

Evolution of Bicycles and their utility as Fitness aids – A Review

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Abstract: The childhood memory of the exhilarating moment when one first learns to balance and ride on the two wheels of a bicycle is unforgettable. Bicycling provides a sense of freedom and mobility, a means for exploration and discovery. It is faster and more efficient than walking, and riders are exposed to nature's elements and social interaction. Cycling can help to protect you from serious diseases such as stroke, heart attack, some cancers, depression, diabetes, obesity and arthritis. Riding a bike is healthy, fun and a low-impact form of exercise for all ages. Cycling is easy to fit into your daily routine by riding to the shops, park, school or work. This research paper encompasses over the evolution of bicycles from ancient times to the present day generation. Attempt has been made through this research to study the transformation in bicycles through wide range of application of technology into their modification and enhancement of their features supporting the fitness regime of people using them. Many available past research articles have been reviewed and the progress of technology into bicycle design and utility has been critically analyzed. The latest technologies in bicycles have been elaborated with their impact on physical fitness maintenance among regular users of bicycles. Compact chainrings, Disc and Hydraulic breaks, Electronic Shifting, Ceramic Speed's Driven pinion-style shaft-drive system and Meglock pedals and some of the newest additions. As a conclusion it has been determined that technology has majorly impacted over bicycle design and utility which makes bicycles the most eco-friendly fitness equipment in the present world.

Key Words: Hydraulic breaks, Electronic shifting, Shaft-drive.

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I. Preface

This article is a review and it reflects the evolution process of bicycle from past till date and the ways in which bicycles are being used as a source of fitness, health and well being. In this article the content that is studied and reviewed focuses on the shape and structure of initial bicycle and modifications and fabrications added from time to time to enhance its utility for healthy and well being.

II. Research Objectives

The objectives of this research paper are

- To study the initial and latest composition of bicycle
- To study the utility process of bicycles for health and well being
- To review the latest transformations in bicycle and its effectiveness in fitness training.

III. Hypotheses

The following hypotheses were drawn for the present research

- Bicycles have taken a visible transformation with respect to shape and structure through centuries.
- The utility of bicycles for health, fitness and well-being has been widely elaborated and focused during recent years.
- Technology has been a critical component in evolution and enhancement of bicycle and its utility.

IV. History of Bicycle

The "Dandy horse", also called Draisienne or Laufmaschine, was the first human means of transport to use only two wheels in tandem and was invented by the German Baron Karl von Drais. It is regarded as the modern bicycle's forerunner; Drais introduced it to the public in Mannheim in summer 1817 and in Paris in 1818. Its rider sat astride a wooden frame supported by two in-line wheels and pushed the vehicle along with his or her feet while steering the front wheel.

The first mechanically-propelled, two-wheeled vehicle may have been built by Kirkpatrick MacMillan, a Scottish blacksmith, in 1839, although the claim is often disputed.

Starley's 1885 Rover, manufactured in Coventry is usually described as the first recognizably modern bicycle. Soon the seat tube was added, creating the modern bike's double-triangle diamond frame. Further innovations increased comfort and ushered in a second bicycle craze, the 1890s Golden Age of Bicycles. Bicycles and horse buggies were the two mainstays of private transportation just prior to the automobile, and the grading of smooth roads in the late 19th century was stimulated by the widespread advertising, production, and use of these devices. More than 1 billion bicycles have been manufactured worldwide as of the early 21st century.

V. Types of Bicycles

Bicycles can be categorized in many different ways: by function, by number of riders, by general construction, by gearing or by means of propulsion. The more common types include utility bicycles, mountain bicycles, racing bicycles, touring bicycles, hybrid bicycles, cruiser bicycles, and BMX bikes. Less common are tandems, low riders, tall bikes, fixed gear, folding models, amphibious bicycles, cargo bikes, recumbents and electric bicycles.

There are two types of Non-gearless bicycles available

Freewheel Cycles: These are the normal gearless bicycles that most people have. In this bicycle, the wheel is not fixed to the pedal and hence you can cruise on the cycles for a while once you reach a certain speed which is very useful when you are riding downhill and you don't need to pedal.

Fixed Wheel Cycles: These cycles have their back wheel hard connected to the pedals. So, the bicycle moves only if you use the pedals. This allows the cyclist to control the speed of the cycles using the pedals. These kinds of cycles are generally used in indoor track cycling events and even for exercise.

Geared Bicycles: Bicycle gearing is the aspect of a bicycle drive train that determines the relation between the cadence, the rate at which the rider pedals, and the rate at which the drive wheel turns.

On some bicycles there is only one gear and, therefore, the gear ratio is fixed, but most modern bicycles have multiple gears and thus multiple gear ratios. A shifting mechanism allows selection of the appropriate gear ratio for efficiency or comfort under the prevailing circumstances: for example, it may be comfortable to use a high gear when cycling downhill, a medium gear when cycling on a flat road, and a low gear when cycling uphill. Different gear ratios and gear ranges are appropriate for different people and styles of cycling.

Uses of Bicycle:

From the beginning and still today, bicycles have been and are employed for many uses. In a utilitarian way, bicycles are used for transportation, bicycle commuting, and utility cycling. It can be used as a 'work horse', used by mail carriers, paramedics, police, messengers, and general delivery services. Military uses of bicycles include communications, reconnaissance, troop movement, supply of provisions, and patrol.

The bicycle is also used for recreational purposes, such as bicycle touring, mountain biking, physical fitness, and play. Bicycle competition includes racing, BMX racing, track racing, criterium, roller racing, sportives and time trials. Bikes can be used for entertainment and pleasure, such as in organised mass rides, artistic cycling and freestyle BMX.

Around the turn of the 20th century, bicycles reduced crowding in inner-city tenements by allowing workers to commute from more spacious dwellings in the suburbs. They also reduced dependence on horses. Bicycles allowed people to travel for leisure into the country, since bicycles were three times as energy efficient as walking and three to four times as fast.

One of the profound economic implications of bicycle use is that it liberates the user from oil consumption. (Ballantine, 1972) The bicycle is an inexpensive, fast, healthy and environmentally friendly mode of transport. Ivan Illich stated that bicycle use extended the usable physical environment for people, while alternatives such as cars and motorways degraded and confined people's environment and mobility. Currently, two billion bicycles are in use around the world. Children, students, professionals, laborers, civil servants and seniors are pedaling around their communities. They all experience the freedom and the natural opportunity for exercise that the bicycle easily provides. Bicycle also has lowest carbon intensity of travel.

Cycling for health and fitness

It only takes two to four hours a week to achieve a general improvement to your health. Cycling is:

- Low impact – it causes less strain and injuries than most other forms of exercise.
- A good muscle workout – cycling uses all of the major muscle groups as you pedal.
- Easy – unlike some other sports, cycling does not require high levels of physical skill. Most people know how to ride a bike and, once you learn, you don't forget.
- Good for strength and stamina – cycling increases stamina, strength and aerobic fitness.
- As intense as you want – cycling can be done at very low intensity to begin with, if recovering from injury or illness, but can be built up to a demanding physical workout.
- A fun way to get fit – the adventure and buzz you get from coasting down hills and being outdoors means you are more likely to continue to cycle regularly, compared to other physical activities that keep you indoors or require special times or places.
- Time-efficient – as a mode of transport, cycling replaces sedentary (sitting) time spent driving motor vehicles or using trams, trains or buses with healthy exercise.

Health benefits of regular cycling

Cycling is mainly an aerobic activity, which means that your heart, blood vessels and lungs all get a workout. You will breathe deeper, perspire and experience increased body temperature, which will improve your overall fitness level.

The health benefits of regular cycling include:

- increased cardiovascular fitness
- increased muscle strength and flexibility
- improved joint mobility
- decreased stress levels
- improved posture and coordination
- strengthened bones
- decreased body fat levels
- prevention or management of disease
- reduced anxiety and depression.

Cycling and specific health issues:

Cycling can improve both physical and mental health, and can reduce the chances of experiencing many health problems.

Obesity and weight control

Cycling is a good way to control or reduce weight, as it raises your metabolic rate, builds muscle and burns body fat. If you're trying to lose weight, cycling must be combined with a healthy eating plan. Cycling is a comfortable form of exercise and you can change the time and intensity – it can be built up slowly and varied to suit you.

Research suggests you should be burning at least 8,400 kilojoules (about 2,000 calories) a week through exercise. Steady cycling burns about 1,200 kilojoules (about 300 calories) per hour. If you cycle twice a day, the kilojoules burnt soon add up. British research shows that a half-hour bike ride every day will burn nearly five kilograms of fat over a year.

Cardiovascular disease and cycling

Cardiovascular diseases include stroke, high blood pressure and heart attack. Regular cycling stimulates and improves your heart, lungs and circulation, reducing your risk of cardiovascular diseases. Cycling strengthens your heart muscles, lowers resting pulse and reduces blood fat levels. Research also shows that people who cycle to work have two to three times less exposure to pollution than car commuters, so their lung function is improved. A Danish study conducted over 14 years with 30,000 people aged 20 to 93 years found that regular cycling protected people from heart disease.

Cancer and cycling

Many researchers have studied the relationship between exercise and cancer, especially colon and breast cancer. Research has shown that if you cycle, the chance of bowel cancer is reduced. Some evidence suggests that regular cycling reduces the risk of breast cancer.

Diabetes and cycling

The rate of type 2 diabetes is increasing and is a serious public health concern. Lack of physical activity is thought to be a major reason why people develop this condition. Large-scale research in Finland found that people who cycled for more than 30 minutes per day had a 40 per cent lower risk of developing diabetes.

Bone injuries, arthritis and cycling

Cycling improves strength, balance and coordination. It may also help to prevent falls and fractures. Riding a bike is an ideal form of exercise if you have osteoarthritis, because it is a low-impact exercise that places little stress on joints. Cycling does not specifically help osteoporosis (bone-thinning disease) because it is not a weight-bearing exercise.

Mental illness and cycling

Mental health conditions such as depression, stress and anxiety can be reduced by regular bike riding. This is due to the effects of the exercise itself and because of the enjoyment that riding a bike can bring.

Hand cycling and health

Hand cycles are similar to recumbent tricycles, but they are powered with hand instead of foot pedals. Velcro straps can be used to secure the hands to the pedals if necessary. This style of tricycle allows amputees, people with spinal injuries and those recovering from certain conditions such as stroke to cycle as a form of exercise and recreation. Hand cyclists get cardiovascular and aerobic benefits similar to those of other cyclists.

Technology and its efficacy towards fitness through bicycles:

The bicycle has undergone continual adaptation and improvement since its inception. These innovations have continued with the advent of modern materials and computer-aided design, allowing for a proliferation of specialized bicycle types, improved bicycle safety, and riding comfort.

VI. Parts and Transformation

1. Frame: The great majority of modern bicycles have a frame with upright seating that looks much like the first chain-driven bike. These upright bicycles almost always feature the diamond frame, a truss consisting of two triangles: the front triangle and the rear triangle.

Historically, materials used in bicycles have followed a similar pattern as in aircraft, the goal being high strength and low weight. Since the late 1930s alloy steels have been used for frame and fork tubes in higher quality machines. By the 1980s aluminum welding techniques had improved to the point that aluminum tube could safely be used in place of steel. Since then aluminum alloy frames and other components have become popular due to their light weight, and most mid-range bikes are now principally aluminum alloy of some kind. More expensive bikes use carbon fibre due to its significantly lighter weight and profiling ability, allowing designers to make a bike both stiff and compliant by manipulating the lay-up.

2. Gearing: Since cyclists' legs are most efficient over a narrow range of pedaling speeds, or cadence, a variable gear ratio helps a cyclist to maintain an optimum pedalling speed while covering varied terrain. Some, mainly utility, bicycles use hub gears with between 3 and 14 ratios, but most use the generally more efficient *dérailleur* system, by which the chain is moved between different cogs called chainrings and sprockets in order to select a ratio.

In a lower gear every turn of the pedals leads to fewer rotations of the rear wheel. This allows the energy required to move the same distance to be distributed over more pedal turns, reducing fatigue when riding uphill, with a heavy load, or against strong winds. A higher gear allows a cyclist to make fewer pedal turns to maintain a given speed, but with more effort per turn of the pedals.

3. Handlebars: Three styles of handlebar are common. Upright handlebars, the norm in Europe and elsewhere until the 1970s, curve gently back toward the rider, offering a natural grip and comfortable upright position. Drop handlebars "drop" as they curve forward and down, offering the cyclist best braking power from a more aerodynamic "crouched" position, as well as more upright positions in which the hands grip the brake lever mounts, the forward curves, or the upper flat sections for increasingly upright postures.

4. Seating (Saddle): Saddles also vary with rider preference, from the cushioned ones favored by short-distance riders to narrower saddles which allow more room for leg swings. Comfort depends on riding position. With comfort bikes and hybrids, cyclists sit high over the seat, their weight directed down onto the saddle, such that a

wider and more cushioned saddle is preferable. Differing saddle designs exist for male and female cyclists, accommodating the genders' differing anatomies and sit bone width measurements, although bikes typically are sold with saddles most appropriate for men. Suspension seat posts and seat springs provide comfort by absorbing shock but can add to the overall weight of the bicycle.

5. Breaks: Bicycle brakes may be rim brakes, in which friction pads are compressed against the wheel rims; hub brakes, where the mechanism is contained within the wheel hub, or disc brakes, where pads act on a rotor attached to the hub. Most road bicycles use rim brakes, but some use disk brakes. Disc brakes are more common for mountain bikes, tandems and recumbent bicycles than on other types of bicycles, due to their increased power, coupled with an increased weight and complexity.

6. Suspension: Bicycle suspension refers to the system or systems used to *suspend* the rider and all or part of the bicycle. This serves two purposes: to keep the wheels in continuous contact with the ground, improving control, and to isolate the rider and luggage from jarring due to rough surfaces, improving comfort. Bicycle suspensions are used primarily on mountain bicycles, but are also common on hybrid bicycles, as they can help deal with problematic vibration from poor surfaces. Suspension is especially important on recumbent bicycles, since while an upright bicycle rider can stand on the pedals to achieve some of the benefits of suspension, a recumbent rider cannot.

7. Wheels: The wheel axle fits into fork ends in the frame and fork. A pair of wheels may be called a wheel set, especially in the context of ready-built "off the shelf", performance-oriented wheels. Tires vary enormously depending on their intended purpose. Road bicycles use tires 18 to 25 millimeters wide, most often completely smooth, or slick, and inflated to high pressure in order to roll fast on smooth surfaces. Off-road tires are usually between 38 and 64 mm (1.5 and 2.5 in) wide, and have treads for gripping in muddy conditions or metal studs for ice.

A gearless or a single speed cycle has a single gear ratio. The cycle goes faster or slower basis how hard you pedal. Bicycles with gear have multiple gear ratios. This enables the cyclist to change the gear ratio basis the terrain he/she is riding on. The derailleurs available on geared cycles lets you shift between different gear cogs, letting you maintain your cadence even as the terrain around you changes. This makes gear cycles more comfortable to ride over longer distances.

VII. Conclusions

The review of transformation in bicycles and their utility for health, fitness and well-being concludes the following points

- Since ages bicycles have been considered the most economic source of transport.
- Bicycles serve not only as the source of transport but also a key instrument for maintaining health and well-being.
- Technology has taken crucial role in transforming each and every part and element of bicycle and enhanced the performance, comfort and purpose of utility for health.
- The benefits of cycling are innumerable and are being increased by the influence of technology.

Suggestions: Through this review article the researcher puts forward the following suggestions

- Bicycles are one of the best sources for human well-being if taken up as a part of daily routine.
- The transformations that occurred in bicycles since its invention are majorly due to the impact of technology which can further be carried out as active research area.
- Bicycles may even be customized based on the body shape and structure of humans so as to provide comfort and as well serve the purpose of exercise.
- More research can be carried out to study the effectiveness of geared and non-geared bicycles.

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