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EFFECT OF SPEED RAMPS ON PREGNANT WOMEN: A CASE STUDY OF TRAVELLERS ALONG KUMASI-CAPE COAST HIGHWAY

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ABSTRACT
A retrospective assessment of built environment could lead to the establishment of a connection between health outcomes and a specific intervention introduced over a period of time. A peculiar issue of concern in the transportation industry is the spring up of speed calming devices without the institution of a strict monitoring and evaluation team to control driver maneouver aimed at progressively building self-explaining roads. Speed ramps on highways do not only contribute to congestion, air and noise pollution in the environment but are also a major source of vibration hazard to vehicle occupants. Pregnant vehicle occupants are susceptible to a number of fluctuating ramp-induced vibrations which is a potential source of pregnancy complications. The intent of this paper is to assess the extent of detriment that speed ramps have on pregnant women based on empirical evidence. To address these issues, the research design ultilises a survey instrument devised to solicit respondents' perceptions and realities about the consequence of speed ramps on pregnant women. Data were collected from selected communities with different socioeconomic characteristics and agoraphobic demeanour in order to understand the speed ramp interventions and its likened unpleasant happenings. These data are quantitatively analysed to examine how speed ramps have influenced the maternal health of two cohorts of reproductive women. There is a relation between the gestational periods and the kind of ordeals experienced by the affected pregnant occupants. The lessons learned from this study and the potential contributions to future road transport research are discussed herein.

Keywords: pregnancy, banging, bleeding, liquor, ramp

1.0 INTRODUCTION

The debate on the underlying relationship between ramp erection and maternal health is the pertinent issues herein, especially when most jobs and service opportunities continue to remain centralized. Developing countries such as Ghana are growing rapidly and a consensus building between ramp erection and its standardisation vis-a-viz the maternal health is of great importance in planning for sustainable growth. The differences in mode of transport accessibility to workplace, hospital and market with emphasis on woman to ramp interaction and injuries need to be investigated.

Notwithstanding the fact that speed ramps are one of the simplest and cost effective traffic calming devices(Kemeh, 2010), they have a number of varied effect on various sized vehicles and occupants. Speed ramps are also the associated with noise production and vibrations emanating from acceleration and braking of vehicles (Emslie, 1997). The inability of most developing countries to ensure the implementation of homogeneity of speed cambers-with respect to the ramp slopes, distance between ramps, drivers climbing speeds, inconsistent painting of ramps and poor warning signs-have caused a huge unforeseen health predicaments affecting both socio-economic and psychological lives of commuters (Emslie, 1997; Charlton & Baas, 2006).

According to transportation researchers, women generally sustain higher strains, sprains, contusions and abrasions as well as internal injuries than their men counterparts during vehicle accidents and impact endurance. In percentagewise, 29% of women sustain contusions and abrasions as compared with 27% of their men counterpart. More so, 48% of women are more likely to sustain strains and sprains as against 37% of men (Ann, 2004). Interestingly, authorities have failed to envisage that these speed calming devices might have equivalent problem on pregnant women and their foetuses. These road improvement strategies have had significant impact on women's trip chaining activities but the impact on their antennal health have not been established yet.

The central goals of most transport policies have been to improve accessibility, environmental pollution, reduce casualties and congestion for the purpose of supporting the economy (Asa, 2004; Barbara, 2004; Salma, 2004). However, the seemingly total neglect of speed ramp standardization by transportation and travel behaviour researchers in Ghana and other developing countries have led to wrongfully constructed, signed, painted and spaced speed ramps on the highways, urban roads, inter alia, which consequently cause accidents and severe impacts to occupants of motor vehicles. Upon sudden encounter of such speed ramp on the road, the driver is left with the only option of fully depressing the brake pedal for maximum deceleration of vehicle to enable it quickly come to a complete halt. It has been reported however that, certain deceleration and frequency of vibration values might be dangerous for vehicle occupants including pregnant women (Dariusz & Jaskiewicz, 2014) who form substantial proportion of motor vehicle commuters in respect of home-to-work trip chaining (McGuckin & Murakami, 1999; Li, et al., 2004; Nobis & Lenz, 2004).

There is the need to establish the causality-which is a measure of effect that an intervention would have on a target population-for these springing up of speed ramps (Mohammad, 2013). To unravel the mysteries behind these problems, a survey is employed to investigate and establish empirical evidence on the extent of antenatal health damage that speed ramps have caused to pregnant mothers. The quantitative survey is centered on the reproductive womenfolks' perceptions and realities attitudes towards the modes of transportation available to them as well as the nature of effect that reckless driving over ramps might have on them.

2.0 MATERIAL AND METHOD

Research Design

Apart from existing literature, a prior assessment of the erected speed ramps on the study area confirmed a huge implementation gap in the policy document of Ghana Highway Authority developed in 2007 on traffic calming measures as far as the recommended ramp dimensions and regulations are concerned (Kemeh, 2010; Emslie, 1997). Moreover, when drivers' maneouvering competence was assessed in on-road test, it is found that speed ramps do not necessarily cause drivers to change speed and conform to predefined speed limits of the ramps as most driver speeds were positively skewed(Charlton & Baas, 2006). Apparently, the scope of this study is largely limited to the assessment of the possible pains and discomforts that pregnant women endure whilst commuting on these substandard speed ramps.

The research presented here fills in a knowledge gap as to the degree of damage caused to these patients and other vulnerable vehicle occupants. Even though, some physicians have asserted that with the best engineered speed ramps, patients in emergency vehicle would continue to be the major victims of speed ramps on highways (Roger, 2003). In respect of maternal health, researchers have not yet envisaged that pregnant women

experience a number of distresses and unpleasant impacts whilst driving on uneven road. Hence, a survey on pregnant women's condition in relation to travelling experience on bumpy road is necessary to serve as a profound exploratory assessment of some explicit ordeals that pregnant women and the foetus endure in the course of a journey.

The conceptual framework *(Figure 1)* of the survey is centered on reproductive womenfolks' perceptions and realities about erected speed ramps on highways and its impact on pregnant motor vehicle occupants. Analysis of pregnancy status, duration of pregnancy, number of children delivered, past antenatal experience, age difference and educational level can lead to a more comprehensive and thorough understanding of the choice of transportation modes and patterns among reproductive womenfolks. In this study, questionnaires were used in 15 communities within the study area and interviews conducted in a couple of months.

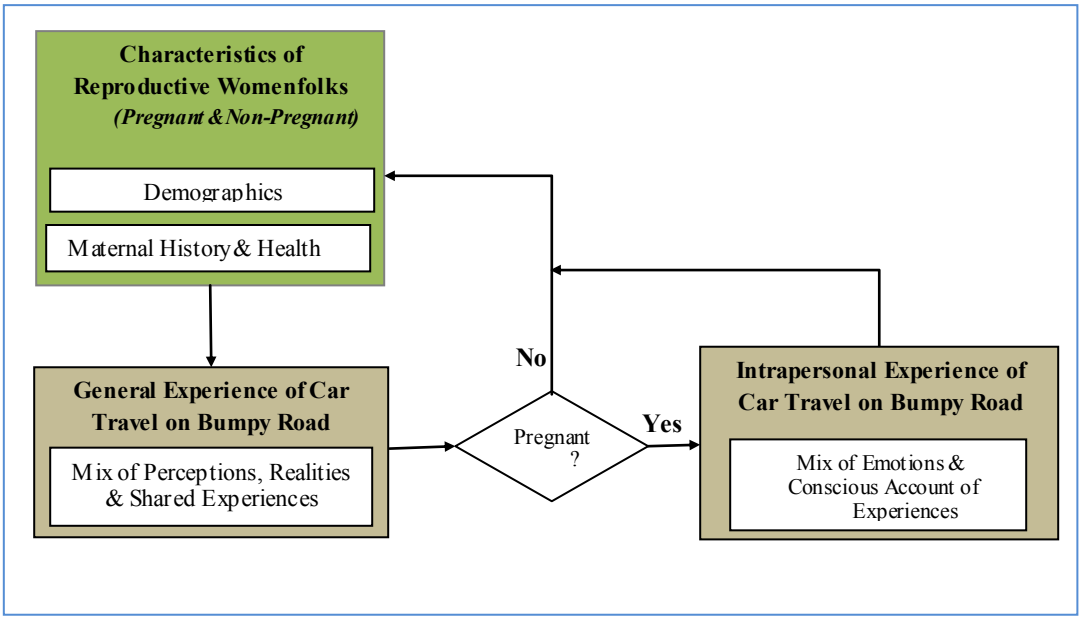

Figure 1: Conceptual framework of reproductive women's travel on bumpy road

Survey Design

The goals of the survey were coherently derived upon conscious reflections that are in line with limitations of preceding research works reviewed. These include evaluating perceptions and realities of reproductive womenfolks about the health implications in relation to commuting on bumpy roads and assessing how their routine trips and driver maneuvering skills on road have affected their antenatal health.

For the purpose of this research, multistage sampling-which connote a complex form of cluster sampling, stratified sampling and random sampling-is used on the basis of size and the wide spread nature of pregnant women and mothers within the study area. A total sample size of 60 respondents was selected based on the multistage sampling technique. It consists of two strata-30 expectant mothers and 30 mothers-drawn randomly from 4 clusters of geographical zones, namely; Sub-Metros, Municipal/District, Major Towns and Minor Towns. Communities were selected based on the degree of availability of speed ramps and zoned base on the size of population. Out of the 15 communities selected for the study, 6 (40%) communities were selected from Sub-Metros and remaining 9 (60%) communities were selected from Municipal/District (20%), Major Towns (20%) and Minor Towns (20%). The same

number of respondents-2 expectant mothers and 2 mothers-were randomly selected and interviewed in each selected community.

The survey was a short but in-depth interview of reproductive women groups using a concise questionnaire-three printed pages that required less than 20 minutes to be administered by trained interviewer using the respondents choice of language-to increase response rate, motivate respondents and reduce respondents burden. Most exploratory questions had multiple choice items and respondent had the opportunity to either select one or more answers depending on the question. Moreover, perceptual questions were on a 3 Likert scale and respondents had to select one answer. The survey aimed to explore women's routine trips, antenatal history and wheel-to-ramp banging interactions encountered using a comprehensive questionnaire. Most questions boarded on past traumatic experience of travelling along bumpy road. The datasets collected from the questionnaires were analysed by using descriptive statistics. The difference in variables obtained among the two data sets for pregnant and non-pregnant women as in the 15 communities are compared using Pearson's Chi-square test based on stated significance levels.

3.0 RESULTS AND DISCUSSION

Notwithstanding the fact that, most women are inherently apprehensive and skeptical about issues, especially those that concern their health and reproductive system, they were tactfully lured into pouring out some confidential experiences that were peculiar to their antenatal health. Comparative analysis of the results of two data sets; pregnant and non-pregnant women within the four clusters of communities discussed herein have revealed interesting trends. Apart from the demographics of the reproductive women in Table 1, two distinct but inter-connected aspects are discussed; including reproductive women's perception and realities as well as the intrapersonal experience of pregnant mothers on effect of ramps in relation to their antenatal health.

Table 1 is a selective preview of demographics of the two cohorts of reproductive women. Incidentally, 30% each for pregnant and non-pregnant groups have had a foetal loss or lost a baby at labour before. More non-pregnant mothers asserted that after ill health the next most profound cause of foetal loss is through speed ramps in the course of trip chaining activities even though this assertion is statistically insignificant. More pregnant mothers (22%) asserted that the causes of foetal loss are unknown and more so, 30% of these respondents were naive about pregnancy.

Table 1: Demographics of Reproductive Women

Variable	Pregnant (%)	Non-Pregnant (%)	Total (%)	Significance
Age Group of Women				*0.090**
20 years and below	10.00	3.30	6.70	
21 up to 25 years	23.30	10.00	16.70	
26 up to 30 years	33.30	33.30	33.30	
31 up to 35 years	26.70	16.70	21.70	
36 up to 40 years	3.30	20.00	11.70	
41 up to 50 years	3.30	16.70	10.00	
Total	100	100	100	
Duration of Pregnancy				
Between 4 to 6 Months	30.00		30.00	
Between 7 to 9 Months	63.30		63.30	

Above 9 Months	6.70		6.70	
Total	100.00		100.00	
Has Woman Ever Given Birth				0.001**
Yes	70.00	100.00	85.00	
No	30.00	0.00	15.00	
Total	100.00	100.00	100.00	
Ever Had Fetal Loss or lost a baby at labour				1.000
Yes	30.00	30.00	30.00	
No	70.00	70.00	70.00	
Total	100.00	100.00	100.00	
Causes of Foetal Loss or Baby's Death				*0.467*
Excessive Hard Working	11.10%	0.00	5.60	
Accident at Home	11.10%	11.10	11.10 %	
Nasty Driving over Speed Ramps by Drivers	11.10%	22.20	16.70	
Poor Anti-natal Service by Health Officials	11.10	11.10	11.10	
Illness	22.20	55.60	38.90	
Other	11.10	0.00	5.60	
Don't Know	22.20	0.00	11.10	
Total	100	100	100	

The differences between the demographics for Pregnant women and Non-Pregnant women were tested using a Pearson's Chi-square Test at 95% Confidence level (2-tailed) in SPSS-version 17.0 Software.

*Significant at 90% confidence interval

**significant at 99% confidence interval

Bumpy Road Travelling Experience: Women's Perceptions & Realities

The perceptions and factual experiences of two women groups are shown in Table 2. A higher percentage of non-pregnant women (93.3%) than pregnant women (73.3%) admitted that speed ramps have effect on their antenatal health. Some pregnant women (16.7%) feel comfortable with the speed ramps whilst a sizeable number of women-comprising pregnant women (10%) and non-pregnant women (6.7%)-were silent on this issue. Concurrently, when a more factual opinion were solicited, similar trends were obtained as 63.3% and 73.3% accordingly for pregnant and non-pregnant women affirmed that they have ever suffered undue wheel-to-ramp impact before. The occurrence of wheel-to-ramp impact and its aftermath ordeals that women factually endured is widely distributed among the various cluster of communities considered in this study Prominent among such pregnancy distresses are abdominal and or waist pain, bleeding per vagina, loss of liquor, improper foetal presentation, miscarriage and other undiscovered consequences.

A relatively higher percentage of non-pregnant women (50%) than their counterpart pregnant mothers (47.4%) reported that they had ever suffered from abdominal and waist pain as a result of travelling on roads with erected speed ramps. Only 5% of non-pregnant mothers were courageous enough to disclose that they have had miscarriages

that are ascribed to speed ramps. Apparently, this may be due to the fact that pregnant women do not want to associate themselves with unpleasant scenarios which may further worsen their depressive moods. This could be buttressed with the fact that a higher percentage, 36.8% of pregnant mother against 25% of their non-pregnant counterpart, were unable to pinpoint any aftermath of a serious ramp bouncing over they encountered.

Comparatively, it is more interesting when women groups were given the same platform to account for what had happen to a friend's or a neighbour's pregnancy. As depicted in Table 2 only smaller percentage of pregnant women (13.3%) than non-pregnant mothers (46.7%) claimed they had witnessed from a friend or neighbour - such pregnancy trauma. It is noteworthy that, among these few pregnant mothers who had the courage to contribute to the subject of shared pregnancy trauma, they were either.

Table 2: Women's Perceptions and Realities about Speed Ramps

Variable	Pregnant (%)	Non-Pregnant (%)	Total(%)	Significance[1]
Speed Ramps have effect on One's Pregnancy				0.052[a]
Yes	73.30	93.30	83.30	
Don't Know	10.00	6.70	8.30	
No	16.70	0.00	8.30	
Experienced a serious wheel-to-Ramp Banging at Time of pregnancy				0.405
Yes	63.30	73.30	68.30	
No	36.70	26.70	31.70	
Trauma Seen Immediately (within 24hours) after Serious wheel-to-ramp banging				0.137
Improper foetal presentation	5.30	0.00	2.60	
Loss of liquor	10.50	0.00	5.10	
Abdominal and or Waist Pain	47.40	50.00	48.70	
Bleeding per Vagina	0.00	20.00	10.30	
Loss or Reduced foetal movement	0.00	0.00	0.00	
Miscarriage / Still Birth	0.00	5.00	2.60	
Premature Delivery	0.00	0.00	0.00	
Other	0.00	0.00	0.00	
Don't Know	36.80	25.00	30.80	
Witnessed/Shared a friend's Trauma Due to Ramp				0.005[b]
Yes	13.30	46.70	30.00	
No	86.70	53.30	70.00	
Trauma that a neighbour/Friend Suffered that is ascribed to Ramps.				0.618
Improper foetal presentation	0.00	0.00	0.00	

Loss of liquor	0.00	0.00	0.00
Abdominal and or Waist Pain	50.00	42.90	44.40
Bleeding per Vagina	0.00	28.60	22.20
Loss or Reduced foetal movement	0.00	7.10	5.60
Miscarriage / Still Birth	0.00	7.10	5.60
Premature Delivery	25.00	7.10	11.10
Other	25.00	7.10	11.10

[1]The differences between the distribution of responses for pregnant and Non-Pregnant women were tested using a Pearson's Chi-square Test at 95% Confidence level (2-tailed) in SPSS-version 17.0 Software.
[a] Significant at 90% confidence interval
[b] Significant at 99% confidence interval

Deliberately or unconsciously not able to pinpoint a more differentiated ordeals that confront women and their transportation issues as compared to their non-pregnant counterpart. However, non-pregnant women were more open in their contributions to the subject of study as they were able to unveil three other specific problems women endure. These include loss or reduced foetal movement, premature delivery and other ordeals such as loosening of cervix, inter alia, as reported by respondents.

Bumpy Road Travelling: The Pregnant Women's Intrapersonal Experience

Table 3 gives a descriptive account of how pregnant women perceive that speed ramps on roads might have effect on them. An association between their perceptions about speed ramps and their factual experiences in relation to road transportation is also considered. From Table 1, pregnant women who were interviewed consisted of third trimester group (63.3%), second trimester group (30%) and above 9th month group (6.6%). There was no respondent identified among the first trimester category. Among these categories of expectant mothers, approximately, 73.3% of them perceive that speed ramp is a threat to their health, 16.7% disregard this perception and 10 % were silent on the subject. But a marginally lower percentage of 69% pregnant women actually claim that they feel very uneasy during wheel-to-ramp banging, a marginally higher 27.6% are comfortable and marginally lower percentage of 3.4% remained indecisive on the issue of uneasiness.

The interesting aspect is that, all the few pregnant women who were in their ninth month had the perception that speed ramps is a threat to one's pregnancy and they asserted that they feel very uneasy when they commute on roads with speed ramps. In Table 3, great numbers, representing 66.7% per each group-for those in second and third.

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Table 3: Expectant Women's Intrapersonal Experience

Variable	2nd Trimester	3rd Trimester	> 9th Month	Total (%)	Significance[1]
Ramps have Effect on Pregnant Women & Foetus					0.117
Yes	88.90	73.70	0.00	73.30	
Don't Know	0.00	10.50	50.00	10.00	
No	11.10	15.80	50.00	16.70	
Uneasiness when Vehicle bounce over Ramps					0.814
Yes	66.70	66.70	100.00	69.00	
Don't Know	0.00	5.60	0.00	3.40	
No	33.30	27.80	0.00	27.60	
Ever Experienced serious bouncing over at pregnancy					0.498
Yes	55.6	63.2	100.0	63.3	
No	44.4	36.8	0.00	36.7	
Ever Suffer a Trauma that is ascribed to Ramps					0.273
Yes	44.40	31.30	100.00	40.70	
Don't Know	33.30	18.80	0.00	22.20	
No	22.20	50.00	0.00	37.00	

[1]The differences between the distributions of responses for Three Pregnant Women Groups were tested using a Pearson's Chi-square Test at 95% Confidence level (2-tailed) in SPSS-version 17.0 Software

Trimesters-confirmed that they experience similar uneasiness during travel over speed ramps. Only 5.6% of those in the third trimester were uncertain as they could not tell whether or not they are comfortable during travel over speed ramps. Similar percentage distributions were obtained for the various gestations groups in relation to expectant mothers' perceptions.

Although, when women were further probed as to whether they have ever experienced a trauma ascribed to speed ramps (beyond 1 day) the response trend declined, more pains and other different disorders manifested compared to the trauma recorded immediately (within 24 hours) after a bouncing over encounter *(Table 3 and Figure 2).* Approximately, 40.7% of pregnant women asserted that they either have had or are having a pregnancy disorder that are ascribed to ramps, 37% said they have no disorder related to the nature of speed ramps and 22.2% asserted that they cannot predict if speed ramps have had effect on them. Again all those expectant mothers in their 9th month claim they have ever had a disorder associated with the ramps whilst those in the second and third trimester groups recorded fairly even distribution of responses.

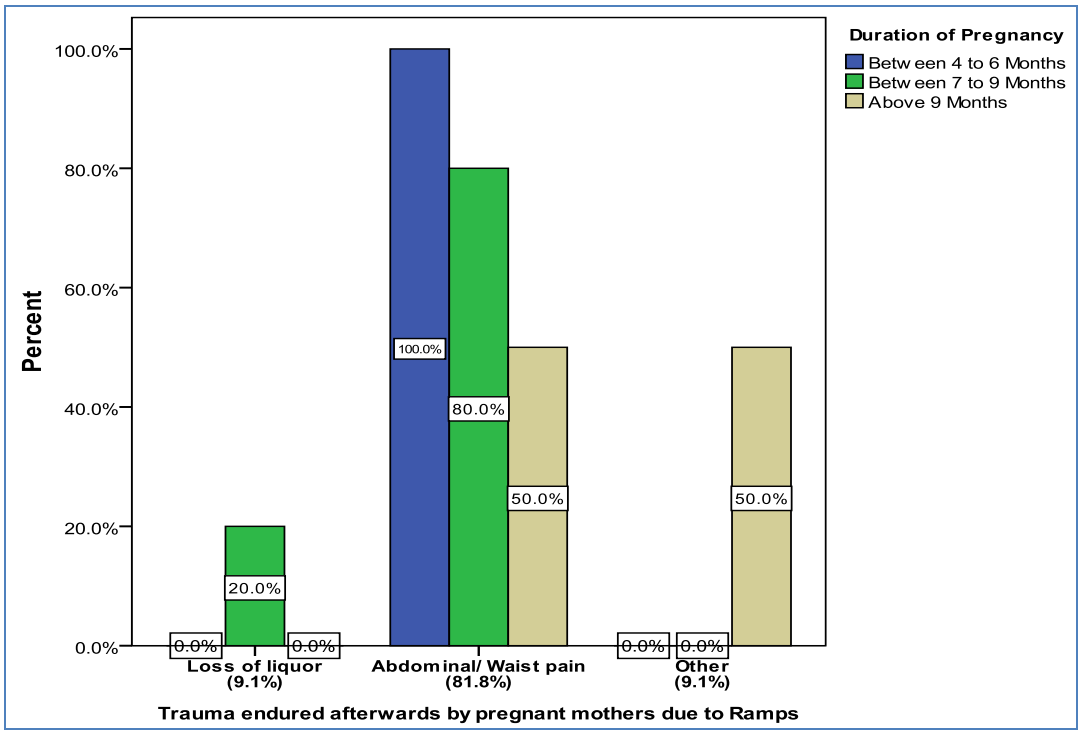

Figure 2: Self-assertive trauma that affected pregnant women per gestation period

Among those who admitted that they have had a pregnancy disorder in relation to speed ramps; 81.8% complained of abdominal and waist pain, 9.1% complained of loss of liquor and 9.1% complained of other disorders but were unwilling to disclose the details. Specifically, pregnant women-consisting of second trimester group (100%), third trimester group (80%), and above their 9th month group (50%)-complained of abdominal and waist pain as indicated in Figure 2. More so, 20% of those in third trimester also complained of loss of liquor and 50% of those in their 9th month did complain of other disorder-which they were reluctant to share.

When the actual problems they are currently enduring due to ramps were compared to what happened to their health immediately after a serious bouncing over, two more health implications were noticed. These include improper foetal presentation and other unknown consequent were exposed by expectant mothers. It is important to note that, the overall percentage of those having abdominal and waist pain rose from 47.4% at bouncing over to 81.8% at manifestation of effect which is in agreement with Sir Austin Bradford Hill's criteria for causality in a biological system (Hill, 1965).

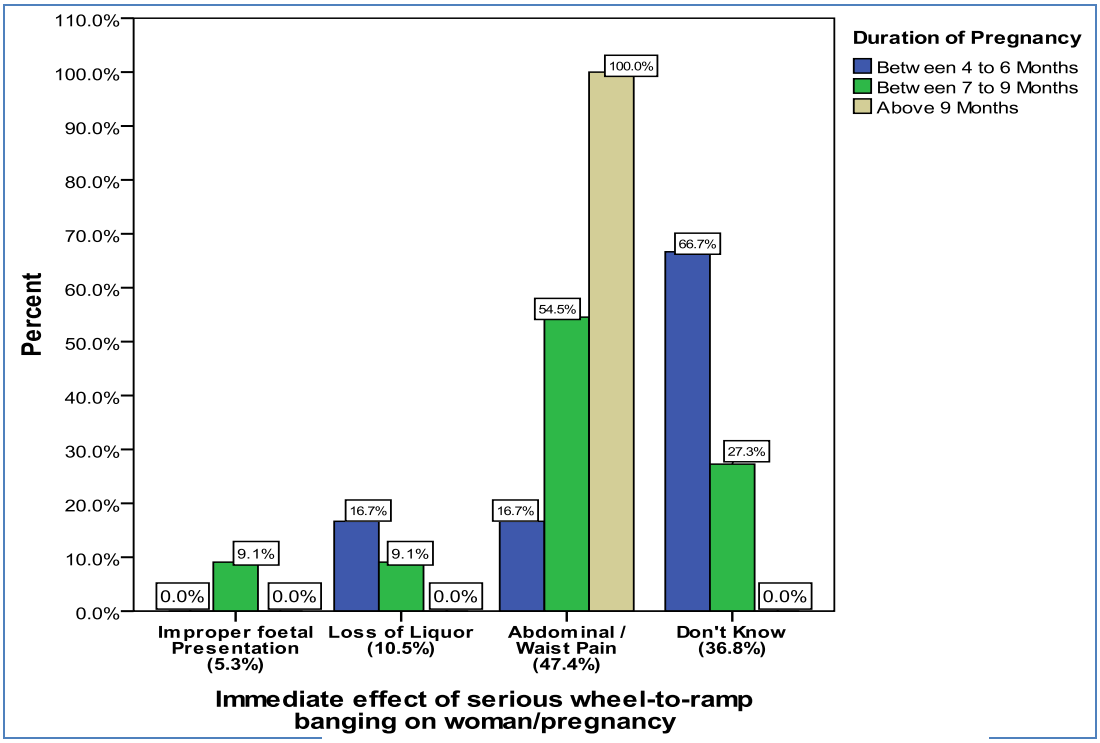

Figure 3: Immediate effect of wheel-to-ramp banging impact: women's realistic experience.

It is clear that out of 63.3% of pregnant women had a serious bounce over ramps *(Table 3*) but 36.8% of them claimed that the immediate consequence were unknown *(Figure 3)*. There is a possibility the 36.8% pregnant women who had a serious bouncing over but did not record any disorder within 24 hours might latter on experience a more diverse complications such as loosening of cervix, among others in the latter part of their gestation period. This finding buttresses the concept that there existed a delay between the bouncing over encounter, the cause and the occurrence of pregnancy disorder, the effect.

4.0 CONCLUSION AND RECOMMENDATION

The quantitative cross-sectional survey has yielded interesting and fairly consistent results. Even though the explorative findings obtained are quiet scary, they are not by mere happenstance as a number of converging evidence have emerged to validate the perceptual claim that speed ramps have had health repercussions on pregnant women. The complexity of empirical evidence revealed towards speed ramps do not only span from ramp construction to its proper observation by drivers but more so from mothers' demographic dynamics to the affirmation of antenatal health problems that are ascribed to speed ramps.

The major findings of interest are those detrimental to the antenatal health of pregnant women, especially when their counterpart non-pregnant women have tremendously alluded to a number of assertions and the fact that the pregnant women have buttressed it with some current traumatic happenings. Significantly more non-pregnant women believe that speed ramps have serious repercussions on pregnancy than their counterpart pregnant women do. Among the pregnant women, higher percentages of those in their second trimester felt that speed ramps pose a threat to their pregnancies than those in third trimester, even though this assertion is statistically insignificant. Probably because pregnant women do not want to discuss unpleasant pregnancy related issues and the fact that the changes associated with their psychological and emotional dynamics may affect

their judgment. However, all those above their 9th month of pregnancy felt very uneasy during a wheel-to-ramp banging and have had disorders associated with ramps whilst two-thirds and about one-third of those within the other gestation periods respectively experienced such uneasiness and disorders.

Moreover, less abdominal and waist pains and other forms of trauma were recorded by pregnant women within 24 hours of a serious wheel-to-ramp banging than those pains ascribed to ramps and other traumas recorded latter on (after one day) by the same women. Probably because more differentiated forms of trauma are expected-days after wheel-to-ramp banging encounter (Hill, 1965; Aghajafari, et al., 2013). Those in third trimester followed by those in second trimester recorded severe cases of liquor leakage than those above their 9th month of pregnancy. Perhaps because between the 28th to 32nd weeks of pregnancy the uterus produces more amniotic fluid to accommodate the growing foetus (Gilbert, 2007), there is the tendency of liquor loss by any appreciable ramp-induced vibrations.

In a generation where most reproductive women commute their trips by vehicle irrespective of the age group, educational status and gestational periods of their pregnancies, road and transportation policy interventions ought to be evaluated periodically. Moreover, future studies may also be tailored towards the quantitation and determination of the threshold vehicle climbing speed versus slope of ramp that may cause mechanical damage to the uterus and subsequently affect the unborn baby.

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