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**INVESTIGATION INTO PEOPLE'S AWARENESS OF EFFECT OF  
CONTAMINATED GROUNDWATER IN ARAROMI SPARE PARTS  
MARKET, AGODI GATE, IBADAN.**

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***Abstract***

*Humans have been a great threat to the environment due to their various activities that results to the release of harmful substances into the environment. The sales and repairs of automobile parts, release of spent engine oil, painting, panel beating, sales of tires among other activities have contributed to the contamination of groundwater (wells) in Araromi automobile spare parts market, Ibadan with heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs). The study was carried out to investigate the people's awareness of the effect of contaminated groundwater from the Araromi spare parts market, Agodi gate, Ibadan. Twenty 20 questionnaires were administered to respondents around each well, making a total of 140 questionnaires in all. Analyses was carried out on the results obtained and the results showed that CWW 1 and CWW 7 were used more often for cooking, drinking, washing bathing and ablution t. Ten mice were placed in each nine concentration groups and control designated CWW 1 25%, CWW 1 50%, CWW 1 75%, CWW 1 100%, CWW 7 25%, CWW 7 50%, CWW 7 75%, CWW 7 100% and the control group administered with distilled water. Five hundred (500 ml) of water samples from seven wells designated CWW 1-7 were taken for further study.*

***Keywords:*** *Heavy metals, Ground water, fluoranthene, benzo(a)pyrene, anthracene, chrysene, benzo(b)fluoranthene, benzo(a)anthracene, benzo 1,2-anthracene and Polycyclic Aromatic Hydrocarbons (PAHs).*

## INTRODUCTION

The environmental hazards associated with the disposal of spent oil on the ground in different parts of Nigeria and in other African countries are enormous. The problem is more severe in Nigeria where private sector investors have neglected the used oil recycling business because of the availability of oil and oil products in the country. Therefore, reduction in recycling of oil has led to environmental pollution. It has been noted that the disposal of spent oil from vehicles by automobile mechanics and generator mechanics in Nigeria has become rampant and uncontrolled due to release and changing of engine oil (Odjegba and Sadiq, 2002). The spill arising from disposal of waste engine oil is a problem that is attributed to auto mechanics and generator mechanics which increase the demand and usage of engine oil (Anoliefo and Vwioko, 2001), the substance poses as threat to the mechanics that frequently come in contact with the spent engine oil.

Ground water could be referred to as all the occupying voids, pores with geographical formation which originated from atmospheric precipitation, the precipitation may either be directly by raining, infiltration or indirectly from rivers, lakes or canals, sands, gravel sandstones and lime stone (Ojo *et al.*, 2011). The composition of groundwater can be altered by human activities such as dissemination of chemicals on microbes, dumping of municipal, industrial waste and the release of used motor oil. The flow of groundwater depends on the topographic bottom of the water shed; the sources of groundwater could be as a result of precipitation and percolation. Most groundwater pollution is due to non-point sources and occurs at different time scales. Therefore, pollution does not actually appear in domestic wells until years after the release from source; this is due to speed flow which ranges from a few tens of feet to a thousand feet per year (Harter 2003). The Araromi automobile spare parts market, located in Ibadan city of Nigeria is the study area where sample collection and survey study are carried out. Apart from the spent oil, other activities in the market such as iron bending, sales of tyres, upholstery, release of metal fragment while dismantling old car parts, iron coating and galvanized, coating of spare parts with spent oil, release of metals from the disposed parts and panel beating may also lead to the release of other contaminants. Spent oil happens to be the major substance that causes contamination in automobile spare parts markets and the colour of the spent oil is usually brown or black; it is an oily liquid removed from a motor vehicle when it is changed or dismantled (USDHHS, 2007). Spent engine oil contains high concentrations of Pb, Zn, Ca, Mg, and lower concentrations of Fe, Na, Cu, Al, Cr, Mn, K, Ni, Sn, Si (Becker and Comeford 1980).

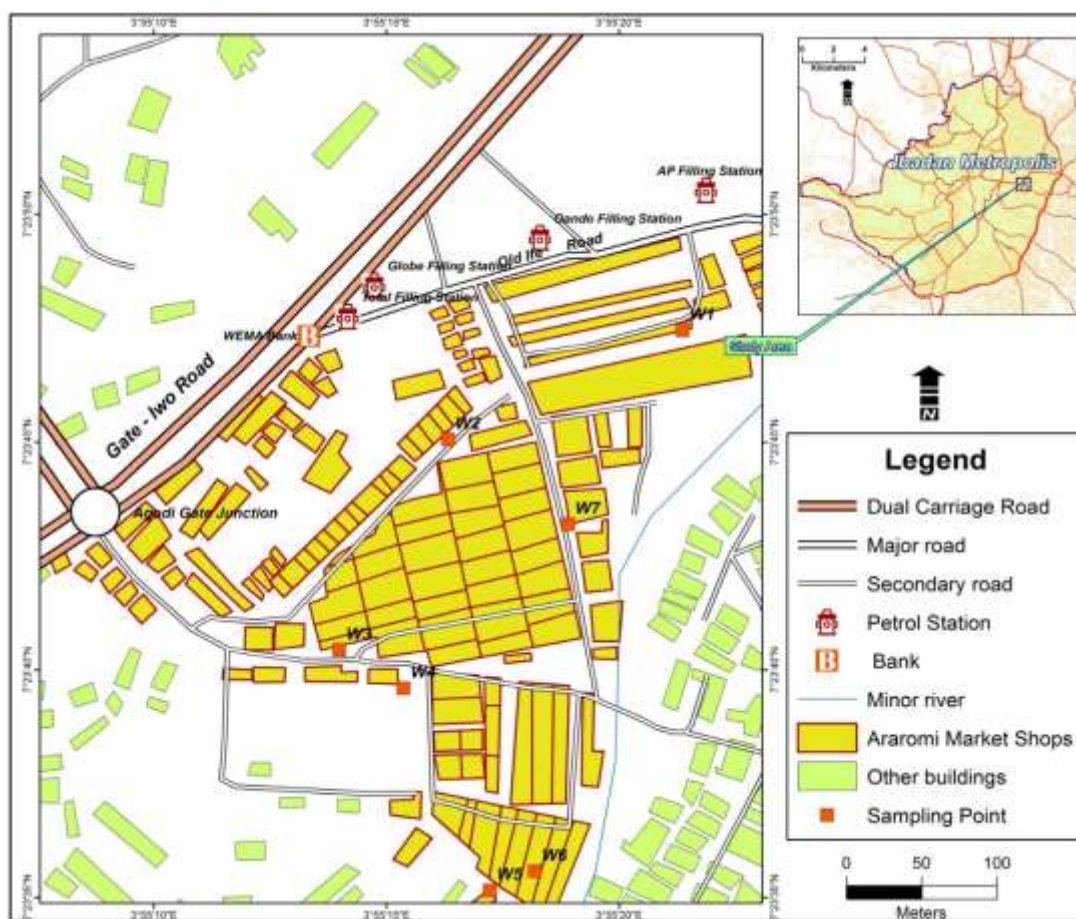
Heavy metals are metals that possess high atomic weight that can damage living cells at once (USEPA, 1999). They have the ability of finding their way into the soil environment down to the ground water where they are absorbed (Agbogidi, 2013). Heavy metals occur naturally in the earth crust but anthropogenic activities have given rise to elevated levels of heavy metals in the environment. Heavy metals are generally characterized as inorganic elements having specific gravity five times that of water. The major sources of heavy metals include mechanical operations such as fluid leakage, component wire, engine oil, electric battery charging, and diesel oil, lubricating oils, galvanizing, spraying and painting, tire sales, combustion, gear box recycling amongst others. (Baath, 1989; Dolan *et al.*, 2006; Agbodigi *et al.*, 2016). Heavy metal contaminants in the environment are eventually deposited in soils in some form of a low solubility compound, such as pyrite (Huerta-Diaz and Morse, 1992) or sorbed on surface-reactive phases. With time these deposited metals such as iron and manganese enter the groundwater through percolation usually during rainfall (Cooper *et al.*, 2005; Hamilton-Taylor *et al.*, 2005). Heavy metal exposure to humans occurs through three primary routes namely inhalation, ingestion and skin absorption. These may occur in myriads of places including auto-mobile spare parts markets. Generally, toxic metals cause enzyme inactivation, damage cells by acting as anti-metabolites or form precipitates or chelates with essential metabolites. According to USDA (2000), acute (immediate) poisoning from heavy metals is rare through ingestion or dermal contact, but it is possible.

Polycyclic Aromatic Hydrocarbons (PAHs) are ubiquitous environmental pollutants generated primarily during the combustion of organic compounds. They are either found naturally occurring in the environment or originating from man-made combustion sources such as automobile emissions and petroleum spills. PAHs are commonly detected in water, soil and air (Rockne *et al.*, 2002). They are chemically composed of two or more benzene rings bonded in linear, cluster or angular arrangement. Examples include pyrene, fluoranthene, benzo(a)pyrene, anthracene, chrysene, benzo(b)fluoranthene, benzo(a)anthracene, benzo 1,2-anthracene among others. They are mostly colourless, white or pale yellow solids (Abdul-shafy and Mansour 2015) and consists of carbon and hydrogen atoms only. The study was carried out to investigate the people's awareness of the effect of contaminated groundwater from the Araromi spare parts market, Agodi gate, Ibadan.

### **Research Methodology**

The study area is the Araromi automobile spare parts market located at Agodi gate in Ibadan North East Local Government Area of Oyo State.

Geographically, it lies between 3° 55.35 north to 7° 23.49 north and longitudes 3° 55.8 East to 3° 55.23 East (Figure 1). The GPS location of the market was taken using a Garmin Etrex 10 GPS device, model number XN2DR30660. The market is located along Agodi gate-Basorun road, it is also a historical commercial centre in the city of Ibadan. Encircled by residential buildings and other buildings used for commercials, these buildings include WEMA bank, filling stations such as Global, Oando, AP and Total filling stations. Spare part repairs, servicing and purchase, galvanizing, iron bending, painting, battery charging, tyre sales, spraying and painting, disposing and changing of engine oils, disintegration of car upholstery are the activities carried out in the market; the activities may induce contamination by heavy metals and PAHs. To the north of the market is the Agodi praying ground and a Catholic Church to the south is the Oje area, to the west is Agodi gate junction and to the east is a tributary of Kudeti river.



**Figure 1: Map of Araromi spare parts market, Agodi gate, Ibadan North East Local Government Area of Oyo state, Nigeria.**



**Figure 2: Well 1 which contained contaminated water.**

**Well 1:** The well has a GPS location of  $07^{\circ} 23.791$  North and  $003^{\circ} 55.356$  East. The well has a total depth of 5.982m, 2.934m depth to water table and 3.048m height of water table. The activities around the well are panel beating, spare parts sales, servicing and repairs from the north, south to the east and west are carried out on the site.



**Figure 3: Well 2 which contained contaminated water.**

**Well 2:** The well has a GPS location of  $07^{\circ} 23.751$  North and  $003^{\circ} 55.272$  East with a total depth of 4.953m, a depth of 3.277m to water table and 1.676m as the height of water table. Activities such as spare parts sales take place to the east,

scrapings and painting of metal parts to the west of the well while a food canteen and a mosque is located to the north and south of the market respectively.



**Figure 4: Well 3 which contained contaminated water.**

**Well 3:** The well has a GPS location of  $07^{\circ} 23.674$  North and  $003^{\circ} 55.233$  East with total depth of is 8.484m with 8.407m depth to water table and 0.0762m height of water table.

Activities around the well include dismantling of old vehicles into new components, automobile spare parts sales, repairs and servicing taking place from the north, east to the west with a dump site located to the north and a food vendor to the south.



**Figure 5: Well 4 which contained contaminated water.**

**Well 4:** The well has a GPS location of  $07^{\circ} 23.660$  North and  $003^{\circ} 55.256$  East, with a total depth of 6.274m, a depth of 6.147m to water table and 0.127m as the

height of water table. The well water is fairly muddy, activities such as riving of engines, spare parts repairs and servicing takes place to the north, hammering, scrapings and painting of metal parts to the east, no activity to the south and a food vendor is located to the west.



**Figure 6: Well 5 which contained contaminated water.**

**Well 5:** The well has a GPS location of  $07^{\circ} 23.287$  North and  $003^{\circ} 55.287$  East, with a total depth of 3.556m, 2.083m depth of water table and 1.473m height of water table. Activities such as spare parts repairs, hammering, scrapings and painting of

metal parts takes place to the west and south of this well, no activity to the east and a food canteen is located to the north and south.



**Figure 7: Well 6 which contained contaminated water.**

**Well 6:** The well has a GPS location of  $07^{\circ} 23.593$  North and  $003^{\circ} 55.303$  East with a total depth of 1.790m, 0.559m depth to water table and 1.232m height of water table. Activities such as spare parts repairs take place to the south, north and east and a food vendor is located to the west.



**Figure 8: Well 7 which contained contaminated water.**

**Well 7:** The well has a GPS location of  $07^{\circ} 23.720$  North and  $003^{\circ} 55.315$  East, with a total depth of 1.321m, depth of 0.127m to water table and 1.194m height of water table.

The well water is clear and activities such as sales of tire takes place to the north, south and west and a food canteen is located to the east.

### **Sampling and Sampling Stations**

Twenty (20) Questionnaires were administered to the traders and residents around each well to give 140 questionnaires in total, this is to obtain information on the water usage (drinking, cooking, bathing, washing), if treatment was used and type of treatment used where necessary. Water samples were collected from seven of the ten dug wells located within the automobile spare parts market for further study. The well samples were designated WELL 1, WELL 2, WELL 3, WELL 4, WELL 5, WELL 6 and WELL 7 respectively. The depth of each well was measured using a graduated rope. The graduated rope attached to the sinker were released with a tape measure and attached to a sinker. The rope was graduated with the aid of a metal rule were released into the well until it reaches the bottom of the well and the measurement of the depth was taken and recorded in Metres.

### **Statistical Analysis**

Data obtained from administering the questionnaires were analyzed using the percentage method on Ms Word (2019) excel.

### **Results**

Twenty questionnaires were administered to respondents trading and residing in the vicinity of each of the seven of groundwater wells making a total a of one hundred and forty questionnaires. Table 1 shows the data extracted from analyzed questionnaire administered to respondents around each well with the



ratio of male to female with the percentage ratio 95:5 for CWW 1, 78.9:21.2 for CWW 2, 90:10 for CWW 3, 85:15 for CWW 4, 80:20 for CWW 5, 73.7:26.3 for CWW 6 and 70: 30 for CWW 7, giving the information that most of the respondents across the wells are males. Most of the respondents were within the age range of 31-40 years with the highest percentage of this group observed around well 2 at 47.4%. It was also observed that the major occupation of the respondents in Araromi automobile market were; spare part dealers which had the highest percentage 64.4% (well 2) and lowest percentage of 0% (well 7). Food vendors had the highest percentage of 21.1% (well 2) and the lowest percentage 5% (well 3) while Apprentices had the highest percentage recorded as 40% (well 3) and the lowest percentage 10%( well 5).

**Table 1: Demographics of Respondents Around the Sampled Araromi Automobile Market.**

		Well 1 (%)	Well 2 (%)	Well 3 (%)	Well 4 (%)	Well 5 (%)	Well 6 (%)	Well 7 (%)
<b>Sex</b>	Male	95	78.9	90	85	80	73.7	70
	Female	5	21.1	10	15	20	26.3	30
<b>Age</b>	10-20	5	10.5	5	45	45	15.8	40
	21-30	20	21.1	45	35	10	15.8	0
	31-40	30	47.4	35	5	30	26.3	25
	41-50	15	10.5	10	10	10	15.8	20
	51-60	25	10.5	5	5	5	15.8	15
	61-70	5	0	0	0	0	10.5	0
	71-80	0	0	0	0	0	0	0
<b>Occupation</b>	Spare part dealer	36.8	68.4	25	50	35	5.3	0
	Upholstery	36.8	0	25	0	20	0	0
	Panel beater	5.3	0	0	10	0	0	20
	Food vendor	10.5	21.1	5	10	5	15.8	45
	Apprentice	10.5	5.3	40	30	10	10.5	35
	Iron bender	0	0	0	0	20	5.3	0
	Welder	0	0	0	0	5	26.3	0

Automobile mechanic	0	0	10	0	0	0	0
Others	0	0	0	0	5	36.8	0

**Table 2: Percentage of respondents cooking**

Activities		Well 1(%)	Well 2(%)	Well 3(%)	Well 4(%)	Well 5(%)	Well 6(%)	Well 7(%)
Cooking	yes	52.6	20	11.8	10	35	21.1	40
	no	47.4	20	88.2	90	65	78.9	60

**Table 3: Percentage of respondents drinking the well water**

Activity		Well 1(%)	Well 2(%)	Well 3(%)	Well 4(%)	Well 5(%)	Well 6(%)	Well 7(%)
Drinking	yes	42.1	20	11.8	10	60	21.1	40
	no	57.9	80	82.4	90	40	78.9	60

**Table 4: Percentage of respondents that used the water for washing.**

Activity		Well 1(%)	Well 2(%)	Well 3(%)	Well 4(%)	Well 5(%)	Well 6(%)	Well 7(%)
Washing	yes	94.7	75	94.1	90	90	84.2	95
	no	5.3	25	5.9	10	10	15.8	5

**Table 5: Percentage of respondents that use the water to bath.**

Activity		Well 1(%)	Well 2(%)	Well 3(%)	Well 4(%)	Well 5(%)	Well 6(%)	Well 7(%)
Bathing	yes	73.7	65	94.1	75	75	52.6	80
	no	26.3	35	5.9	25	25	47.4	20

**Table 8: Percentage the rate of water usage in each well**

		Well 1(%)	Well 2(%)	Well 3(%)	Well 4(%)	Well 5(%)	Well 6(%)	Well 7(%)
<b>Water usage</b>	Cooking	52.6	20	11.8	10	35	21.1	40
	Drinking	42.1	20	11.8	10	60	21.1	40
	Washing	94.7	75	94.1	90	90	84.2	95
	Bathing	73.7	65	94.1	75	75	52.6	95
	Ablution	73.7	85	11.8	40	65	52.6	70
<b>Rate of water usage</b>	Daily	85	84.2	84.2	58.8	95.0	94.1	95
	weekly	10	10.5	15.8	29.4	5.0	5.9	5
	Monthly	5	5.3	0	11.8	0	0	0

Well 1 has the highest of usage for cooking at 52.6% while well 4 had the lowest with 10% ( Table 2). Well 1 has the highest of usage for drinking with 42.1% while well 4 had the lowest with 10% (Table 3). Well 1 has the highest of usage for washing with 95% while well 2 had the lowest with 75% (Table 4). Well 3 has the highest of usage for bathing with 9.1% while well 6 had the lowest with 52,6% (Table 5). From Table 2 above, most of the respondents use the water daily and the highest percentage was seen in well 7 (95%) while few respondents use the water on weekly and monthly basis. It was also observed from the questionnaire analysed that more than 50% of the respondents use the water for cooking in well 1(52.6%), which is the highest percentage in the wells analyzed followed by 40% in well 7. 60% of the respondents in well 5 drinks from the well, followed by well 1(42.1) and well 7 (40) respectively. Majority of the respondents wash with the water in well 7 (95%) and well 1 (94.7) respectively with well 7 having the highest percentage. Well 7 and well 1 has the highest number of people that use the water for bathing and for Ablution. In conclusion, the anthropogenic activities going in the Araromi spare parts market have been shown to contaminate the ground water in this market with heavy metals and PAHs and the demographic results obtained from the study showed that there were more males than females using the wells with the percentage ratio 95:5 for CWW 1, 78.9:21.2 for CWW 2, 90:10 for CWW 3, 85:15 for CWW 4, 80:20 for CWW 5, 73.7:26.3 for CWW 6 and 70: 30 for CWW 7. The major respondents around the contaminated wells are spare part

dealers, panel beaters, food vendors, apprentice, iron benders, welders, upholstery; these respondents make use of CWW 1 and CWW 7 more than the other contaminated well water for bathing, cooking, drinking, washing and ablution daily. This may negatively have impact on reproductive hormonal levels and testicular damage and may in the long-term cause infertility in men residing or working in the vicinity of the market as shown by this study. These negative effects could be minimized through the following methods;

1. Sensitization of residents on the threat the activities pose to ground water within the market as well their health.
2. Government should be providing alternative sources of water for the residents.
3. Remedial measures should be put in place for ground water of the site prior to use.

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### Questionnaire

Dear Respondent,

This study is designed to obtain information about the effects of contaminated groundwater in Araromi automobile spare parts market as it relates to the liver, kidney, male and female reproductive systems of mammals. This research is purely academic and responses will be treated confidentially.

Please kindly answer the questions truthfully as possible.

Be assured that any information provided will be treated with the strictest confidence.

Thank you and God bless.

Omole, Esther

### SECTION A: Socio Demographic and Economic Characteristics of the Respondent.

Please tick (√) or fill in the appropriate answer where necessary.

Date: \_\_\_\_\_

Serial No: \_\_\_\_\_

Study site: \_\_\_\_\_

Sex: \_\_\_\_\_

Age: \_\_\_\_\_ (10-20) (21-30) (31-40) (41-50) (51-60) (61-70) (71-above).

Occupation: Student    Trader    Civil Servant    Others, Please specify \_\_\_\_\_

Educational Background..... Degree [  ] NCE [  ], JSCE/SSCE [  ] Elementary [  ]

None

### SECTION B: Environmental Assessment

Do you reside or work here? Yes [  ] No [  ] If yes, how long \_\_\_\_\_

How often do you use the well in the market? Daily  Weekly  Monthly   
What do you use the well for? Cooking  Drinking  washing  Bathing  
Religious Activity (Ablution)  others, please specify \_\_\_\_\_  
Do you treat your water before use? Yes  No  If yes, what type of treatment? \_\_\_\_\_  
Have you ever met the well opened? Yes  No   
If yes, how often? Always ( ), Not always ( ), Sometimes ( ), Once in a while ( )  
Have you ever met the well dirty? Yes / No  
Does the well dry up often? Yes  No   
If yes, how often? Once a year  twice a year  three times a year  Others \_\_\_\_\_  
Do people wash by the well? Yes  No   
Has the water ever had strange odour, taste or colour? Yes  No  If yes, Please  
specify \_\_\_\_\_  
Do people wash their wears and wares? Yes/No. If Yes, How do you dispose your waste  
(rubber, wire, metals, spent oil)? Gutter  open space  floor  nearby water bodies,   
others \_\_\_\_\_  
Do people wash with detergents, bar soaps, bleach or only water? Please specify \_\_\_\_\_  
Are there other sources of water aside from the wells in the market? Yes  No

### SECTION C: Human Assessment

Have there been any adverse effects from drinking the well water? Typhoid  malaria  
cholera  Dysentery  Polio  Arsenicosis  intestinal worms'  lead-poisoning  
diarrhea  hepatitis A  Trachoma (Eye infection)   
Has there been any history of illness/sickness outbreak? Yes  No  If yes, please  
specify \_\_\_\_\_  
How long have the well been there? .....

Have you ever had any of these symptoms? Lack of appetite ( ), Vomiting ( ), Weight loss  
( ), Pain in the abdomen ( ), Yellowing of the skin, eyes or nails ( ), Nausea ( ), Fatigue ( ),  
Swelling of the stomach/abdomen ( ), itching ( ), Dark urine ( ), severe bleeding ( ), pale  
stool ( ).

Have you ever seen blood in your stool? Yes / No

Have you ever had any of these symptoms? Sleep problems ( ), Pressure in chest ( ), Seizure  
( ), Shortness of breath ( ), Reduced amount of urine ( ), Coma ( ), Muscles twitches/cramps  
( ), Drowsiness ( ), Swelling of the legs, ankles and feet ( ), Decreased mental sharpness ( ).

Have you ever had vasectomy? Yes / No

Do you have a history of diabetes in your family? Yes / No

Do you have symptoms like, Swelling or lump in your testis ( ), painful urine ( ), Erectile  
dysfunction ( ), pain during sexual intercourse ( ), inability to smell ( ), Back pain ( ),  
Pelvic pain ( ), Cramping ( ), Small volume of fluid (retrograde) ejaculated ( ), Difficulty  
with ejaculation ( ).

Have you ever had hypertension? Yes / No

Have you ever had low birth weight? Yes / No

Have you ever experienced any of these? Insufficient milk during lactation ( ), Preterm  
delivery ( ), Miscarriage ( ), Irregular menstrual cycle ( ), Abdominal pain ( ), Pain during  
sexual intercourse ( ).