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Chapter

Review of Environmental and Public Health Impact of Automobile Wastes and Automobile Transportation in Nigeria

John Kanayochukwu Nduka, Henrietta Ijeoma Kelle, Emeka Chima Ogoko and Perpetua Chioma Okafor

Abstract

Automobiles are machines designed for transportation; it is a self-propelled vehicle with power source for its propulsion and is used for transporting. Most vehicles imported into Nigeria are rickety and are mostly out of use, and since there is no regulation with regard to quality and quantity of vehicles to be imported coupled with lack of technology to deal with automobile waste, large volumes of automobile waste dot the Nigerian landscape. Negative environmental and public health issues of automobile waste and automobile transportation result from the fact that its several components (metals, metalloids, polymers, etc.) on decomposition or expiration release toxic substances such as phenols (C_6H_5OH), benzene (C_6H_6), polycyclic aromatic hydrocarbons (PAHs), and so on into the environment, while on operation, automobiles are the most significant source of air pollution as unburnt diesel releases particulate matter ($PM_{2.5}$, PM_{10}), oxides of carbon, oxides of nitrogen, oxides of sulfur, volatile organic compounds (VOCs), smoke, soot and ash particles, metal oxides, as well as nitrate and sulfate groups. The aim of this work is to explore and draw out salient points from previous literature with regard to detrimental environmental and public health issues of automobile wastes and automobile transportation.

Keywords: automobile transportation, toxic chemical substances, environmental pollution, public health issues, imported auto-waste

1. Introduction

An automobile is a machine whose ultimate designed function is to transport men and goods. It is also called a motor car [1]. It is a self-propelled vehicle which contains the power source for its propulsion and is used for transporting passengers and goods on the ground, such as car, bus, trucks, articulated vehicles, etc. It is also a transportation equipment unit which consists of a frame supporting the body and certain power developing and transmitting units which are further supported by tires and wheels through springs and axles [2]. An automobile is simply

anything vehicular that has its own power source and it is mobile. Eckermann, [3] ascertained that the first automobile, i.e., steam powered, was first built in 1769 by Nicolas-Joseph Cugnot, but the first powered gasoline was developed by Karl Benz in 1885 through manufacturing processes [4]. Most automobiles today are propelled by internal combustion engines. Tremendous growth has occurred in the automobile industry, after the designing of internal combustion engines. Today, the automobile industry plays a crucial role in the social, economic, and industrial growth of any country. Automobiles offer very advantageous help to man such as movement of people and goods to their places of interest (such as city to city, city to the hinter land, church or religious activities, markets, schools, tourist sites, cross borders of countries, etc.). Sports cars are for sporting activities, sometimes for other personal interest, luxury, and entertainment. Increasing the number of automobiles on any country road means increased traffic-related problem such as road congestion, increase in ambient air temperature due to engine heating and exhausts combustion, delayed time of movement, and traffic emission pollution. Gaseous pollutants from automobiles such as carbon (IV) oxide (CO_2), carbon monoxide (CO), methane (CH_4), sulfur (IV) oxide (SO_2), and nitrogen (IV) dioxide (NO_2) and particulate aerosols were reported in Nigeria above ambient level [5].

Another emerging problem associated with automobile transportation is the ever-increasing automobile waste, for the fact that large volumes of aging vehicles are imported into Nigeria, coupled with lack of adequate legislation on life span of vehicles to be imported into Nigeria. It become an all comers affair, and the effect is that aged, rickety, worn-out automobiles dot the Nigerian environment [6–8]. Climatic factors such as acidic rain, moisture (dew) and sun act on them as they corrode, degrade and decompose to release toxic chemicals into the environment. This in addition to others constitutes environmental and public health issue.

2. Classification of automobiles

Rajput [2] and Kirpal [9] classified automobiles based on the following factors:

2.1 On the basis of load

Automobiles can be classified based on the load or their capacity. The heavy transport vehicle (HTV) or heavy motor vehicle (HMV), which carries heavy materials, possesses large mass and is bigger in size. Examples are tractor, heavy-duty trucks, etc. They also have light transport vehicle (LTV) or light motor vehicle (LMV) which carries light things and is less in size (e.g., car).

2.2 On the basis of wheels

Automobiles could be two-wheeler vehicle (TWV) (e.g., scooter, motorcycle), three-wheeler vehicle (TWV) (e.g., auto rickshaw), four-wheeler vehicle (FWV) (e.g., car, jeep, trucks, busses, etc.), six-wheeler vehicle (SWV), and more depending on the carrier design.

2.3 On the basis of fuel used

In this category, we have petrol vehicles, diesel vehicle, electric vehicle, which use battery to drive (forklift, battery truck and electric car), steam vehicle (e.g., steam engine boat), and gas vehicle (i.e., vehicles that use liquefied petroleum gas and compressed natural gas).

2.4 On the basis of purpose

They can be classified based on the purpose they serve, i.e., it could be passenger-designed vehicles, goods designed vehicles, and special-purpose vehicle (such as armored car, ambulance, etc.).

2.5 On the basis of transmission

Automobiles could be: (i) Conventional vehicles with manual transmission, whose gear ratios have to be changed manually while driving (e.g., car with five gears). (ii) Semiautomatic transmission system: Some automobiles are designed in such a way that facilitates manual gear ratios changing with a clutch pedal. (iii) Automatic transmission system: Automobiles with automatic transmission do not require gears to be changed manually, but they are capable of changing gear ratios automatically as they move.

2.6 On the basis of drive

They could be (i) left-hand drive (steering wheel fitted on the left hand), (ii) right-hand drive (steering wheel fitted on the right hand), and (iii) fluid drive (vehicles that employ torque converter (e.g., fluid flywheel)).

2.7 On the basis of suspension system

Automobiles can be classified based on the type of suspension system designed with it. We have three types of suspensions. They include:

i. The independent suspension—it allows the wheels to rise and fall on their own vertically without affecting the opposite wheels, e.g., swing axle, multi-link suspension, trailing arm, etc. [10].

ii. Dependent suspension—it has a beam (a simple cart axle) or driven axle that holds the wheels parallel to each other and perpendicular to the axle e.g., beam axle, De Dion axle [11].

iii. Semi-dependent system—in this case, the motion of one wheel does not affect the position of the other, but they are not rigidly attached to each other, e.g., a twist-beam rear suspension [12].

3. Components of an automobile

Since the seventeenth century, several attempts have been made to design and construct a practical operative automobile. To achieve the purpose of making a vehicle move, various constituents' materials combine to form an automobile. There are six major components of an automobile. They include the following:

3.1 The super structure or the body structure (frame)

This includes the chassis which supports the engine, wheels, body, braking system, steering, etc. It is the main mounting support for all components including the various parts of the body of a car. It deals with the static and dynamic loads without undue deflection or distortion [2]. Other parts of the body includes the bonnet (hood), bumper, cowl screen, deck lid, fender, header panel, radiator core support,

grille, roof rack, rims and hubcap, spoiler, fuel tank door, trunk, door, door seal, door handle, door latch and hinge, door water shield, tire; central locking, window motor, window seal, windscreen, sunroof glass, fuel tank, horn, trunk accessory, and wing mirror and glass.

3.2 The transmission system

The main function of transmission system is to transfer power from engine to rear wheel via gearbox to obtain the various gear ratios [13]. The speed and torque of the wheels change in relation to the speed and torque of the engine due to the gears in the transmission. They include clutch assembly (clutch lining, clutch disk, clutch fork, clutch plate, clutch cable, clutch fan, clutch hose, clutch shaft, clutch spring and clutch pedal) [14], gear assembly (i.e., gear pump, gear ring, gear shift lever knob, gear couplings and gear box, which contains the idler gear, knuckle, master cylinder, bearings, counter or output shaft, pinion, and gear set), propeller or drive shaft, rear axle shaft, trans-axle housing, differential set (i.e., spider gears, differential seal, pinions, differential flange and differential clutch), speedometer, transmission set (i.e., transmission gear, transmission seal and transmission spring), flywheel ring gear [1], shift valve, speed reducer or governor and wheel and torque converter [9].

3.3 The internal engine system

This part of the automobile is designed as an engine. It is a device which converts chemical energy from fuel through combustion with air (inside a combustion chamber) into mechanical energy with the use of other components in the engine. The internal engine supplies the power which is delivered by the transmission system to the wheels through the clutch or fluid coupling [2]. The system is subdivided into three parts:

i. The engine components, which includes engine the block [15], engine shake damper, vibration absorber, fan belt, gudgeon pin, piston (i.e., piston pins, crank pin, piston pin brush, and piston ring), engine valve, harmonic balancer, accessory belt, petrol engine, camshaft assembly (i.e., camshaft bearing, camshaft fastener, camshaft locking plate, camshaft push rods, and camshaft phase variator), air duct, connecting rod (i.e., connecting rod bearings and bolt), crankshaft [9], crank case, crank pulley, crankshaft oil seal, distributor, drive belt, cylinder head (attached with cylinder head gasket and cylinder head cover parts), rocker arm, rocker arm cover, starter motor (starter pinions and rings), air blower, turbo charger and super charger, radiator parts (radiator, radiator gasket, radiator pressure cap, overflow tank, thermostat, radiator bolt), water tank parts (water tank, water pump, pump gasket, and water pipe), oil system (oil filter, oil pan, oil gasket, oil pipe, oil pump, and oil strainer) and valve springs and valve seal.

ii. The exhaust system, which includes exhaust pipe, muffler (or silencer), exhaust manifold and exhaust manifold gasket, heat shield, exhaust clamp and bracket, exhaust flange gasket, catalytic converter, resonator and spacer rings.

iii. The fuel system, which includes, air filter, carburetor, choke cable, fuel cap, fuel cell component, fuel distributor, fuel filter and fuel filter seal, fuel pump, fuel injector, fuel injector nozzle, fuel cooler, fuel pump and gasket, fuel pressure regulator, fuel rail, fuel intake manifold and gasket, fuel tank, throttle body and fuel water assembly [15].

3.4 The control system

It comprises of the suspension, steering, and brake systems. They are control arms or A-arms, shock absorber [16], axle, spindle, springs (air spring, leaf spring, parabolic spring, ball joint, rubber, and springs), tires [17], power steering assembly [18], steering arm, steering box, steering wheel, steering column assembly, steering shaft, steering rack (rack and pinion), kingpin, steering pump, strut, chamber arm, pan-hand rod, pit-man arm, stub axle, tie rod, tie bar, toe link, track rod, suspension link and bolt, idler arm, beam axle, swing axle, wheel alignment, trailing arm [19], automatic braking system, antilock braking system (ABS), brake fluid, brake lining, disk brake, drum brake, adjuster wheel, anchor, hydraulic fluid, hydraulic brake [20], inboard brake, vacuum brake booster, dual circuit brake system, metering and combination valves, wheel cylinder, wheel stud, brake roll, brake backing plate, brake rotor, brake lever (handle), brake piston, brake pump, brake shoe, brake hose, brake caliper pins and bracket and brake pad [21].

3.5 The auxiliaries

This part of an automobile consists of all the electrical and electronic components and battery system. They include audio/video devices (i.e., antenna assembly and cable, radio media player, video player, tuner, speaker), voltage regulator, alternator, gauges [22] (such as ammeter, odometer, manometer, hydrometer, oil pressure gauge, speedometer, water temperature gauge, pressure gauge, fuel gauge, vacuum gauge, tire pressure gauge, etc.), thermostat, ignition box, ignition coil, sparking cable, distributor cap, electronic timing controller, calibrator, remote lock, engine compartment, starting system (starter solenoid, door switch, ignition switch, switch cover, glow plug, and starter motor) [23], lightning (spotlight, interior light and lamps, headlight, fog light, trafficators, turn-signal control, license plate lamp and bulbs), sensors (air bag sensor, coolant temperature sensor, throttle position sensor, crankshaft and camshaft position sensor, fuel pressure sensor and automatic transmission speed sensor), navigation/GPS navigation device system, central locking system, battery system (battery box, battery cable, battery control system, battery plate and battery cap), sulfuric acid and distilled water [22].

3.6 Car interiors

Dash panels, secret compartment or trap, car seat, seat belt, seat cover, arm rest, bucket rest, head rest, carpet and floor materials, children and baby seat, and bench rest [24].

3.7 The miscellaneous and accessories components

These are minor accessories found in an automobile. They include air-condition system (air-conditioner clutch, compressor, hose, relay, valve, cooler, suction hose pipe, gas receiver, condenser filter, and cabin filters), bearings (i.e., grooved ball bearing, needle bearing, roller bearing, sleeve bearing, plain bearing, needle bearing, and wheel bearing), hose (fuel vapor hose, high-pressure hose, and radiator hose), adhesive tape and foil, air bag, speedometer cable, phone amount, rubber (extruded and molded), screw, nut (flange and hex nuts), fastener [25], split or cotter pin [26], rivet [25], draglink, dynamic seal, O-rings, shim, central console, glove compartment, washer, hood and trunk release cable and paint and sun visors [27].

4. Chemical constituents of some parts of an automobile

The automobile industry uses a tremendous number of materials to build cars, including iron, aluminum, plastics, steel, glass, rubber, petroleum products, copper, steel, etc. In all there are more than 6000 (˃600) components of an automobile. These parts are used to create everything from the small parts such as dashboard needles and wiring to the big parts such as the engine block or the transmission gears. Due to the high demand of automobiles and technological advancement, suitable materials have been used for the production of automobile components that are durable and serve the purpose of the automobile. Some of the chemical components of the various automobile parts are tabulated below:

5. Environmental effect associated with automobile waste and automobile transportation

5.1 Menace of automobile workshops

Due to poverty and the dire need to own vehicles for ease of movement, these aging vehicles still attract customers from Nigeria's middle class and those at the lower rung of the economy [8]. Large numbers are taken to automobile workshop for repair and refurbishing. Automobile workshops are important considering public health issues because they are carried out in poor environmental settings coupled with lack of safety and hygienic lifestyle (eating with unwashed hand, wearing of dirty and contaminated workshop clothes for a long time, etc.) of workshop artisans, yet it is a beehive of activities because it has become the source of employment to several informal sector workers such as auto repair, servicing and refurbishing, auto parts scavenging, car wash, tire pumping and repair, auto-electrician, wheel balancing and alignment, oil sales and servicing, spare parts sales, water and food vendor, etc. [6–8]. Apart from esthetic pollution, automobile workshop contributes significantly to environmental and public health discourse. Several literatures have documented that pollutants such as heavy metals [41], benzene, nitrobenzene, gasoline fumes, exhaust gases, particulate matter, etc. are released by activities at auto workshops and automobile and have negatively affected surface and underground water and adjacent farmlands [42–44]. In major Nigerian cities, automobile workshops are in clusters along major roads comprising unregulated activities such as automechanics and panel beaters (car body work). Large expanse of would have been arable lands are occupied and polluted. Drainage system is blocked by waste generated from automobile workshops, heavy metals, waste oils, and noxious gases that are released into the environment, adjacent farmlands and food crops, which may possibly be contaminated by heavy metals and toxic substances. Exposed subjects at automobile workshops (auto technicians) are established to have high risk of cardiovascular and pulmonary diseases [45].

5.2 Automobile wastes

Importation into Nigeria of second hand ("Belgium") cars is second to none in Africa; therefore the Nigeria landscape is replete with many rickety and not road worthy, aging, and aged vehicles. Lack of spare parts and adequate technology makes repair and refurbishing of automobiles an uphill tax coupled with unfavorable weather condition such as high temperature (Nigeria been in the tropics), acidic rainfall and high relative humidity, acidic mist and aerosols [6, 7, 46, 47],

S/N	Major parts of automobile	Chemical component	References
1	Car body	Iron-carbon Al, Mg, silicon alloy, Al, Mg alloy	[28]
2	Chassis	Al, Mg, alloy	[29]
3	Bumper/trunk	Fiber glass composite or acrylonitrile butadiene styrene, steel Al	[29]
4	Door panel	Carbon, Fe, steel, or Al	[30]
5	Window shields	Consist of glass made from Kevlar (poly-parc phenylene terephthalamide), K_2O, MgO, Al_2O_3 Polymethylmethacrylate	[30]
6	Rims	Alloy wheel rims consisting of Al/Mg	[29]
7	Radiator cores and tanks	Alloy of Cu, Zn, and steel	[30]
8	Tires and tubes	Elastomers, oils, resins, carbon black, steel cord and silica, contains natural and synthetic rubber (styrene-butadiene rubber (SBR))	[30]
9	Wheels	Al, Mg, Si, Cu	[30]
10	Glass	SiO_2	[30]
11	Sun visor	Made from substrates of polypropylene	[31]
12	Racks	Al alloys	[32]
13	Rivets	Al alloys, steel, Cu, Fe, Ni	[33]
14	Batter, battery case, plates, and connectors	Ni, Cd, Pb, HDPE	[22]
15	Pumps and valves	Cu, Co, Be, Al	[30]
16	Automotive exhaust system components	Cr, Ni, Si, Fe, Mn	[2]
17	Engine block	C, Si, Mn, Fe, Ni, Zn, Cu, Mg	[29]
18	Engine bearings, bushings, valves	Fe, Cu, Sn, and Zn	[2]
19	Engine cylinder	Cast iron and Al alloy	[2]
20	Hubcap: also known as wheel cover	Plastics	[34]
21	Radiator	Aluminum sheets	[35]
22	Multi-suspension system	Forged from aluminum system	[32]
23	Cotter or spilt pin	Cr, Fe, Cu, Zn, Al, Mg	[36]
24	Axles	Cr/Mo	[30]
25	Tie rod, pinion, and steering column	Stainless steel and Al	[32, 34, 37]
26	Steering arms	C, Fe, and Cr	[38, 39]
27	Suspension coils and springs	Fe, Mn, Si, P, V, Ni, Cr, Sn, Zn, Al, and C	[30]
28	Clutch assembly	Cu, Sn, and P	[30]
29	Gear assembly system	Cu, Zn, and steel	[25, 30, 40]
30	Crankshafts	Mn, Cr, Mo, Ni, Si, Co, V, Al	[30]

Cd = cadmium, Fe = iron, C = carbon, Al = aluminum, Si = silicon, Mg = magnesium, Cu = copper, Zn = zinc, Co = cobalt, Be = beryllium, Ni = nickel, Cr = chromium, Mg = manganese, Sn = tin, Mo = molybdenum, V = vanadium, K_2O = potassium oxide, MgO = magnesium oxide, SiO_2 = silicon (IV) oxide. Alloy = a combination of two or more metals, steel = an alloy of iron and carbon, and HDPE = high-density polyethylene.

Table 1.
Some chemical component of automobile parts.

unequaled and unprecedented high level road accident occasioned by poor road infrastructure and network, the net effect is that many vehicles are out of use and ultimately become waste. Recently wastes are regarded as "materials out of place" as against previous concept of "objects of non-usefulness." Automobile wastes are sometimes regarded as bulky waste, which include waste generated from servicing vehicles, automobiles, motorized trucks, and related equipment; they are made up of waste battery, scrap metal, used motor oils and lubricants, hydraulic fluids, bottom sludge, old motor parts, greases, waste engine oil, paints, petrol and diesel, which are generated and disposed indiscriminately. Abandoned vehicles dot Nigerian environment (workshops, roads, institutions, homes etc.) where they are left to the vagaries of weather to decompose and release some toxic substances, documented in **Table 1**, into the environment (**Figures 1** and **2**).

Figure 1.
Decomposing automobile wastes along Awka portion of Enugu-Onitsha Federal Highway.

Figure 2.
Decomposing automobile wastes at Nnamdi Azikiwe university, Awka works department.

6. Greenhouse effect, global warming and acid rain

Greenhouse gases are gases that are capable of absorbing infrared radiation emitted from the earth's surface and reradiate them back to the earth surface.

The major component chemicals of greenhouse gases (GHGs) include hydrocarbons (HC), oxides of nitrogen (NO_x—NO, NO_2, N_2O_3, NO_3), oxides of carbon (CO_x—CO, CO_2), particulate matter, sulfur dioxide (SO_2), photochemical oxidants and water vapor (H_2O), ozone, and chlorofluorocarbon (CFCs) [48]. All these gases are in higher concentration released into the atmosphere by automobile emission and decomposing automobile waste irrespective of transportation mode [49]. Negative health effects associated with high concentrations of greenhouse gases already documented include asthma, respiratory distress, cancer, birth defects, low birth weight in children, genetic mutations and premature death [50, 51]. The resultant effect of higher concentration of greenhouse gases in the tropospheric region of the atmosphere is the increase in the air temperature. Anthropogenic activities destroying the ozone layer contributing to global warming stem from manmade compounds and chemicals with high global warming potentials (ozone layer destroyer) [52, 53]. Synergistic effect of global warming is much evidenced on melting of global ice stacks (glaciers), rise in sea level, and flooding of coastal regions. Three gaseous compounds (CO_2, SO_2, and NO_2) emitted by automobiles are of the compounds known as acid anhydride of which SO_2 and NO_2 are outstanding for they significantly contribute to acid rain. Exposure to ambient concentrations of CO can have resultant formation of carboxyhemoglobin together with inhaled particles, which increase blood viscosity, thereby hampering oxygen delivery to the tissues [54]. A direct effect of gaseous emission by automobiles is acidic precipitation which affects terrestrial and aquatic ecosystems with attendant public health implication as has been widely reported in Nigeria [46, 47, 55]. Depending on the soil in nature, acid rain affects the soil. Acidic precipitation dissolves organic matrix and mineral matter largely present in the soil, which are K^+, Ca^{2+}, Mg^{2+}, Na^+, and anions (HCO_3^-, SO_4^{2-}, Cl^-, CO_3^-); these replaces the hydrogen of the acid rain and make the soil acidic. The pH of surface water may not change much due to acid rain because of the counterbalancing effect of water chemistry. Apart from acidic precipitation caused by SO_2 and NO_2 emitted from automobiles, minor concentration of SO_2 in air causes respiratory tract problem, irritation, secretion of mucus, and death at increased level of 500 ppm. NO_2 causes lung tissue inflammation at (50–100 ppm) exposure levels, bronchitis fibrosa obliterans (150–200 ppm) exposure, death (550 ppm) exposure [56]. Skin cancers and lesion, stomach ulcers, ocular congestion or corneal problems, and epithelial cell or leukocyte damage are possible health challenges associated with exposure to acid rain [55, 57]. The above chronicled facts show that emission from automobile transportation can synergize change in climate (alteration between balance in incoming and outgoing radiation elements over a period of time in the atmosphere leading to differed quality of air over time) [58] and that climate change is intricately weaved to human health.

7. Public health issues associated with automobile waste and automobile transportation

For the fact that automobiles are the most important vital means of transportation owing to their ubiquitous nature, portability, flexibility, comfort,

and affordable cost (when compared with trains, ships, and airplanes), more and more people all over the world are purchasing vehicles for their personal, office, and company use. Some families have as much as two, three, four, etc. depending on their purchasing power. In Nigeria, the Federal Road Safety Corps (FRSC) stated that there are more than seven [8] million vehicles on Nigeria road [59]. The automobiles are helpful to human population, and they can transport people and goods to places of need such as offices, markets, schools, sporting events, hospitals, leisure centers, etc. This is made possible by adequate road network interconnecting the cities and the rural communities. The inevitable effect is the numerous public health issues associated with automobile transportation. The use of premium motor spirit, diesel, paints, and other gaseous materials [45] has led to the increased pollution and negative health effect. Incomplete combustion of fuel due to lack of air, poor mixing of air with combustion gases, and low combustion temperature lead to particulate matter emission; the whole property is a function of operating condition of the engine, lubricant oil, fuel composition, and the gas filtering equipment [60]. Substances that can be emitted from automobile exhaust include CO, H_2, CO_2, H_2O, hydrocarbons (CH_n), volatile organic compound (VOCs), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), particulate matter ($PM_{2.5}$ and PM_{10}), soot [61], and metals such as vanadium, lead, nickel, cadmium, potassium, sodium, phosphorus, lead, zinc, copper, manganese, iron, barium, etc. [60, 62]. Other possible constituents of automobile exhaust emission include benzenes, polycyclic aromatic hydrocarbons, etc. The list above is considered as the exhaust emission, while the evaporative emissions are the vapors of fuel which are released into the atmosphere unburnt. The car exhaust emission has a great deal of negative effect on the human health and the environment. Car exhaust pollutants cause coughing, breathing difficulties, eye irritation, and distress to the respiratory system (throat, lungs, and chest). Specifically, heavy metals such as lead cause an occupational potent widespread human and environmental toxicant produced by burning leaded fuel and can interferes with normal functioning of red blood cells, thus hampering important enzymes in the body, damages and shortens the lifespan of red blood cell and cause anemia. Serious exposure burden can cause renal dysfunction, fatigue, arthritis, birth defects, hallucination, psychosis, autism, etc. [63]. Severe exposures to cadmium cause tracheobronchitis, pneumonitis, pulmonary edema, contacting cadmium by inhaling of cadmium-laden smoke fast rack respiratory, kidney, liver and bone damage. The bone becomes tender (osteomalacia), depletion of mineral density (osteoporosis) which accentuate backbone and joint pain, thereby increasing the risk of fractures [64]. Irritation of the nose and throat, headaches, dizziness, body weakness, cough, chest pain, and chills are inflammatory symptoms. Cadmium and its compounds are also carcinogenic. Nickel, when in the body, can alter its chemical nature but cannot be destroyed, and its binding to form ligands and transportation throughout the body depicts nickel metabolism. Interference of nickel with zinc, manganese, magnesium, and calcium physiologically is regarded as its toxicity [65, 66]. Myocardial infarction, acute stroke, and burn injury are disease conditions linked with altered serum concentration and transport of nickel [67] inhaling automobile smoke laden with nickel can lead to high accumulation in the lungs, nasal septum, liver, and kidney [68]. Erythrocytes and leukocytes inhibited production, blood vessel damage, vomiting, irregular and abnormal heartbeat, which are caused by short-term exposure to reduced concentration of arsenic. Malfunctioning of cells, respiration, enzyme cell, and mitosis are caused by arsenic because it is a protoplasmic poison; the main effect is on the sulfhydryl group of cell [69]. Documented toxicological and health

effect of manganese include decrease in semen quality [70] and Parkinsonism [71, 72]. For the fact that manganese is recognized to have different neuronal deficits such as learning disabilities, emotional liability, hallucination, compulsive behaviors, attention disorders, low fetal birth weight, and infant mortality [72–74], it is regarded as a potent toxin. The mucous membrane is the major target of inhaled hexavalent chromium or chromium-containing compounds, and then it synergizes asthmatic reaction, bronchial cancer, ulceration, and perforation of the nasal septum [75]. Although the human body for its physiological process requires copper in trace amount, increased exposure to copper through inhalation of automobile smokes/fumes will lead to copper toxicity such as early childhood liver cirrhosis (ECLC) and gastrointestinal symptoms [76]. The ubiquitous nature of polycyclic aromatic hydrocarbons emanates from natural processes such as forest fires, oxidation of biogenic precursors, unburnt petroleum products and other anthropogenic factors, which are released into the environment [77]. PAHs are hazardous chemicals that negatively impair human health [78, 79]. Accordingly, automobile transportation is a veritable source of PAHs in the environment being an anthropogenic pollutant, and the urban atmosphere is laden with PAHs originating from incomplete combustion of fuel in the transportation engine [80]. PAHs being highly lipophilic and insoluble in water persist in the environment (air, water, and land), and many of its compound are known carcinogenic, mutagenic, and teratogenic to organism [81].

Particulate matter ($PM_{2.5}$ and PM_{10}) are tiny suspended microscopic particles like dust, soot, ash, solid/liquid objects, gases, and aerosols that can originate from daily life activity. They can travel long distance in air been less dense than air. Those that originate from automobile/diesel engine exhaust may consist of complex mixture of organic molecules (conjugated and straight chain), incompletely burnt carbon, oxides of metals, acid anhydrides, and phosphate, nitrate, and sulfate group. The respiratory system is the major attack site of inhaled particulate matter. Penetration of inhaled airborne particles through the airways increases with the increasing reduction in particle size for those >0.5 μm [82]. The health effect from inhaled particulate matter may be affected by the site of deposition within the respiratory system. Deposited particles within the respiratory system are influenced by biological, physical, and chemical process which includes dissolution into body fluids with absorption by blood, migration into cells by phagocytosis, and movement with mucus and blood fluid [83]. Cancer, asthmatic allergies, inflammation, cardiovascular and respiratory disease, and mutagenic and teratogenic effects are health issues associated with particulate matter inhalation [84]. Bronchovascular disease has been reported among subjects exposed to welding aerosol [85]. Cancers of larynx, nasal cavities, and paranasal sinuses were established in subjects exposed to and inhaled chromate paints [86, 87]. Pollution keratoconjunctivitis (PKC) was reported among children in hydrocarbon processing in Niger Delta area of Nigeria [88]. Among automobiles, it is established that two-wheeled vehicles (motorcycles) emit more particulate matter into the ambient air than four-wheeled vehicles (cars) and therefore more polluting effect. This fact can be exacerbated in cities with high traffic gridlock (traffic congestion) as vehicular emission poses great threat to environmental and public health. The united nation (UN) 1998 report states that over 600 million people are exposed to hazardous effect of traffic-associated pollutants after 21 years; this figure must have increased.

8. Conclusion

High voluminous importation of aging and rickety automobiles with engines of questionable combustion efficiency, weak and deplorable road

infrastructure, and high road accidents leading to automobile breakdown and favorable elements of weather (high temperature, acidic rain fall, dew, etc.), decomposition of automobiles, and release of toxic substances into the environment is inevitable, and this is coupled with toxic substances emitted by combustion of fuel/diesel during transportation. For the fact that Nigeria lacks adequate technology to deal with automobile waste, including recycling, there is a need to put in place, strengthen, and implement legislation regime so as to regulate the importation of automobiles into the country. Nigeria with a population of over 180 million people provides a large market for auto manufacturers. The government can negotiate with the manufacturers to establish a recycling plants, and this can remove large volume of auto-waste from the roads. The government can also assist the citizens to purchase new vehicles rather than fairly used ones through car loans. Adequate monitoring program by vehicle inspectorate officers to ensure road worthiness of vehicles. Tax incentives can be given to citizens who agree to limit car ownership to one. The government can also establish a comprehensive mass transportation network system that can convey large number of people on a daily basis. This can reduce the number of vehicles plying the road on a daily basis. Periodic air quality monitoring can be carried out to determine the levels of carbon (II) oxide, carbon (IV) oxide, oxides of nitrogen and sulfur, particulate matter, etc. in the air. Alternatively, non-fuel means of transportation such as beast of burden, bicycles, and trucks can be resuscitated and can lead to a significant reduction in number of vehicles on the road, meaning a decrease in pollution level and minimal health risk. The conclusion is that automobile waste and automobile transportation have some negative effect on the environment and public health.

Acknowledgements

The authors would like to thank the Federal Government of Nigeria, through its agency, the tertiary education trust fund (TETFund), for funding this research, covering 2016–2017 (merged) institutional-based research project (RP) intervention.

DOI: http://dx.doi.org/10.5772/intechopen.88491

Author details

John Kanayochukwu Nduka[1*], Henrietta Ijeoma Kelle[2], Emeka Chima Ogoko[2] and Perpetua Chioma Okafor[3]

1 Environmental Chemistry and Toxicology Research Unit, Pure and Industrial Chemistry Department, Nnamdi Azikiwe University, Awka, Anambra, Nigeria

2 Department of Pure and Applied Science, Faculty of Sciences, National Open University, Abuja, Nigeria

3 Department of Natural Sciences, School of General Studies, Federal Polytechnic, Oko, Nigeria

*Address all correspondence to: johnnduka2000@yahoo.co.uk

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