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The aim of this SSM is to explore the effectiveness of ultrasound in monitoring well-being and growth in the fetus. The particular focus will be on how Doppler imaging is used to assess fetal well-being and exploring how Doppler ultrasound imaging could also be used to predict for SGA due to pre-eclampsia. Method Three online databases (PubMed, Google Scholar and Web of Science) were used to search for articles which focused on this SSM title and the particular aims. Inclusion/exclusion criteria's were applied to the database searches to refine the results till 4 articles were chosen for appraisal. Results The first two articles found provided significant evidence of Doppler imaging being effective in monitoring fetal activity and its well-being. The third article found suggested that Doppler imaging is a good tool in predicting small for gestational age babies due to pre-eclampsia however the fourth article didn't provide strong enough evidence to support this claim Conclusion Doppler imaging provides a range of parameters most of which are useful in monitoring fetal activity. However some indices are more useful than others in this monitoring and future studies should be carried out to investigate this.

## **Introduction**

Obstetric ultrasound has drastically helped develop the quality of prenatal care provided to the mother and child since its introduction in 1958 by the Scottish physician Ian Donald.(1) His initial idea that sonar technology could be used in medical treatment was met with much doubt however with the help of other colleagues and willing patients at the Royal Maternity Hospital in Rottenrow he was able to measure and monitor fetal head sizes and through physicians at other hospitals the method was greatly refined till fetal

cephalometry became the main technique for determining baby growth in utero.(2) Since its introduction, medical ultrasound has helped significantly develop and redefine the technologies used for prenatal care such as the expansion into Doppler sonography, contrast media and compression ultrasonography.(3) These different technologies, especially ultrasound scanning and Doppler sonography, are used around the world to provide a range of information on the status of the mother, the fetus and the progress of the pregnancy. The different methods of sonography are also used to detect any developmental defects in the pregnancy and to monitor these possible abnormalities. The United States Centre for Disease Control and Prevention states that " every 4. 5 minutes, a baby is born with a birth defect" and " about one in every 33 babies is born with a birth defect, which is the leading cause of infant death." (4-6) This shows the importance of having accurate and efficient methods of monitoring fetal activity as well as up-to-date guidelines and standards to run this monitoring through. The NICE guideline on antenatal care (developed by the NCCWCH) (7) is an example of this and is regularly updated to support new evidence and cover all aspects of antenatal care. The RCOG green top guidelines (8) and the BMUS (9) policies further support the need for safe ultrasound services and adequate resources. The green top guidelines, particularly number 31 from the RCOG, are used " to make recommendations regarding the diagnosis and management of small-for-gestational-age (SGA) fetuses." (8) These fetuses that are SGA " have a condition called intrauterine growth restriction (IUGR)" (10) whereby the fetus is deprived of its essential nutrients, vitamins and oxygen which are required for accurate development of the organs and tissues. Pre-eclampsia is one of the factors that lead to SGA through IUGR <https://assignbuster.com/web-of-science-categories-health-and-social-care-essay/>

(10) as it is an increase in blood pressure which restricts the flow of blood into the placenta and so the majority of blood flow is focused towards the vital organs of the baby such as the brain and heart resulting in decreased blood flow towards the abdomen. This leads to an unequal growth pattern in the head and abdomen which is detected through ultrasound scanning and Doppler imaging.(11)The aim of this work will be to explore the effectiveness of ultrasound in monitoring well-being and growth in the fetus. The particular focus will be onUsing Doppler imaging to assess fetal well-beingExploring how Doppler ultrasound imaging could be used to predict SGA due to pre-eclampsia

## **Methodology**

Initial information regarding ultrasonography was sourced through booklets provided by the convenor. Google search and the university library gave further access into the importance of ultrasound monitoring in antenatal care. Websites such as Wikipedia and e-books on obstetrics and gynaecology also provided further depth into the subject of ultrasound till the RCOG green top guidelines led to the specific aims proposed by this work. Three main databases were used for access to articles to be critically appraised. These were PubMed (12) Web of Science (13) and Google Scholar.(14)Google Scholar (14)This database was accessed on the 29/01/2013 where two different search terms were applied. These were the search terms " doppler abnormalities IUGR" and " Doppler indices in SGA fetuses". Out of the first page of results a relevant article was chosen and two overall articles were chosen from this database. (15, 16)PubMed (12)FilterExcludedIncluded

## Article types

All other article types  
Clinical Trial  
Randomized Controlled Trial

## Text availability

All other available texts  
Free full text available

## Publication Dates

All articles > 5 years old  
All articles < 5 years old

## Species

Animals  
Humans

## After these filters were applied there were 3235 results remaining

This website was accessed on the 29/01/2013 where the initial search of ultrasound yielded 400633 search results. The following filters were then applied to the search results which left 3235 results. Table 1: Filters applied to PubMed on 29/01/2013  
To further narrow the results the search term "ultrasound" was combined with the search term "pre-eclampsia". This gave a final 16 results which were each analysed and any unrelated articles, such as those talking about drugs or any that didn't involve the subject of pre-eclampsia and ultrasound, were ignored. This left one article which was chosen for appraisal (17)  
Web of Science (13)  
The Web of Science database was accessed on the 29/01/2013 through the Web of Knowledge website. The search term "ultrasound pre-eclampsia" was applied which yielded 281 results. The table shows the filters applied to the search results to refine them. Filter Excluded Included

## **Web of Science Categories**

All other categories Obstetrics Gynecology Pediatrics Reproductive Biology

## **Document Types**

All other types Article

## **Publication Dates**

All articles > 5 years old All articles < 5 years old

## **Languages**

All other English

## **After these filters were applied there were 58 results remaining**

Table 2: Filters applied to Web of Science on 29/01/2013 The remaining 58 results were each analysed and the one that focused the most on the posed question was appraised. (18) These databases returned vast amounts of literature and only 4 accessible papers were chosen to be explored. (15-18)

## **Discussion**

It has been claimed that Doppler imaging can possibly be a useful tool in monitoring pregnancies and their health through continuous examinations of the fetus and establishing possible trends from normal to abnormal readings. The following study was carried out in order to examine this claim. (15) This longitudinal cohort study examined 171 singleton pregnancies from women who had developed late onset SGA fetuses in their third trimester. Doppler imaging was used to take three different indices throughout the study in order to see if they developed had from normal readings to abnormal

readings. These three readings were " uterine (UtA), umbilical (UA) and middle cerebral artery (MCA) Doppler velocimetry". (15) Various inclusion and exclusion criteria's were also applied to the cohort of women chosen such as all fetuses had to be in their third trimester and below the 10th centile to ensure they were late onset SGA pregnancies, the initial UtA and UA pulsatility index (PI) readings had to be below the 95th centile and the MCA-PI reading had to be above the 5th centile to ensure fetuses with normal Doppler profiles were chosen. The Doppler velocimetry was then carried out fortnightly and 616 scans were recorded from the 171 fetuses. A fourth extra index was also calculated called the cerebroplacental ratio (CPR) by combining the UA-PI with the MCA-PI. The results of the study show that after 37 weeks of gestational age (GA) a clear pattern can be established. From the 37th week of GA till the final examination before delivery a clear decrease in the CPR and MCA-PI can be seen however the UA-PI and the UtA-Pi remained relatively constant. The insignificant change in the UA-PI and UtA-PI readings show that carrying out " uteroplacental Doppler is of little clinical value" as stated in the article (15) however the significant decrease in the CPR and the MCA-PI shows that cerebral Doppler could be the best method of detecting fetuses at " a high risk of adverse perinatal outcome." (15) Also it can be said that this study has shown, using CPR from Doppler imaging is the best index to monitor fetuses with late onset SGA. The study used a large enough sample size (n= 171) and covered a broad range of medical and social histories such as involving primiparous women and women who had already given birth before. The study also covered different ethnic backgrounds, women who smoked and women of low socio-economic class showing that the results of the study can be applied to the general

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population. The following study (16) also supports this claim that Doppler imaging can be used to examine fetal well-being by taking several Doppler parameters and monitoring their progression through the pregnancy till delivery. This longitudinal prospective study (16) examined 104 singleton pregnancies from women who had developed early-onset placental dysfunction. Several inclusion criteria's were applied to the prospective women of this study to ensure that fetuses at an early stage of growth restriction were examined. These inclusion criteria's were that the abdominal circumference (AC) had to be below the 5th percentile, the " UA-PI had to be elevated more than 2 SD above the mean and the CPR had to be more than 2 SD below the mean." (16) Doppler indices were then taken at regular intervals to see how these changed as the placental disease developed. The indices taken were the UA-PI, MCA-PI, ductus venosus-PI (DV-PI) and the umbilical vein-PI (UV-PI). A total of 668 Doppler examinations were taken from the fetuses where clear trends in the results could be observed. Three clear separate groups were established from the data each suffering from a different dysfunction of the placenta. The first group of women developed mild placental dysfunction as a result of abnormal UA reading. The UA-PI increased abnormally at 32 weeks of GA however it remained within 3 SD of the normal. The second group of women developed progressive placental dysfunction as their UA reading increased abnormally above 3 SD after 29 weeks of gestation. The MCA and DV readings then also became abnormal in this group requiring early delivery of the fetuses at 33 weeks of GA. The third group developed severe early-onset placental dysfunction where the UA reading increased very early on in the pregnancy (27 weeks GA) which then quickly led to an abnormal DV reading. The results show that different

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dysfunctions can develop in the fetus leading to retardation in the growth and that the deciding factor between these different dysfunctions is the gestational age at which the abnormalities arise. Doppler imaging therefore can be used to continuously monitor fetuses to detect when an abnormality in the UA parameter arises indicating a growth restriction within the fetus as well as the degree of this restriction associated with the age of onset. This study which obtained approval from the " Institutional Review Board at each participating centre" (16) involved a large sample (n= 104) of women and also covered many different ethnic backgrounds. It also accounted for women who had previously given birth showing that the data and any results that were established from it could be applied to the general population. It has been found that using Doppler imaging in pregnancy may be valuable in predicting small for gestational age babies due to pre-eclampsia. The following study was performed in order to investigate this.(17)This longitudinal multi-centre study, which " was approved by the South Thames Multicentre Research Ethics Committee" (17), examined pregnant women with fetuses between 22 to 24 weeks of gestation, where pulsed wave Doppler imaging was used to take a measurement of the pulsatility index (PI) of the women's uterine artery. Background information such as aspects of the women's social life and medical history were also covered such as if they were cigarette smokers or if they had a past history of pre-eclampsia. The results of the study show that the women who were unaffected by either pre-eclampsia or SGA had a lower mean PI. The mean PI then increased by 0. 11 in women who developed SGA and by 0. 41 in women who developed pre-eclampsia, indicating that there may be a possible correlation between an increased PI and the chances of developing pre-eclampsia or SGA. However

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as these figures are means it doesn't show the full story as if the interquartile range is examined it shows that the figures overlap in all three groups. Also it should be noted that in the group of women who developed pre-eclampsia over a quarter of them had a past history of the condition showing that if they have had the condition before then there is an increased chance of them suffering from it again. Analytical studies were also carried out on the data in the study where it was found that " there was an inverse significant association between the gestational age at delivery and prevalence of SGA"(17) in the pre-eclampsia group showing that there is definitive trend between pre-eclampsia leading to SGA and that babies born pre-term have a higher chance of developing SGA. This inversely significant trend was also shown when comparing the gestational age at delivery and the mean uterine PI showing that as the gestational age at delivery decreased the mean uterine PI increased. From this it can be said that babies born pre-term as a result of pre-eclampsia have an increased chance of SGA and that the chances of having a higher mean uterine PI are also increased, which can be detected through pulsed wave Doppler imaging. The study involved 30 639 women showing that any data produced and any results or statements formed from this study can said to be significant. However other aspects of this study such as the fact that only women between the ages of 25 to 34 were examined and that the majority of these women were of a white ethnic group could cause bias as the whole universal population is not accurately represented. The fourth article (18) also provides data to suggest that Doppler imaging in pregnancy may be valuable in predicting pre-eclampsia and possibly small for gestational age babies. This primary prospective study used three-dimensional power Doppler (3D-PD) imaging to <https://assignbuster.com/web-of-science-categories-health-and-social-care-essay/>

examine women whilst they were pregnant between 10 weeks and 6 days and 13 weeks and 6 days. Various indices were measured using (3D-PD) such as the vascularization index (VI), flow index (FI) and vascularization flow index (VFI).(18) The outcome of the women and their pregnancies were then scored on a grade of normal, pregnancy induced hypertension (PIH), SGA or both. It was found from the study that all indices were similar in all groups however the VI was significantly lower in women who developed PIH however this association doesn't involve or predict for SGA. This study shows that PIH could possibly be detected for using the VI through 3D-PD however this method of Doppler imaging is not good enough to predict for SGA. The sample size used in the study was fairly large (n= 208) and therefore the results are generally valid although there was no mention of ethnic background which means that it can't be applied to the general population as it may be possible that some ethnicities were not accounted for in this study.

## **Conclusion**

The aim of this work was to explore how effective Doppler ultrasound is in monitoring well-being and growth in the fetus as well as how it can be used to predict SGA due to pre-eclampsia. The four articles that were chosen showed these aspects of Doppler ultrasound imaging and how effective it is in examining fetuses. Evidence provided from the articles was scrutinised till a statement was established claiming that certain Doppler parameters were useful for monitoring fetuses. In the first article (15) discussed there was a clear relationship in the results between the decreasing CPR and the development of late onset SGA showing the significance of Doppler in

monitoring the fetus. The second article (16) placed more importance on the UA-PI in detecting for developments of growth retardation in fetuses. Future studies could be carried out on the CPR alone using cerebral Doppler imaging to investigate how important and effective this parameter actually is in monitoring the well-being of SGA fetuses. The third (17) and fourth (18) articles both provided evidence of using Doppler to predict for SGA as a result of pre-eclampsia however only the third one actually did show this. From the data it was established that babies born pre-term as a result of pre-eclampsia have an increased chance of SGA and higher mean uterine PI, which can be detected through pulsed wave Doppler imaging. The fourth article could only establish the relationship of detecting for pre-eclampsia, through VI from 3D-PD, but not for predicting SGA as a result of pre-eclampsia. However the data from the fourth article (18) did show significant differences in the crown-rump-length (CRL) between the "normal group" and the "either PIH or SGA group" which is something that could be investigated in future studies to see if the CRL has any significance in predicting for SGA and PIH. Also as neither of these studies accounted for the much diverse population around the world, future studies could incorporate this factor to provide evidence which accurately represents the general population. As mentioned in the introduction, the Royal College of Obstetricians and Gynaecologists green-top guideline no. 31 (8) makes recommendations concerning the management of SGA fetuses. The guideline suggests that "uterine artery Doppler has limited accuracy in predicting fetal growth retardations (FGR)" (8) which contradicts the findings in this SSM. It should be noted though that this green-top guidelines was based off a systematic review which was published in 2000 so it may be out-dated now. However <https://assignbuster.com/web-of-science-categories-health-and-social-care-essay/>

the guidelines do also suggest that Doppler imaging should be "evaluated further" (8) as suggested above. During this SSM various limitations were encountered. Due to the word limit and time limit of four weeks only a certain number of articles could be appraised narrowing the study and also some articles on the databases had to be filtered out as they were not accessible through the university network or required payment for the full article.

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