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SEASONAL VARIATIONS IN CHILDREN'S WEIGHT GROWTH RATES

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Abstract: The growth rates of 1583 children in 8 day care centers in Paris weighed from 1 to 4 times every months were analyzed for the presence of seasonal patterns.

In the age range 3—36 months there are seasonal variations of weight velocities for both sexes which at least partly may be accounted for by the patterns of the children's attendance at the centers.

Regardless of seasons boys but not girls show an acceleration of weight in their third year.

Key words: Seasonal variations, weight growth rates.

Introduction

Seasonal variations in growth rates have been reported in West European children For example BRANSBY (1945) observed that children grew faster in stature during spring than during autumn and winter. MARSHALL (1975) however found maximum mean growth rates to occur at midwinter. Few researchers have included age in the analysis of seasonal patterns of growth. Since findings are conflicting and sufficient data on the interaction of age and seasons lacking the present study was carried out to investigate the effects of seasons on the change of growth velocity in children at different ages.

Subjects and Methods

Health surveillance in day care centers includes routine weighing of children by trained nurses. For this study, four day care centers in Paris, located in the 11th, 13th, 14th an 17th wards were selected where access to the weight records was provided to us from the opening day of these centers. Children from age 1 month up to 40 months are enrolled on the basis of availability of places so that the age of entering and leaving the centers varies as well as the length of stay: Thus the data are typically mixed longitudinal and involve 1583 children (844 boys and 739 girls). On a regular schedule, the children are weighed without clothes in the morning upon their arrival. Weights are noted and filed in the medical records. The demographic elements of the Paris day care centers (PDC) growth data are shown in Table 1.

Table 1

Demographic features of the PDC data

	Number of children enrolled in day care center					Mean age (months)		Mean duration (months)	
	1	2	3	4*	all	entering	leaving	stay	between 2 weighings
Boys	288	247	232	77	844	9.63	26.38	17.00	0.61
Girls	232	216	204	87	739	9.07	26.21	17.35	0.59
all	520	463	436	164	1583				

	Day care center			
	1	2	3	4
Years of data recording	1961—77	46—77	61—77	62—79

* Due to technical problems not all children from this day care center are included

Let $a(t)$ denote the age of a child at the calendar time t. Weight velocity $v_{a(t)}$ at age a and time t is computed as the rate of weight change

$$v_{a(t)} = \frac{w_{a(t+1)} - w_{a(t)}}{a(t+1) - a(t)}$$

where $w_{a(t)}$ is the weight at age $a(t)$.

Thus $a(t)$ is classified into seasons and 8 age classes of 3 months length each centered at 3, 6, 9, 12, 18, 24, 30 and 36 months. In each age class mean weight velocity is computed for each season and ranks are allocated to seasons in increasing order of mean velocities. We test the null hypothesis of no seasonality of weight velocity in the whole age range 3—36 months by using Kendall's coefficient of concordance of the rankings of seasons at all ages.

Results

In Table 2, the 3-monthly means of weight velocities are given with their standard errors for successive ages. The number of measurements presents a mode at age 18 months and is consistently the lowest in summer due to the one-month vacations taken by the children. Changes in velocity are perhaps better expounded by graphics. Figure 1 shows the mean weight velocities for the four seasons for boys and girls separately. Figure 2 expresses the difference between boys and girls in growth velocities at each season.

Boys show a constant decrease in weight growth velocity until age 24 months in winter and summer and age 30 months in spring and autumn followed by an increase afterwards. Weight growth velocity in girls decrease constantly in the studied age range 3—36 months.

Except in summer, boys grow faster than girls before age 12 months, drop to a lower growth rate until age 30 months and catch up again at 36 months. At age 3 months weight velocity in summer is lower for boys than for girls

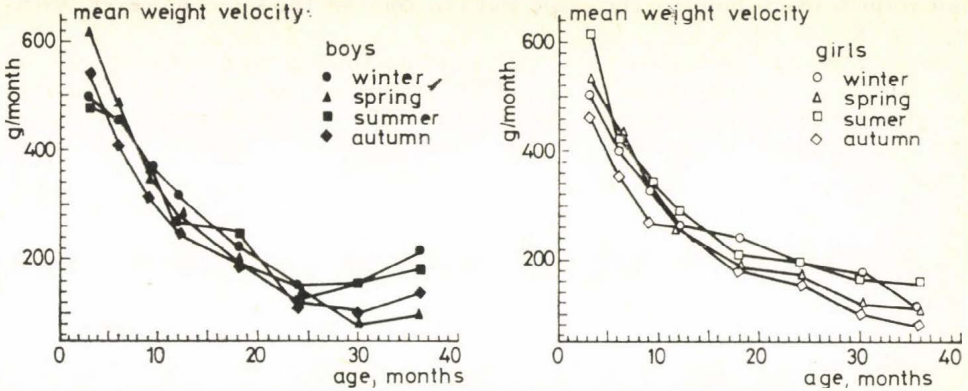

Fig. 1. 3-monthly mean weight velocities for the four seasons. 1/a: Weight velocity for boys, 3-monthly means plotted at successive ages; 1/b: Weight velocity for girls, 3-monthly means plotted at successive ages

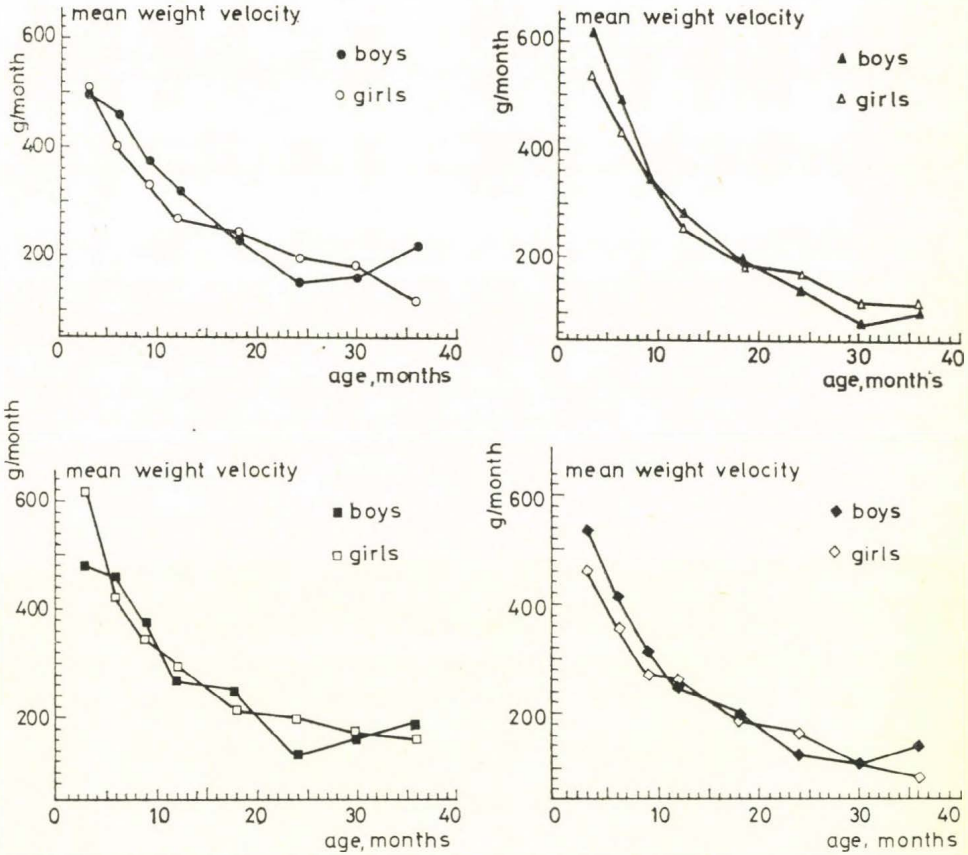

Fig. 2. 3-monthly mean weight velocities of boys and girls at each season; 3-monthly means plotted at successive ages. 2/a: Winter, 2/b: Spring, 2/c: Summer, 2/d: Autumn

and from 6 to 36 months the basic pattern remains the same, however, with greater irregularity.

Mean velocities are more dispersed in spring than in other seasons. Mean velocities in spring spread on the range 81—621 g/mo for boys and 114—536 g/mo for girls while the next largest range is 99—537 g/mo for boys and 156—618 g/mo for girls in summer. (Compare also Figure 2 to Figures 1—3—4 in Table 3).

Table 2

Weight velocities, PDC data

	Age Months	Winter			Spring			Summer			Autumn		
		N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE
		G/MO											
BOYS	3	217	495	37	248	621	39	150	480	79	163	537	58
	6	646	456	34	836	489	34	581	456	22	767	411	11
	9	778	369	21	782	351	17	613	372	12	933	312	22
	12	830	318	28	789	270	23	601	279	26	864	246	20
	18	1255	225	17	1366	195	15	953	243	23	1243	195	19
	24	848	150	15	795	147	14	549	126	15	900	120	13
	30	764	156	15	735	81	30	430	159	23	724	99	23
	36	475	216	15	505	102	25	278	183	27	459	138	23
GIRLS	3	208	504	35	272	537	35	181	618	73	145	462	35
	6	640	399	25	882	435	20	569	423	30	766	354	35
	9	775	327	17	737	345	19	592	342	29	770	267	19
	12	881	258	18	788	264	25	476	291	25	838	258	21
	18	1202	240	23	1249	189	18	864	210	18	1111	183	17
	24	774	195	21	794	117	16	475	165	17	691	102	21
	30	700	177	21	642	117	16	475	165	17	691	102	21
	36	499	114	20	476	114	19	217	156	24	356	78	15

There is a significant agreement in the ranking of seasons at all ages for both boys ($W = .61$, $p < .001$) and girls ($W = .68$, $p < .001$). Based on the statistics of the sums of ranks, estimates of the true ranking of winter, spring, summer and autumn in this order are also given in Table 3. In increasing order of mean weight velocities they are (4, 2, 3, 1) for boys and (2.5, 2.5, 4,1) for girls. For the latter, the estimated ranks of winter and spring are tied and given the midvalue 2.5.

Table 3

Coefficients of coherence and ranks estimates

	W	P	Seasons sequence	Estimate of the true ranking
Boys	.61	<.001	(W, Sp, Sm, A)	(4, 2, 3, 1)
Girls	.68	<.001	(W, Sp, Sm, A)	(2.5, 2.5, 4, 1)

W: Winter, Sp: Spring, Sm: Summer, A: Autumn
1: Slowest growth, 4: fastest growth

Discussion

BACKMAN (1934) suggested that the "infantile growth" reached its peak velocity in the third year. The question of the existence of "waves" of growth realized as successive growth spurts is still an open one. Except for the relatively well documented adolescent peak velocity phenomenon and the less well investigated mid growth spurt at about 7 years, other spurts are of a more speculative nature since "hard" data are lacking to document their existence. Backman's study dealt only with heights in boys. With an acceleration of weight growth in boys but not girls in the age range 30—36 months, our PDC data support BACKMAN's claim.

MARSHALL (1975) reported that children reached their maximum growth rate in mid-winter. From 3 to 30 months, the PDC children weight velocities show seasonal variations with particularly maxima occurring in autumn and high values in summer. An alternative explanation for this seasonality may be that during the one-month vacation in summer children experience different conditions including a full time care by their parents. They resume their attendance at the centers in autumn.

That boys gain weight the fastest in winter may also just well be a rebound after the relative deceleration in autumn. Such an interpretation does not at least contradict another consistent finding about the greater susceptibility to environmental influences in boys than in girls. This argument stands also to account partly for the irregularity for boys mean velocities in summer and their low summer rate of weight growth at age 3 months.

According to some authors including DÁLEN (1975), season of birth exerts an influence on health. The greater dispersion of mean weight velocities in spring suggests an interaction with the season of birth since children born in winter attain age 3 months in spring. Further investigation on an eventual interaction between the season of birth and the season of growth will be carried.

The observations reported in this paper lead to the conclusion that in the interpretation of seasonality of growth, besides light and atmospheric variations (MARSHALL 1975), attention should also be given to the seasonal rhythmicity of the living.

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REFERENCES

BACKMAN, G. (1934): *Das Wachstum der Körperlänge des Menschen.* — Kunglicke Svenska Verenskapsakademiens Handlingar, Series *3;* 14, n° 1 (145 pp).

BRANSBY, E. R. (1945): The seasonal growth of children. — Medical Officer, *73;* 149—151; 157—159 and 167—168.

DÁLEN, P. (1975): *Season of birth.* Amsterdam, North Holland.

MARSHALL, W. A. (1975): The relationship of variations in children's growth rates to seasonal climatic variations. — Annals of Human Biology, *2;* 243—250.

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