INTRODUCTION:
Women now have greater involvement within the hypo and hyperbaric workplace as divers, instructors, in the military, and as pressure chamber attendants. Since the 1970s controversy has persisted regarding the issue of a relationship between the menstrual cycle and decompression illness (DCI) - encompasses the two conditions decompression sickness (DCS) and arterial gas embolism (AGE) following pulmonary barotraumas.

Although there are numerous non-diving studies comparing the effect of the menstrual cycle and sporting performance, the number of studies investigating DCI and the menstrual cycle is small. However, both retrospective and prospective work from the hypo and hyperbaric environments suggest a differing risk factor of DCI or problems during diving over a typical 28-day cycle. We scrutinised the available relevant published data (“The Literature”). Additionally we reviewed records from women treated with DCI to further investigate any potential relationship (“The Study”).

METHODS:
The Literature
Results of relevant published studies in hypo and hyperbaric environments from 1988 to 2006 were evaluated.

The Study
Records were evaluated from treatment chambers worldwide where women had been diagnosed and treated in a chamber for DCI (QinetiQ and DORDC 1997 – 2005).

• the study was questionnaire based. Only records fulfilling the inclusion criteria were used where the number of days between the first day of the last menstrual cycle and the problem dive was known.
• Information regarding oral contraceptive pill use, usual length of menstrual cycle, age, depth of dive prior to onset of symptoms, type of symptoms, and smoking habits were also gathered.
• All menstrual cycles were normalised to 28 days (0-27), with day 0 being the first day of bleed. The days from the first day of the last menstrual period (LMP) to the day of the incident were calculated. The Chi-square goodness-of-fit test was used to assess whether the distribution of DCS incidents was uniform across the normalised four weeks (28 days) of the menstrual cycle.

RESULTS:
The Literature
The 7 altitude and diving related publications (abstracts and papers) showed a relationship between DCI, or problems during diving, and the point in the menstrual cycle at which they occur (Table 1).


St Leger Dowse found no correlation between DCS in the last two weeks of the cycle. Though when age was taken into account there was a marked in the non-OCP group where there was strong evidence to support the confirmation of a relationship with the menstrual cycle and the risk of DCS.

The OCP findings however are less clear. This may be due to a number of factors such as insufficient data for each week of the menstrual cycle, the varying types of OCP used by the women, and their usage of the OCP. Anecdotal evidence suggests women on the OCP extend their menstrual cycles for social reasons, with a recent study observing extended cycles of 25 to 40 days and more.

The Study and the Literature
Many studies assume women on the OCP to have a classic 28 day cycle. It could be argued that assuming a 28 day cycle, or normalising the OCP data, may shift the distribution of Incidents across the cycle time-frame. Lee (2003) and St Leger Dowse (2006) found no relationship with the OCP when normalising their OCP data, but when OCP data were analysed in the St Leger Dowse study using only true 28 day cycles, the results were significant.

Problems reported during diving were prospectively recorded across a menstrual cycle and suggested a risk factor associated with increased diving. The highest risk was in week three before the onset of the critical week at the end of a 28 day cycle. 513 women, 938,800 dives, 11,509 menstrual cycles.

DISCUSSION:
The Literature
The conclusions of the literature were all consistent in spite of varying exposures, methodologies, analyses, and differing populations. The available evidence from the literature consistently suggests that there is a relationship between the risk of DCS during hyperbaric or hypobaric exposure, or the occurrence of problems during hyperbaric, and the time in the menstrual cycle. Results were significant, particularly in the non-OCP groups. The issue regarding the OCP is inconclusive.

The Study
Overall the incidences of DCI were not evenly distributed over a typical 28 day menstrual cycle. This was particularly marked in the non-OCP group where there was strong evidence to support the confirmation of a relationship with the menstrual cycle and the risk of DCS.

The OCP findings however are less clear. This may be due to a number of factors such as insufficient data for each week of the menstrual cycle, the varying types of OCP used by the women, and their usage of the OCP. Anecdotal evidence suggests women on the OCP extend their menstrual cycles for social reasons, with a recent study observing extended cycles of 25 to 40 days and more.

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The literature over a period of 18 years was taken from both hypo and hyperbaric environments, retrospective and prospective data, and from military and civilian disciplines. Analysis over the menstrual cycle differed between studies, with some observing the incidence of DCI by individual, whilst some publication studies observed the incidence of DCI by attitude exposures. In spite of these differences a common theme was seen in all studies. Whether this is the result of hormonal fluctuations of the menstrual cycle remains unquantified and is a subject for further investigation.

CONCLUSION:
We suggest evidence is building that a relationship between the menstrual cycle and DCI may exist. The results of the literature evaluated here are supported by analysis of the data of this study.

There may be a potential health and safety issue emerging regarding women, DCI and the menstrual cycle, and thus a case implementing prospective research where the variables can be controlled.