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PERIODISATION: TAILORING TRAINING BASED ON THE MENSTRUAL CYCLE MAY WORK IN THEORY BUT CAN THEY BE USED IN PRACTICE?

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INTRODUCTION

Since the FIFA Women's World Cup in 2019, there has been increased media attention on the menstrual cycle and how it may contribute to overall football performance and success. The menstrual cycle has been reported as the second most important biological rhythm, that not only affects female reproduction, but also regulates physiological, metabolic, thermoregulatory and cognitive functions (Constantini et al. 2005). Potentially, this could be an additional consideration to further optimise training prescription around a player's individual biology, enhancing adaptive responses. Subsequently, this has led to clubs announcing that they tailor individual training programmes around players' menstrual cycles (Rowan 2020). For coaches involved in team sports, although the extent of these 'marginal' improvements will vary between players, additive effects across a squad may theoretically result in significant, game-changing outcomes. However, in terms of implementation, this means tracking each phase for each player, and providing guidance on elements of athletic performance such as training, nutrition and sleep. Whilst these factors may influence 'what' a coach prescribes, associated mood and behavioural changes typically experienced as part of premenstrual syndrome may also influence 'how' you coach through altered coach–athlete relationships. Although there is potential scope for such an idea, current research is

conflicting and does not show a consensus. However, a greater shared awareness will not only better equip both coaches and players in training prescription but may also positively impact the players' confidence in coach–player relations. In this editorial, we will discuss the practical and research considerations needed before implementing menstrual cycle phase-based periodisation in football, with the aim to stimulate future research and bridge the gap between theory and practice within this area.

THEORETICAL BASIS FOR PLANNING TRAINING AROUND THE MENSTRUAL CYCLE

In theory, it could be suggested that there are optimal windows of opportunity for training adaptations within certain phases of the menstrual cycle, which are bound to specific hormonal levels (see review: Janse de Jonge 2003). For example, it has been suggested that immediately pre- and post-ovulatory phases are optimal for high-intensity training (Hamilton 2012). The potential explanation is an increased level of pain tolerance, highest level of maximal voluntary force production, and a shift in metabolism which promotes the use of muscle glycogen. This has been linked to the rapid surge of luteinizing hormone, triggering an increase in testosterone, in conjunction with rapid declines in oestrogen (Hamilton 2012). Furthermore, during the follicular phase, there is a potential shift towards a greater reliance on fat oxidation, which may allow players to complete higher volumes of training, that potentially could lead to greater training adaptations (Campbell and Febbraio 2001). Moreover, due to the increased levels of inflammation and evidence of detrimental premenstrual syndrome symptoms (Takeda et al. 2015) on wellbeing during the late luteal and early stages of the follicular phase, it could be suggested to decrease load and allow for adequate recovery (Hamilton 2012).

PRACTICAL APPLICATION OF MENSTRUAL CYCLE EFFECTS – A COMPLEX PICTURE

That being said, there is a paucity of evidence-based practice to support the implementation of periodised training, based on the menstrual cycle. Several factors require consideration when interpreting and applying the effects of the menstrual cycle on football performance and training, as well as during the design of future research. It is well known that there is large within and between-individual variation in hormonal profiles (i.e., different maximum and minimum concentrations of oestrogen and progesterone), and that even those who appear to have a ‘normal’ menstrual cycle

might have instances of non-physiologically 'normal' cycles (*i.e*., anovulatory cycles) (Mujika and Taipale 2019). Moreover, the length of the menstrual cycle is not always the idealised 28 days, with many females susceptible to changes in the length of the follicular phase between cycles (Reed and Carr 2000) and may well be subject to change across a season (Karacan et al. 2013) due to fluctuating training and competitive loads. Therefore, in order to investigate the effects of menstrual hormones on the training response, hormones need to be monitored longitudinally over months and potentially years of an athlete's career. However, continuous blood or saliva sampling can be invasive (blood sampling) and not feasible (e.g., it is expensive, requires specialist equipment and training and does not provide information in a timely manner) for all players. Moreover, more practical alternatives such as calendar- based calculation of the menstrual cycle will not accurately inform practitioners for correct prescription of training. Within current research, all of the above factors have been observed to contribute to large drop-out rates in participants from scientific studies, which could be interpreted as a lack of commitment to such invasive and time-intensive measures (Julian et al. 2017, 2020). One solution to this could be to consider whether monitors of menstrual status function in research and applied practice should be the same measures. Undoubtedly, absolute measures of key menstrual hormones are essential in research settings (blood or saliva) to create accurate and individualised player hormonal profiles that can be correlated to markers of performance (e.g., strength and plyometric capabilities), injury, and training response. In practical settings, the development of a cost-effective and immediate method of monitoring hormone levels is necessary to affect training in a timely manner. However, less valid and reliable measures could be considered useful and feasible in determining menstrual cycle length (training diaries and wellbeing measures, no direct measures of hormones) and the time-point of ovulation (e.g., ovulation prediction kits, milky discharge) within the cycle. This may provide information about the individual courses/ranges of each player's menstrual cycle, and could be used for phase prediction, and would also allow immediacy of information that can be used to modify training protocols as required. Nevertheless, although, this use of proxy measures may help solves some of the practical challenges of menstrual cycle monitoring, further studies should aim to understand whether these are acceptable surrogate measures to control and account for the menstrual cycle, within practice.

Players involved in intermittent team sports by nature require a complex blend of multiple training qualities that are trained concurrently. Moreover, much of the data is based off universal female data rather than sports specific data, and only assesses one component of fitness when investigating the effects of menstrual cycle phases specific training (Sung et al. 2014). As such, understanding the

concurrent training responses in relation to specific phases and hormones remains vague and requires further investigation.

Finally, the implementation of numerous individualised training programmes based on menstrual cycle phase alongside the traditional training demands might be too much for such a small network of staff, who may not have the relevant knowledge base to act on the information collected. For such a resource-intensive venture, the 'magnitude' of positive training adaptations gained by programming around the menstrual cycle needs to exceed physiological adaptations achieved by investing in a well-designed, evidence-based strength and conditioning programme for it to be a worthwhile investment. Individual player responses are likely to vary significantly. Exploration of what combination of factors (for example, combination and ratio, or absolute hormonal levels) contributes and dictates which players require intensive monitoring and individualisation of programming around the menstrual cycle remains to be discovered.

CONCLUSION

In conclusion, currently, there is limited evidence justifying the resources needed to implement periodization strategies based on the menstrual cycle, although for some players anecdotal reports clearly evidence significant impacts on their wellbeing and readiness to train at certain time-points within the cycle. A very limited number of well-designed research studies confirming the extent and magnitude of physiological effects of the menstrual cycle on actual performance exists, including a lack of studies on the validity and usefulness of more feasible and cost-effective surrogate measures that can be used for monitoring. Therefore, there is a need for future studies in this field to address the concerns and critical issues presented within this editorial.

Disclosure statement

No potential conflict of interest was reported by the authors.

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