for the eyes that are designed to reduce the risk of injuries to eyes. They give protection against impacts from Particles or debris, light, Radiations, Wind blast, Heat and sea sprays. The preliminary equipments used are spectacles, various kinds of Goggles and hoods. Let us discuss some of them in detail.

Spectacles are safety glasses that closely resemble common eyewears. But they are different. They include side seals to reduce the ability of debris to get behind the lenses from the sides. They often have mount insert frames for users with suboptimal vision power.The most often used eye protective equipments are Goggles. They protect the eyes by enclosing the area. By doing so they prevent the entry of water, particulates or chemicals into the eyes.There are various types of Goggles that attribute to their specific purposes.

Blow torch goggles offer protection from glare and flying sparks They also give extraordinary protection against hot metal splashes from a blow torch. They cannot be used for arc welding(Bekele et al. 1999). Racquetball protects eyes from swinging racquets and also from the impacts of hard rubber balls. They keep the eyes safe from direct and peripheral threats with a strong and durable polycarbonate wraparound construction. Also it protects the eyes from 90-100% of harmful UV radiation.Double coated, untinted lenses mean no fogging up or optical distortion so that the user can see better at all times(McLean et al. 2008).They are ideal for woodworking and carpentry, metal and construction work, lab and work, shooting, cycling or racquetball.

Welding goggles offer protection against debris. Heat emitted from welding. So, As the name says they are used in welding industries. They are intended to protect the eyes not only from the heat and optical radiation produced by the welding, such as the intense ultraviolet light produced by an electric arc, but also from sparks or debris and thus prevent arc eye(Timothy, Samyuktha, and Brundha 2019).Dark adapter goggles help eyes adapt to the darkness when suddenly switching from bright light to dark light. The goggles are made with red-tinted plastic lenses and are also called red adaptation goggles. They used in the field of meteorology and astronomy for adapting the eyes to the dark prior to an observation at night. They also aid with the identification of clouds during bright sunshine or glare from snow(Brundha 2015)

Swimming goggles are used for protecting the eyes from salt water, from irritation and blurring vision and they are most commonly used among the People.AN6530 Goggles are aviation goggles that are used by the aviators in open cockpit aircrafts and airplanes(Crosley 1989). They protect the eyes from wind and still. Fatal vision goggles are designed to simulate vision altering effects of Psychiatric drugs, in Particular alcohols. They are used for awareness purposes that show the adverse effects of drunk and impaired driving. Hood also called as non rigid helmets often come with impact resistant windows usually made of plastic materials. They are convenient in carrying and storing(Hennessy, Lanni-Manley, and Maiorana 2006).

HEARING PROTECTIVE EQUIPMENTS:

Hearing protection devices protect us from exposure to high level noise and the resultant risks of impaired hearing. They prevent occupational hearing loss. The devices are customised to serve their unique purposes. Some of them are addressed here. Ear plugs are the often used ear and hearing protection devices. They are inserted into the ear canal to protect the user's ears from loud high noises, water intrusion, foreign bodies, dust,wind(Shulman and MacIsaac 1995). They also help in preventing hearing loss and tinnitus. As we had various types of Goggles, there are various types of ear plugs used for a variety of purposes. Ear muffs are a pair of ear coverings that are connected by a flexible band. They

provide protection from noises. They are made up of foam filled cushions that provide excellent comfort and protection and they amplify weak signals(Lenzuni 2009). But in overtime usage they can become hot and uncomfortable that they cannot be used anymore.

The next in the list is reusable ear plugs. As the name implies, they can be washed with soap and water and can be reused, They come in different sizes and last up to a year.

The next one is an odd one called Musician's ear plugs. They are designed in such a way that they attenuate sounds evenly across the frequency bands and they do not affect the user's perception on base and treble levels(Cook-Cunningham 2019). They are also great communication ear protectors and come in reusable forms.The Cheap foam ear plugs are the most popular types. They are made from expandable self adjusting low pressure foams. They are tapered for easy insert and offered in corded and uncorded models. Metal detachable ear plugs are hearing protection products that are used in the food industry. They feature a detectable metal bee. They come in disposable forms(Brundha and Visha 2019). Semi insert ear plugs are used for short time use. They have got a pair of cone shaped rubber tips on a metal or plastic frame that is meant to be worn under the chin while the cones go and seal the ear canals(Hutchinson, Alexander, and Cawley 2010).

Canal caps have flexible tips that plug the ear canals. They do not extend into the ear canal, they close only the opening. It is ideal for situations where hearing protection must be taken on and off frequently. Unlike other protective devices, designing a hearing protection device is very hard because of the adverse effects that results from over protection. It cannot provide enableness to the wearer as the wearer cannot hear any emergency alarms(Carr and Crawford 2016).

FOOT PROTECTIVE EQUIPMENTS:

Foot protection devices give protection against falling and rolling objects, crushing, penetrating, hot, corrosive and poisonous materials. They also give protection from electrical hazards and slippery surfaces.Safety toed shoes and boots offer protection from falling and prevents rolling hazards. They are designed based on ANSI Z41 - 1999 standards. Rubber shoes give protection from flooded floors and are used in concrete works(Gu 2016).

Toe guards are fits over toes that protect the toes from compression and impact hazards. They are often made of aluminium and steel , sometimes of plastic and from Thermoplastic Rubber Gel. This means they stretch to fit any toe and stay in place. Toe Caps serve as a cushion, preventing toe from having direct contact with the inside of the shoe. They absorb the stress over the toe area.Shoes with slip resistant soles protect from accidents or falls from wet surfaces.Slip resistant soles have got special soles. They provide traction from oily surfaces(Chen and Chaudhry 2005, Saivignesh and Brundha 2019)

Insulated boots keep the wearers feet warm, They are used in cold weathers.It comes with a faux fur cuff to help keep feet warm down to -25°F/-32°c. The vulcanized rubber outsole delivers high-traction performance on wet and slippery surfaces(Rao, Hosur, and Jeelani 2016).Metatarsal guards are guards that protect the top of the foot from compression injuries. They are strapped to the outside of shoes and give protection to the instep area from getting crushed by heavy objects.The guards should be used in any workplace where there is a danger of injuries caused by heavy items falling, dropping or rolling onto the top of the foot. They may be manufactured from aluminum, steel, lightweight composites or synthetic materials(Cork 2016)

ANTI BALLISTICS/ BALLISTIC PROTECTIVE EQUIPMENTS:

Ballistic protection is the protection of the body and eyes against projectiles of various shapes, sizes and impact velocities. Usually Ballistic vests are used for ballistic protection. Ballistic protective equipments purchase is legal and requires a license for purchase. They help in reducing or halting the penetration and impact of projectiles and shrapnels from explosion.The history of Ballistic protection

traces back to the late 19th century. It was a soft body armour manufactured from silk. They were effective against low velocity bullets at 400 feet per second or less but not effective against bullets of 600 feet per second speed. Secondly, the silk used for the manufacture process was expensive(Naik 2016).

Kevlar's Jacket invented by Dupont forms the basis of today's modern bullet proof jackets.One of the armour discovered in the recent past is state of art fiber reinforced Ballistic composites. They are produced by compressing and curing stacks of impregnated woven fabrics. They excellently serve their purpose.Polyethylene fiber reinforced ballistic products contain either woven fabrics or impregnated and cross ply unidirectional reinforcement.Hard body armours are made from rigid materials such as ceramics reinforced plastics, metal plates and composites.Ceramic armour hybrid systems consist of monolithic ceramics or composite ceramic metal body forms covered with ballistic nylon bonded to high performance textile fabrics(Hepper et al. 2011).

In Spite of the great advances in Ballistic protection materials, because of the heavy weight of the materials and expenses, the Protectors of the country, the soldiers are not provided with Bullet proof vests. As they are so heavy, they generate a lot of heat and soldiers may die from heat strokes instead of ballistics. So a material of light weight and less expensive is yet to be invented.

CONCLUSION:

It can be concluded from the above review that Personal Protective Equipments offer all sorts of protection to mankind. The article had discussed various Face protective, Eye protective, Head protective, Ear protective, Ballistic protective and Foot protective equipments.
It is an ever growing field of invention that always tend to serve the mankind

AUTHOR CONTRIBUTIONS:

Anu Iswarya Jaisankar, contributed to the data acquisition and drafting of Manuscript. Dr.M.P.Brundha, contributed to the design, editing and critical revision of the manuscript. Dr.D.Ezhilarasan, contributed to the supervision and proof reading of the manuscript.

CONFLICTS OF INTEREST:

The authors declare that there are no conflicts of interest.

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