TABLE IV—THE NEURAMINIDASES OF HUMAN AND ANIMAL INFLUENZA-A VIRUSES

Source of neuraminidase †	Neuraminidase-inhibition titres with the following antisera *:						
	Anti-pure A2/57 neuraminidase	A2/Sing/1/57	A2/Eng/12/64	A2/HK/1/68	AO/Bel	A/Eq 1/Prague	A/Eq 2/Miami
Human:							
A2/Singapore/1/57	*2500*	*250*	30				
A2/England/12/64	500	10	*1500*	50			
A2/Tokyo/3/67 ..	300	10	1000	200			
A2/Hong Kong/1/68	50	10	1500	*200*			
A2/Hong Kong/8/68	80	10	1000	250			
AO/Bel					3000		
A1/FM/1/47 ..					500		
Animal:							
A/Turkey/Mass/65	5000	150	800				
A/Equi 1/Prague/56						120	
A/Equi 2/Miami/63							150

* Antisera used were from hyperimmunised rabbits except for those for A2/Hong Kong/1/68, equine-1 and equine-2 viruses, which were post-infection ferret sera.

† The virus preparations used in neuraminidase-inhibition tests were treated with pronase to destroy hæmagglutinin.

Serum dilution producing 50% inhibition of neuraminidase activity.

Blank spaces denote titres less than 1/10.

reported,[11] some of the earlier A2 strains cross-reacted with an avian strain A/turkey/Massachusetts/65 but the A2/Hong Kong/68 strain no longer shows this cross-reaction. There was no cross-reaction between any of the equine and A2 strains, but the antibody content of both equine antisera may have been too low to reveal minor cross-reactions.

DISCUSSION

Several antigens are associated with the influenza virion [12]: an internal soluble (S) antigen and the external viral (V) antigens including the viral hæmagglutinin and neuraminidase which are distinct structural components of the lipoprotein envelope.[13] All influenza-A viruses share a common ribonucleoprotein S antigen. They are divided into subtypes according to host range and similarity of viral antigens.

The Hong Kong variants show a definite relationship to A2 strains by H.I., neutralisation, and neuraminidase-inhibition tests and should be classified as members of this subtype. However, the magnitude of antigenic drift is greater than has been previously demonstrated within the A2 subtype.

The extent of antigenic change is reflected in results of H.I. tests on human sera reported by several laboratories.[14–18] Sera tested were collected from the general populations in different areas, from persons recently immunised with several different influenza-vaccine formulations, and from confirmed cases of influenza during the 1967–68 outbreak in the United States. Antibody responses to A2/Hong Kong/68 were absent or minimal in all groups.

The antigenic relationship between the Hong Kong-like isolates and the A/equine-2 strains also indicates the unique nature of these A2 variants. Although the heterotypic titres of monospecific antisera are low, reciprocal cross-reactions both by H.I. and neutralisation tests are unequivocal. The high levels of antibody titres to Hong Kong strains after A/equine-2 infections of horses offer further confirmation of this antigenic relationship. However, neuraminidase studies suggest that the similarity of the two viruses is limited to the viral hæmagglutinin. The neuraminidase antigens of the Hong Kong isolates are related only to those of other human A2 strains.

The reciprocal crossing reported here for the Hong Kong isolates and the A/equine-2 strains confirms and extends the earlier reports[19–21] of minor antigenic similarities between influenza viruses of both species. At this point, there is no evidence to suggest that these interspecies antigenic linkages have any ætiological significance in human epidemics or equine epizootics of influenza. However, these findings underscore previous comments made by Tumova and Pereira [22] regarding the classification of influenza-A viruses. As new strains from different species are studied, a continuous spectrum of antigenic variation may become apparent within the whole influenza-A family.

We thank Wilma B. Yarbrough, Penney B. Gentry, Diana Craig, and Deborah Eltzroth, International Influenza Center for the Americas, Atlanta, Georgia, and V. G. Law, Susan Piddington, and R. W. Newman, World Influenza Centre, London, for their technical assistance.

Requests for reprints should be addressed to the National Institute for Medical Research.

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Special Articles

MENSTRUATION AND EXAMINATIONS

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Summary An analysis of the results of advanced (A) and ordinary (O) level examinations revealed a lower pass-rate, lower distinction-rate, and lower average mark when the examinations were taken during the premenstruum or during menstruation. This was most striking in girls whose menstrual loss continued longer than 6 days and those with menstrual cycles exceeding 31 days. In 42% of the ninety-one girls, whose normal menstrual pattern was known, the stress of the O-level examinations produced an alteration in their menstrual cycle. This resulted in more girls menstruating during examination week than would have been expected from their normal pattern. The tendency was for the cycle to be lengthened rather than shortened, but some girls had temporary amenorrhœa during the examination month.

INTRODUCTION

Dalton [23] has shown the deleterious effect of menstruation on a schoolgirl's weekly work and Wickham [24] demonstrated that Army personnel had lower intelligence scores during menstruation. This study analyses the

results obtained by schoolgirls in advanced (A) and ordinary (O) level examinations to determine the significance of menstruation as a handicap to schoolgirls.

METHOD

The results used were those obtained by boarding-school children aged 16–19 taking A-level and 14–17 taking O-level examinations of the University of Cambridge Local Examinations Syndicate in June, 1967. A-level results were given for the whole subject and for individual papers, but the O-level results were known for only the whole subject. Results were available for thirty-four girls sitting 68 A-level examinations in seventeen different subjects, comprising a total of 180 individual papers, and also from thirty-four boys sitting 94 A-level examinations in ten subjects. Results were available for ninety-one girls sitting 447 O-level examinations in eighteen different subjects. The results were given as grades which were converted to marks by taking the mark midway between the known maximum and minimum for the grade.

When they had completed their examinations, the A-level girls were asked individually for the dates of their last menstrual period. The O-level girls routinely record their dates of menstruation in special books and so their normal menstrual pattern was known.

TABLE I—RESULTS OF A-LEVEL EXAMINATIONS IN RELATION TO MENSTRUATION

—	Inter-menstruum	Menstruum	Pre-menstruum
Individual papers	105	44	31
Average mark	57%	54%	54%
Distinction-rate	15%	9%	6%
Pass-rate	87%	84%	74%

TABLE II—GRADE VARIATIONS IN 162 A-LEVEL EXAMINATIONS

Variation	Boys	Girls	Total
0–1 grade	23 (25%)	22 (32%)	45
2–3 grades	50 (53%)	31 (46%)	81
4 or more grades	21 (22%)	15 (22%)	36
Total	94	68	162

The " premenstruum " was defined as the 4 days immediately preceding menstruation; the " intermenstruum " as the days between menstruation and the premenstruum; and " paramenstruum " as the 8 days of the premenstruum and menstruation. There were insufficient papers in the 4 post-menstrual days to allow for separate statistical analysis of this phase.

RESULTS

A Level

Of the 180 individual papers 44 were taken during menstruation, 31 during the premenstruum, and 105 during the intermenstruum.

The results (table I) revealed that during the premenstruum the pass-rate was 13 (87—74)% lower than that obtained during the intermenstruum; the distinction-rate was 9% lower and the average mark obtained was 3% lower.

Examinations consisted of two to four separate papers, testing different skills—e.g., written, practical, or oral (languages). The grade variations found in 162 examinations revealed a striking similarity between the boys and girls, and in both groups 78% of the candidates had variations within three grades (table II). However, among the fifteen girls with variations of four or more grades in one subject it was notable that eleven (73%) had their poorest grade during their paramenstruum, the expected number of girls on an even distribution would have been nearer four, since perhaps two girls out of every seven might be expected to be in the paramenstrual period at any one time ($\chi^2 = 14{\cdot}7$, $P < 0{\cdot}001$). Thus the influence of menstruation was a significant factor for girls with large variation in grades. While the average mark showed a paramenstrual drop of 3% for all candidates, this obscured the fact that in 11 examinations the paramenstrual drop was between 30 and 60%.

TABLE III—EFFECT OF SPACING OF O-LEVEL PAPERS ON THE INFLUENCE OF MENSTRUATION

Interval	Inter-menstruum		Menstruation		Pre-menstruum		Total	
	Exams	Av. mark	Exams	Av. mark	Exams	Av. mark	Exams	Av. mark
Single day ..	87	58%	47	53%	28	55%	162	56%
Over 7 days ..	33	54%	61	51%	60	51%	114	52%

Av. = average.

O Level

The grade for individual papers in the O-level examinations being unknown a different method of analysis was necessary. " However, it was possible to analyse 162 examination results obtained in English literature, English language, history, German, and Life of Christ because these were completed in a single day." From this it was found that during menstruation there was a drop of 5% below the average mark obtained during the intermenstruum ($P < 0{\cdot}05$). In contrast there was an interval of 8 or more days between the two papers of biology, chemistry, physics, needlework, cookery, Spanish, music, and additional mathematics; thus, in these subjects no girl could be wholly at a disadvantage resulting from the phase of her menstrual cycle, for at least one part must have been taken during the intermenstruum. An analysis of 114 results in these subjects, in which one part of the examination was taken during the paramenstruum and compared with those taken wholly during the intermenstruum, showed that the handicap a candidate suffered was only 3% (table III).

Type of Menstruation

An analysis of the paramenstrual failure-rate in relation to the duration of menstrual loss revealed that while this failure-rate was 17% for girls whose menstrual loss lasted up to 4 days, the rate increased progressively and for those

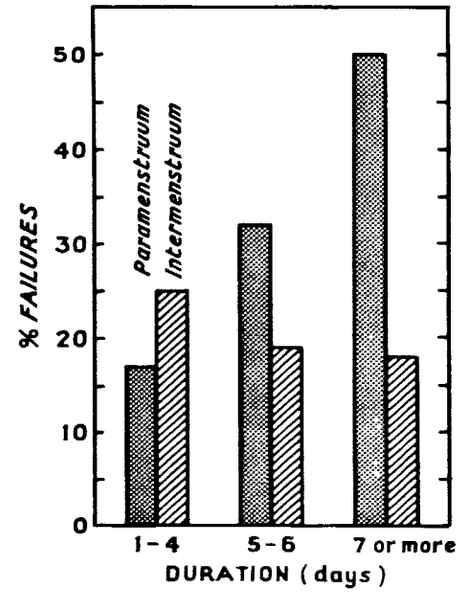

Fig. 1—O-level failures and duration of menstrual loss.
The mean failure-rate for examinations taken in the intermenstruum ranged between 18 and 25%.

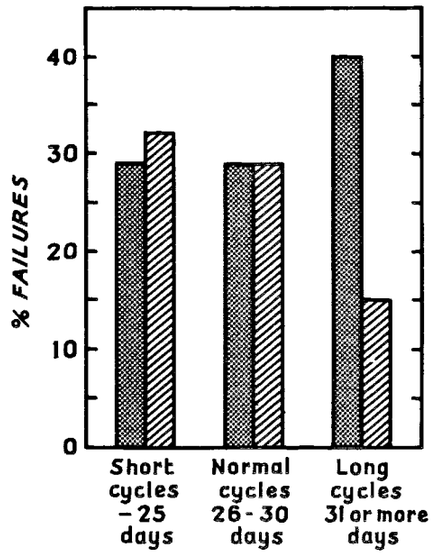

Fig. 2—O-level failures and length of cycle.

whose loss lasted 7 or more days it reached 50% (fig. 1). Again the paramenstrual failure-rate was 29% for those with short menstrual cycles of 25 days or less, and for those with normal cycles of 26–30 days, but this rose to 40% for those with long cycles (fig. 2).

The Menstrual Cycle

The emotional effect of O-level examinations is shown in fig. 3 when the sudden increase in the number of girls menstruating correlates with the days on which the maximum number of examinations was taken. Written examinations commenced on June 14 and reached their peak on June 21. During May there was an average of sixteen girls menstruating each day, but menstruation figures rose abruptly during the week of examinations, reaching a maximum of thirty-six girls menstruating on June 19. Of the ninety-one girls, the cycle during the examination month was shorter by 4 or more days in

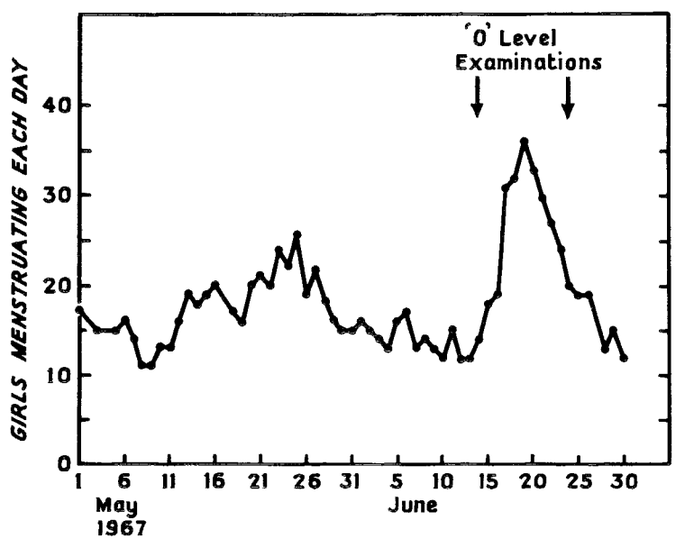

Fig. 3—Effect of examinations on incidence of menstruation.

eleven, was longer by 4 or more days in nineteen, and a further eight girls missed their normal menstruation during June. Therefore, the stress of the examination caused an alteration in the length of the menstrual cycle in 42% of the girls. This rise in the number of girls menstruating during examination week explains why there were insufficient girls taking examinations during their post-menstrual phase to permit analysis.

DISCUSSION

These findings reveal that a girl suffers an average handicap of 5% when taking A and O level examinations during her paramenstruum, but this handicap is not evenly distributed among all candidates, being most striking among those with long menstrual loss and long menstrual cycles. There is an increasing demand among candidates for medical help to alter the menstrual cycle to avoid menstruation happening at times of public examination. The results given here suggest that such action is justified especially for those with long menstrual loss and long menstrual cycles.

The paramenstrual handicap can be lessened by spacing the two papers in each subject with an interval of 8 or more days, so that no candidate is wholly in the paramenstruum during both papers. It should be possible for the timetables of the various examining boards to be designed so as to allow for this interval between papers. A more satisfactory solution, though more difficult for the examining boards, might be for all examination papers to have alternatives at intervals of 8 or more days, the candidates being able to choose their examination dates in advance.

The effect of emotional stress in altering the normal menstrual pattern has long been recognised by gynæcologists and many laywomen, but many may be surprised that this appears to be the first statistical evidence of its occurrence. It demonstrates that the same emotional stress, in this case examinations, can produce different effects on different individuals—viz., lengthening or shortening of cycle or temporary amenorrhœa.

I thank the head teachers of the schools for their cooperation and interest and Mr. T. S. Wyatt, secretary to the University of Cambridge Local Examinations Syndicate.

Dogma Disputed

THE DURATION OF PREGNANCY

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DESPITE great advances in knowledge and technique and great reductions in morbidity and mortality rates, there remain many gaps in our knowledge of obstetrics. The most important one, which may influence all the others, is the time factor. Ideas on this have changed little in a hundred years; indeed it would seem that any change has been in the wrong direction. While we pay close attention to peripheral detail we may well have neglected a central principle. If we could estimate more accurately the time of maturity, we would be going a long way towards solving common problems of morbidity and mortality that may leave in their wake a train of avoidable tragedy. Although we must accept that the length of pregnancy is variable, our teaching exaggerates the variability.

The accepted method of calculation of the expected date of delivery (E.D.D.) is common to all modern text-books: ask for the date of the last menstrual period (L.M.P.), add 7 days, and subtract 3 calendar months (or add 9 months). For example, if the L.M.P. was on June 5, 1968, then the E.D.D. would be March 12, 1969. Whichever date in the year is taken, the interval between L.M.P. and E.D.D. is approximately 40 weeks or 280 days.

Many years ago it was thought that conception was most