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FURTHER OBSERVATIONS ON ROUTINE MEDICAL EXAMINATIONS OF UNIVERSITY ENTRANTS IN NORTHERN IRELAND

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Every undergraduate entrant in his or her first year at The Queen's University of Belfast is examined by the Medical Officer (W.J.) or his assistant. We described the procedure, methods, and criteria used in an earlier report (Johnston, Cheeseman, and Merrett, 1957), which also gave estimates of physical and clinical measurements and the incidence of impaired vision and hearing in the 1949–54 entrants in a format similar to those now presented for entrants in 1954–59 (Tables I to VI). Since 1949 all but 740 out of 5,935 examinations have been conducted by the same physician (W.J.) assisted by two nursing sisters (one in 1949–54 and another in 1954–59). The only difference in methods between the quinquennia has been the introduction of an arm girth measurement at the beginning of academic year 1955–56 and the modification of methods of measuring sitting height and assessing hearing at the beginning of 1945–55.

Arm girth is measured by the physician using a tape measure to the nearest cm. from the mid-point between the lateral tip of the acromion process and the lateral epicondyle of the humerus with the arm extended. Sitting height is measured as before, except that a flexible tape is used instead of a fixed scale and a watch is now used as the source of sound in the test for hearing.

Throughout this report, which is mainly concerned with comparisons between entrants in the two quinquennia 1949–54 and 1954–59, the word "significant" is used only to describe results unlikely to arise by chance more than once in twenty trials ($P < 0{\cdot}05$). Where standard errors are quoted they follow the $\pm$ sign after the estimate to which they refer.

ANALYSIS OF RESULTS, 1954–59

Tables I to VI and the Appendix show the analysis of the data collected for the 3,219 entrants in 1954–59.

TABLE I

AGE AND SEX DISTRIBUTION OF ENTRANTS EXAMINED, BY YEAR OF ENTRY

Sex	Year of Entry	Age (yrs)					Age (yrs)	
		17–	18–	19–	20+	Total	Mean	Standard Deviation
Male	1954–5	71	170	70	71	382	19·5	4·5
	1955–6	46	193	85	100	424	19·6	3·6
	1956–7	57	214	95	109	475	19·9	4·2
	1957–8	60	203	151	124	538	19·6	3·5
	1958–9	50	239	170	127	586	19·4	3·1
	Total ..	284 (11·8)	1,019 (42·4)	571 (23·7)	531 (22·1)	2,405 (100)	19·6	3·8
Female	1954–5	45	65	16	11	137	18·5	3·6
	1955–6	28	77	26	30	161	18·7	1·8
	1956–7	39	89	16	19	163	18·7	3·0
	1957–8	32	77	25	25	159	19·0	3·9
	1958–9	34	117	29	14	194	18·5	2·5
	Total ..	178 (21·9)	425 (52·2)	112 (13·8)	99 (12·2)	814 (100)	18·7	3·0

Figures in brackets give percentage age distribution for each sex.
Comparison of age distribution between years of entry:
(*a*) Males $\chi^2 = 50{\cdot}05$; d.f. = 12; $P < 0{\cdot}001$
(*b*) Females $\chi^2 = 32{\cdot}12$; d.f. = 12; $0{\cdot}01 > P > 0{\cdot}001$.

TABLE II

PHYSICAL MEASUREMENTS

Measurement	Sex	Mean Measurement for Stated Age Group (yrs)					Standard Deviation within Age Group
		17–	18–	19–	20+	Total	
Weight (kg.)	Male M	66·5	67·7	68·8	68·2	67·9	8·64
	Female F	59·1	58·8	60·7	58·2	59·0	8·27
	Difference (M–F)	7·4 ± 0·80	8·9 ± 0·48	8·1 ± 0·86	10·0 ± 0·91	8·9 ± 0·34	
Height (cm.)	Male M	172·9	173·4	173·7	171·4	173·0	6·83
	Female F	160·3	160·3	161·1	158·9	160·2	5·83
	Difference (M–F)	12·6 ± 0·60	13·1 ± 0·35	12·6 ± 0·62	12·5 ± 0·66	12·8 ± 0·25	
Sitting Height (cm.)	Male M	94·2	94·7	95·3	93·6	94·5	5·22
	Female F	89·9	89·7	90·0	87·9	89·6	4·62
	Difference (M–F)	4·3 ± 0·46	5·0 ± 0·28	5·3 ± 0·49	5·7 ± 0·52	4·9 ± 0·19	
Chest Girth (cm.)	Male M	88·1	89·2	90·2	89·7	89·4	5·28
	Female F	83·9	84·0	85·3	83·8	84·1	5·75
	Difference (M–F)	4·2 ± 0·53	5·2 ± 0·32	4·9 ± 0·59	5·9 ± 0·62	5·3 ± 0·23	
Chest Expansion (cm.)	Male M	8·3	8·6	8·7	8·3	8·5	1·76
	Female F	7·3	7·2	7·1	6·7	7·1	1·40
	Difference (M–F)	1·0 ± 0·15	1·4 ± 0·09	1·6 ± 0·15	1·6 ± 0·16	1·4 ± 0·06	
Arm Girth (cm.)*	Male M	25·6	26·1	26·4	26·6	26·2	2·22
	Female F	24·7	24·6	24·9	24·4	24·6	2·07
	Difference (M–F)	0·9 ± 0·23	1·5 ± 0·13	1·5 ± 0·23	2·2 ± 0·24	1·6 ± 0·09	

* Estimates relate to the years 1955–59 only.

TABLE IV

CLINICAL MEASUREMENTS

Measurement	Sex	Mean Measurement for Stated Age Group (yrs)					Standard Deviation within Age Group
		17–	18–	19–	20+	Total	
Pulse Rate (beats per min.)	Male M	77·0	75·5	75·8	74·2	75·5	9·87
	Female F	78·2	78·1	76·6	76·5	77·7	10·28
	Difference (M–F)	−1·2 ± 0·97	−2·6 ± 0·59	−0·8 ± 1·06	−2·3 ± 1·12	−2·2 ± 0·41	
Systolic Blood Pressure (mm.Hg)	Male M	126·6	127·3	127·0	123·8	126·4	12·22
	Female F	118·3	118·6	117·9	117·3	118·3	11·65
	Difference (M–F)	8·3 ± 1·14	8·7 ± 0·68	9·1 ± 1·21	6·5 ± 1·29	8·1 ± 0·48	
Diastolic Blood Pressure (mm.Hg)	Male M	69·6	70·7	71·1	72·1	71·0	9·02
	Female F	67·7	68·3	68·4	68·0	68·2	8·41
	Difference (M–F)	1·9 ± 0·83	2·4 ± 0·50	2·7 ± 0·88	4·1 ± 0·93	2·8 ± 0·35	
Vital Capacity (litres of air)	Male M	4·0	4·1	4·1	3·8	4·0	0·68
	Female F	2·8	2·8	2·8	2·6	2·7	0·51
	Difference (M–F)	1·2 ± 0·06	1·3 ± 0·03	1·3 ± 0·06	1·2 ± 0·06	1·3 ± 0·02	

Apart from the results of hearing tests (Table VI) and arm girth measurement (Table II) not previously available, the age and sex trends of the various estimates (Tables II, III, and IV) are not materially different from those noted for 1949–54 in the earlier report (see Summary, paras 4 to 7). No age and sex differences in the proportion with defective hearing were noted in the later quinquennia (Table VI).

No association was found between arm girth and age in the female students, but the average measurements for males increased significantly with age and were significantly higher than those for females at every age.

COMPARISON BETWEEN 1949–54 AND 1954–59

An analysis of the age distributions showed that the males in the later series were significantly older,

TABLE III

CORRELATION COEFFICIENTS (r) BETWEEN AGE AND VARIOUS MEASUREMENTS

Correlation between Age and Stated Measurement	All Students		Students Aged 20 yrs and Over	
	Male	Female	Male	Female
Weight	0·11†	0·002	0·23†	0·07
Height	−0·11†	−0·04	−0·08	0·07
Sitting Height	−0·06†	−0·05	0·01	0·18
Chest Girth	0·12†	0·04	0·22†	0·17
Chest Expansion	−0·08†	−0·07	−0·13†	0·07
Arm Girth	0·16†	0·02	0·21†	0·16
Pulse Rate	−0·07†	−0·08*	−0·06	−0·21*
Systolic Blood Pressure	−0·06†	−0·04	0·07	−0·28†
Diastolic Blood Pressure	0·10†	0·05	0·15†	0·20*
Vital Capacity	−0·17†	−0·05	−0·09*	0·10

* $0·05 > P > 0·01$ † $P < 0·01$

TABLE V

VISUAL ACUITY

Visual acuity		Percentage Distribution			
		Male		Female	
		Later Data	Earlier Data	Later Data	Earlier Data
6/6 and better	In both eyes	63·70	59·46	58·72	58·40
	In one eye, other worse	12·31	12·51	14·74	11·87
6/9 or 6/12	In both eyes	2·37	6·26	2·21	5·73
	In one eye, other worse	3·33	5·65	5·28	4·80
6/18 to 6/36	In both eyes	2·91	5·24	3·19	4·53
	In one eye, other worse	4·95	3·00	4·67	4·53
6/60 or less	In both eyes	10·44	7·88	11·18	10·13
Total		100·0	100·0	100·0	100·0
χ^2 (on absolute numbers)		88·65		17·26	
Degrees of freedom		6		6	
Probability		< 0·001		0·001–0·01	

Later Data

Between Age Groups

Males χ^2 (on absolute numbers) $= 19·05$; d.f. $= 18$; $0·50 > P > 0·30$

Females χ^2 $= 6·14$; d.f. $= 12$; $0·95 > P > 0·90$ (ages 19− and 20+ combined)

Males v. Females

χ^2 (on absolute numbers) $= 11·94$; d.f. $= 6$; $0·10 > P > 0·05$

by about 3 months, on average than those in the earlier series. No such average difference was found for the females. The male difference arose because relatively more 17-year-old and fewer 19-year-old males were examined in the earlier years. Consequently, comparisons of each measurement between the quinquennia are presented for separate groups of students of like age and sex. These comparisons are given in Table VII for the quantitative variables and in Tables V and VI for visual acuity and hearing.

TABLE VI

HEARING

Age group (yrs)	Percentage with Defective Hearing in Later Series		Percentage Difference in Later Series (Males–Females) ± Standard Error
	Males	Females	
17−	2·82 (6·11)	1·69 (6·41)*	1·13 ± 1·38
18−	3·04 (6·03)*	2·59 (4·95)	0·45 ± 0·94
19−	4·38 (6·44)	2·68 (6·25)	1·70 ± 1·75
20+	5·08 (11·14)*	5·05 (4·88)	0·03 ± 2·40
Total	3·78 (7·17)*	2·70 (5·47)*	1·08 ± 0·69

Later Series. On absolute numbers test for association with age:

Males $\chi^2 = 5·29$, d.f. $= 3$; $0·20 > P > 0·10$

Females $\chi^2 = 1·28$, d.f. $= 1$; $0·30 > P > 0·20$ (ages 17− and 18− combined and 19− and 20+ combined)

Figures in brackets refer to earlier series.

* Significant difference between the two series.

PHYSICAL MEASUREMENTS

Up to age 19 both males and females of the later series were heavier on average than those of the earlier series, although not significantly so (Table VII, opposite). This confirms the results of the earlier series which occasioned some surprise because the average weight reported by us was higher than that reported by other workers for groups (including University students) of comparable age and sex.

Males of all ages in the later series were taller on average than those in the earlier series; the differences were significant for each age group with the exception of the 17-year-olds. A similar difference existed for the female students, but only in the case of the 19-year-old females was it significant.

In the three youngest age groups of males and in the youngest females, sitting height was on average greater in the later series than in the earlier, but these differences may be due to the different methods of measurement.

Although the only significant difference in chest girth between the two series of males occurred in the oldest age group, the males of the later series had a significantly greater average chest expansion in each age group. Female students of the later series had on average a significantly greater chest girth than those of the earlier series, but at each age had a smaller average chest expansion, two of the differences (at ages 18− and 20+) being significant.

CLINICAL MEASUREMENTS

In 1954–59 there were differences in mean systolic and diastolic pressure between the four age groups in males but not in females (Appendix A, Serials 18, 19, 20, and 21); in the case of systolic pressure this was largely due to a much lower mean in the oldest

TABLE VII

COMPARISON OF TWO SERIES (LATER–EARLIER)

Measurement	Sex	Mean Difference in Measurement (1954–59) Data – (1949–54) Data				
		17–	18–	19–	20+	Total
Weight (kg.)	M	0·7 ± 0·68	0·3 ± 0·38	0·8 ± 0·54	−0·7 ± 0·55	0·3 ± 0·25
	F	1·1 ± 0·86	0·2 ± 0·55	1·7 ± 1·02	−0·6 ± 1·17	0·5 ± 0·40
Height (cm.)	M	0·9 ± 1·70	1·3* ± 0·30	2·0* ± 0·42	1·0* ± 0·42	1·3* ± 0·20
	F	0·5 ± 0·62	0·6 ± 0·40	1·7* ± 0·73	−0·7 ± 0·84	0·6 ± 0·29
Sitting Height (cm.)	M	0·8* ± 0·38	1·0* ± 0·21	1·5* ± 0·29	0·3 ± 0·30	0·9* ± 0·14
	F	1·3* ± 0·45	−0·3 ± 0·29	1·0 ± 0·54	−0·7 ± 0·61	0·7* ± 0·21
Chest Girth (cm.)	M	−0·3 ± 0·42	−0·2 ± 0·24	0·2 ± 0·33	−0·8* ± 0·34	−0·2 ± 0·15
	F	1·9* ± 0·55	1·6* ± 0·36	2·6* ± 0·67	2·1* ± 0·75	1·8* ± 0·26
Chest Expansion (cm.)	M	0·3* ± 0·13	0·5* ± 0·07	0·6* ± 0·10	0·5* ± 0·10	0·5* ± 0·05
	F	−0·2 ± 0·14	−0·4* ± 0·09	−0·2 ± 0·17	−0·6* ± 0·19	−0·3* ± 0·07
Pulse Rate (beats per min.)	M	−1·5 ± 0·76	−3·2* ± 0·43	−3·0* ± 0·60	−3·1* ± 0·61	−2·9* ± 0·28
	F	0·3 ± 1·03	−1·3* ± 0·66	−3·1* ± 1·23	−0·2 ± 1·40	−1·1* ± 0·47
Systolic Blood Pressure (mm.Hg)	M	−2·7* ± 0·95	−2·7* ± 0·53	−3·6* ± 0·75	−6·1* ± 0·76	−3·6* ± 0·35
	F	−5·6* ± 1·19	−7·2* ± 0·77	−7·9* ± 1·42	−4·9* ± 1·62	−6·8* ± 0·55
Diastolic Blood Pressure (mm.Hg)	M	−0·5 ± 0·71	−0·2 ± 0·40	−0·04 ± 0·56	−1·7* ± 0·57	−0·4 ± 0·26
	F	−2·2* ± 0·92	−2·7* ± 0·59	−3·6* ± 1·09	−3·0* ± 1·25	−2·8* ± 0·43
Vital Capacity (litres of air)	M	0·05 ± 0·06	0·14* ± 0·03	0·17* ± 0·05	−0·06 ± 0·05	0·09* ± 0·02
	F	0·06 ± 0·06	0·03 ± 0·04	0·09 ± 0·07	−0·02 ± 0·08	0·04 ± 0·03

* Difference significant at $P < 0·05$.

male age group. Table III suggests that male systolic pressure decreased with age whereas diastolic increased; this was also true of the females aged 20 years and over. Both means were significantly greater in males than in females of like age.

The correlation between blood pressure estimates and arm girth shown by some workers (*e.g.* Pickering, Roberts, and Sowry, 1954) could affect comparisons of pressures between age groups, but in this series it has been found that only males had different average arm girth between age groups. As the arm girth estimates are based on only the last 4 years of 1954–59, the blood pressure estimates for males have been re-examined for 1955–59. This analysis shows similar differences in systolic and diastolic blood pressure between the four male age groups. As no differences were found in blood pressure and arm girth estimates between the age groups for females, no further analysis was carried out on their data.

The correlation coefficients (r) between blood pressure and arm girth for males of all ages were +0·19 for systolic and +0·15 for diastolic; both coefficients were significantly greater than zero. Thus in our males there is some association between arm girth and blood pressure. An attempt to compare age groups using mean pressures adjusted to a common arm girth (*i.e.* covariance analysis) failed for systolic pressure because the relationship between blood pressure and arm girth was not similar in each age group, although it was for diastolic pressures. (The correlation coefficients between systolic pressure and arm girth varied between 0·11 and 0·32 in the age groups). The following multiple regression equations for males were obtained:

Systolic Pressure $y = 102·3398 - 0·3486x_1 + 1·1732x_2$ (with a standard deviation from regression of 12·16 mm.Hg)

Diastolic Pressure $y = 53·5543 + 0·1852x_1 + 0·5521x_2$ (with a standard deviation from regression of 8·95 mm.Hg),

where y is the blood pressure in mm.Hg, x_1 is the age in years, and x_2 is the arm girth in cm.

Analysis of covariance of diastolic pressure showed that, after adjustment to a common arm girth value, although average diastolic blood pressure increased with age, the differences between age groups were not significant. The adjusted means were 71·0 mm.Hg in the 17-year-old group, 71·4 in the 18, 71·7 in the 19, and 72·4 in the 20 year and over group for arm girth of 26·25 cm.

Average systolic pressure in the later series was significantly lower than that in the earlier series at each age for each sex. The differences ranges from 2·7 to 7·9 mm.Hg and in general the differences between age groups were greater for males than for females. Females of the later series also had significantly lower mean diastolic pressure than females of a similar age in the earlier survey. Lower diastolic means in the later period also occurred among males, but they were significant only in the oldest age group.

The differences in average blood pressure estimates observed between the two series may be explained by differences in arm girth, but as this was not measured before 1955 we cannot test the validity of this argument.

In the comparison of the other clinical measurements between the two series the following points are of interest:

(1) For three age groups in males and for two in females the average pulse rate in the earlier series was significantly faster than that in the later series (Table VII). The average differences for males ranged between 1·5 and 3·2 beats per minute and for females between 0·3 and 3·1 beats per minute.

(2) The only significant differences in vital capacity between the two series was found in male entrants aged 18 and 19 years, those of the later series having the greater average vital capacity by 0·1 and 0·2 litres respectively.

(3) As there were no significant differences in distribution of visual acuity between the age groups for either males or females in either series, comparison has been made between the two series for each sex for all ages combined. The differences between the two series can be seen in Table V; the high χ^2 value is almost entirely due to the difference between the two series in the proportion of students with a recorded visual acuity of 6/9 or 6/12 in both eyes.

(4) The percentage of males with colour blindness was found to be 5·5 in the later series and 6·9 in the earlier. The difference (1·4 $\pm$ 0·74) was not significant.

(5) Although the methods of assessing hearing acuity differed between the two series, comparison of the proportions of students with defective hearing has been made between them, for students of similar age and sex. This showed that, in all but one female age group, relatively more students in the earlier than in the later series had hearing defects, three of the differences between the series being significant. These differences may, of course, be due to the change in the source of sound as described earlier. The largest difference occurred in males aged 20 years and over, when the large proportion (11 per cent.) in the earlier series was almost certainly due to the inclusion of ex-service men.

SUMMARY

(1) This report gives information on 2,405 males and 814 female undergraduates who were medically examined in their first year at the Queen's University of Belfast during the 5 years 1954–59. About 80 per cent. of the students were under 20 years of age (78 per cent. of the males and 88 per cent. of the females).

(2) Average measurements by age group and sex are given for each of the physical measurements (Table II) and for each of the clinical measurements (Table IV). These Tables, together with the correlation coefficients (Table III) and the analyses of variance (Appendix A), show the age and sex patterns of the various measurements in the present series. The distribution by visual acuity is given in Table V and by hearing in Table VI.

(3) Both systolic and diastolic blood pressures in males were found to be significantly associated with both the age and the arm girth of the student. Equations have been calculated to show the relationship existing between these variables for data collected in 1955–59.

(4) Where possible, comparison of examination results in 1954–59 has been made with those in 1949–54 already reported by Johnston and others (1957). The results of these comparisons for the physical and clinical measurements are given in Table VII, the distribution by visual acuity in Table V and by hearing in Table VI.

(5) In most age groups, the male students of the later series were found to have a significantly greater average height, sitting height, and chest expansion than males of similar age in the earlier series. Only in one age group was this true of the average height and sitting height of the female students. At each age the females of the later series had, on average, a relatively greater chest girth, but for two age groups the chest expansion was relatively smaller.

(6) Average pulse rate was found to be significantly slower in the present series in three male and two female age groups. Systolic blood pressure was lower at each age in the later than in the earlier series for both male and female students; the females in the later series also had a significantly lower average diastolic blood pressure for each age group. Two significant differences in average vital capacity occurred

between males of the two series, the average for the later series being the greater.

(7) The distributions of visual acuity were not similar between the two series for either male or female students (Table V). Relatively fewer males and females of the later series had a recorded visual acuity of 6/9 or 6/12 in both eyes than in the earlier. Although not significant, a smaller proportion of males in the later series had colour vision defects. Relatively fewer students had hearing defects in the later series than in the earlier.

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APPENDIX

ANALYSIS OF VARIANCE

Serial No.	Variable	Sex	Source of Variation	Sum of Squares	d.f.	Mean Square
1	Age (yrs)	Male	Between yrs of entry	54·02	4	13·50
			Within yrs of entry	34020·17	2400	14·18
			Total	34074·19	2404	
			$F < 1$; $n_1 = 4$; $n_2 = 2400$; $P > 0{\cdot}20$			
2		Female	Between yrs of entry	23·69	4	5·92
			Within yrs of entry	7315·27	809	9·04
			Total	7338·96	813	
			$F < 1$; $n_1 = 4$; $n_2 = 809$; $P > 0{\cdot}20$			
3		Both	Between sexes	511·77	1	511·77
			Within sexes	41413·14	3217	12·87
			Total	41924·91	3218	
			$F = 39{\cdot}75$; $n_1 = 1$; $n_2 = 3217$; $P < 0{\cdot}001$			
4	Weight (kg.)	Male	Between age groups	1085·45	3	361·82
			Within age groups	179045·80	2401	74·57
			Total	180131·25	2404	
			$F = 4{\cdot}85$; $n_1 = 3$; $n_2 = 2401$; $0{\cdot}01 > P > 0{\cdot}001$			
5		Female	Between age groups	389·61	3	129·87
			Within age groups	55393·36	810	68·39
			Total	55782·97	813	
			$F = 1{\cdot}90$; $n_1 = 3$; $n_2 = 810$; $0{\cdot}20 > P > 0{\cdot}10$			
6	Height (cm.)	Male	Between age groups	1840·87	3	613·62
			Within age groups	112062·98	2401	46·67
			Total	113903·85	2404	
			$F = 13{\cdot}15$; $n_1 = 3$; $n_2 = 2401$; $P < 0{\cdot}001$			
7		Female	Between age groups	270·34	3	90·11
			Within age groups	27535·50	810	33·99
			Total	27805·84	813	
			$F = 2{\cdot}65$; $n_1 = 3$; $n_2 = 810$; $P \simeq 0{\cdot}05$			

APPENDIX. ANALYSIS OF VARIANCE (continued)

Serial No.	Variable	Sex	Source of Variation	Sum of Squares	d.f.	Mean Square
8	Sitting Height (cm.)	Male	Between age groups	872·29	3	290·76
			Within age groups	65369·33	2401	27·23
			Total	66241·62	2404	
			$F = 10{\cdot}68; n_1 = 3; n_2 = 2401; P < 0{\cdot}001$			
9		Female	Between age groups	314·22	3	104·74
			Within age groups	17255·01	810	21·30
			Total	17569·23	813	
			$F = 4{\cdot}92; n_1 = 3; n_2 = 810; 0{\cdot}01 > P > 0{\cdot}001$			
10	Chest Girth (cm.)	Male	Between age groups	946·62	3	315·54
			Within age groups	66976·08	2401	27·90
			Total	67922·70	2404	
			$F = 11{\cdot}31; n_1 = 3; n_2 = 2401; P < 0{\cdot}001$			
11		Female	Between age groups	175·11	3	58·37
			Within age groups	26769·90	810	33·05
			Total	26945·01	813	
			$F = 1{\cdot}77; n_1 = 3; n_2 = 810; 0{\cdot}20 > P > 0{\cdot}10$			
12	Chest Expansion (cm.)	Male	Between age groups	66·86	3	22·29
			Within age groups	7440·28	2401	3·10
			Total	7507·14	2404	
			$F = 7{\cdot}19; n_1 = 3; n_2 = 2401; P < 0{\cdot}001$			
13		Female	Between age groups	21·79	3	7·26
			Within age groups	1589·92	810	1·96
			Total	1611·71	813	
			$F = 3{\cdot}70; n_1 = 3; n_2 = 810; 0{\cdot}05 > P > 0{\cdot}01$			
14	Arm Girth* (cm.)	Male	Between age groups	184·96	3	61·65
			Within age groups	9911·46	2019	4·91
			Total	10096·42	2022	
			$F = 12{\cdot}56; n_1 = 3; n_2 = 2019; P < 0{\cdot}001$			
15		Female	Between age groups	15·47	3	5·16
			Within age groups	2873·41	673	4·27
			Total	2888·88	676	
			$F = 1{\cdot}21; n_1 = 3; n_2 = 673; P > 0{\cdot}20$			
16	Pulse Rate (beats per min.)	Male	Between age groups	1633·03	3	544·34
			Within age groups	233452·26	2401	97·23
			Total	235085·29	2404	
			$F = 5{\cdot}60; n_1 = 3; n_2 = 2401; 0{\cdot}01 > P > 0{\cdot}001$			
17		Female	Between age groups	386·03	3	128·68
			Within age groups	85680·51	810	105·78
			Total	86066·54	813	
			$F = 1{\cdot}22; n_1 = 3; n_2 = 810; P > 0{\cdot}20$			

* Last 4 years of 5-year period.

APPENDIX. ANALYSIS OF VARIANCE (continued)

Serial No.	Variable	Sex	Source of Variation	Sum of Squares	d.f.	Mean Square
18	Systolic Blood Pressure (mm.Hg)	Male	Between age groups	4655·64	3	1551·88
			Within age groups	358555·86	2401	149·34
			Total	363211·50	2404	
			$F = 10{\cdot}39$; $n_1 = 3$; $n_2 = 2401$; $P < 0{\cdot}001$			
19		Female	Between age groups	157·77	3	52·59
			Within age groups	110007·50	810	135·81
			Total	110165·27	813	
			$F < 1$; $n_1 = 3$; $n_2 = 810$; $P > 0{\cdot}20$			
20	Diastolic Blood Pressure (mm.Hg)	Male	Between age groups	1232·49	3	410·83
			Within age groups	195214·14	2401	81·31
			Total	196446·63	2404	
			$F = 5{\cdot}05$; $n_1 = 3$; $n_2 = 2401$; $0{\cdot}01 > P > 0{\cdot}001$			
21		Female	Between age groups	62·26	3	20·75
			Within age groups	57253·62	810	70·68
			Total	57315·88	813	
			$F < 1$; $n_1 = 3$; $n_2 = 810$; $P > 0{\cdot}20$			
22	Vital Capacity (litres of air)	Male	Between age groups	46·14	3	15·38
			Within age groups	1125·90	2401	0·47
			Total	1172·04	2404	
			$F = 32{\cdot}79$; $n_1 = 3$; $n_2 = 2401$; $P < 0{\cdot}001$			
23		Female	Between age groups	3·47	3	1·16
			Within age groups	207·60	810	0·26
			Total	211·07	813	
			$F = 4{\cdot}51$; $n_1 = 3$; $n_2 = 810$; $0{\cdot}05 > P > 0{\cdot}01$			