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Assessment of anthropometric indexes of children and adolescents with Down syndrome

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Abstract

Objective: To compare the agreement in the classification of the weight-for-age (W/A) and height-for-age (HA) indexes for children and adolescents with Down syndrome (DS) according to selected international reference distributions.

Methods: A cross-sectional study was carried out in children (2 to 9.9 years old) and adolescents (10 to 17.9 years old) with DS from cities in the state of Rio de Janeiro, Brazil, in 2005. The W/A and H/A indexes were classified according to the percentiles of two curves developed for individuals with DS and one distribution developed for healthy subjects. The cut-off limits applied for categorization were: below the 5th percentile (< P5) and above the 95th percentile (> 95). The weighted Kappa index was estimated to assess agreement between the classifications ($p < 0.05$).

Results: Information was obtained on 98 children and 40 adolescents. From 1.0 to 18.4% of the children were < P5 for W/A, and the agreement for this index was considered weak (Kappa = 0.16; 95%CI -0.03-0.34; $p < 0.01$); no agreement was observed between the H/A classifications. For adolescents, W/A < P5 varied from 2.5 to 5.0%; once more there was no agreement for this classification (Kappa = 0.16; 95%CI -0.15-0.48; $p > 0.05$). There was good agreement for the H/A index (Kappa = 1.00; 95%CI 0.23-1.00; $p < 0.01$).

Conclusion: There was weak agreement between classifications of anthropometric indexes according to three different distributions. The data indicated that the construction of specific curves for individuals with DS would facilitate the identification of overweight, which is often observed among these patients.

J Pediatr (Rio J). 2008;84(4):350-356: Nutritional assessment, children, adolescents, Down syndrome, anthropometry, weight-for-age, height-for-age.

Introduction

Down syndrome (DS) is a genetic anomaly in the 21st pair of chromosomes which has an extra chromosome (trisomy 21). This abnormality causes physical and mental impairment, such as muscular hypotonia (in particular oral), congenital heart disease, reduced immunity, gastrointestinal disorders, obesity, delayed psychomotor development and neurological problems, and hearing and sight deficiencies.[1,2]

Growth occurs in a different way among children with DS and it is characterized by earlier onset of the growth spurt and reduced linear growth velocity, which results in shorter stature than general population.[3-13] There is also a predisposition to overweight, particularly among adolescents and adults[7,14,15] that may itself be related to the growth deficiency since it reduces energy requirements. In addition to being a risk factor for metabolic disorders, overweight is an aggravating factor for other conditions that affect this group, such as heart diseases and muscular hypotonia. Therefore, nutritional assessment of children and adolescents with DS is

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important to enable the diagnosis and monitoring their nutritional conditions.

Percentile distributions of anthropometric indexes, such as weight-for-age (W/A), weight-for-height (W/A) and height-for-age (H/A) specific for children and adolescents with DS have been developed reflecting the lower growth velocity and the restricted height observed in this group. The distribution compiled in the United States[6] is one of the most often cited in the literature[4,5,10-12,16,17] and has distributions for weight, height and head circumference by age (HC/A), according to sex and covering the age group from 2 to 18 years.

In Spain,[8,9] distributions have been established for children and adolescents with DS from 3 months to 17 years of age including the same indexes covered by the United States distribution.[7] In Sweden[4] and in the United Kingdom and Ireland,[5] specific distributions have been compiled for weight, height/length and head circumference, by age group and sex, from birth to 18 years of age.

In Italy, Piro et al.[13] developed curves for weight, length/height and head circumference for children with DS from 0 to 5 years of age. In Saudi Arabia, Al Husain[18] also compiled curves by age group and sex, for weight, length/height, head circumference and weight for length/height for children from 0 to 5 years of age with DS and compared them with curves developed for children of the same group but without this condition.

In Brazil, Mustacchi[19] carried out a longitudinal study with 174 children from 0 to 8 years of age with DS, in the urban zone of São Paulo, between 1980 and 2000. The author assessed weight, height and head circumference and compiled distributions for the indexes H/A, W/A and HC/A, according to age group and sex. In this country there studies investigating assessment of anthropometric indexes in children and adolescents with DS are scarce. There is also no record of studies investigating the use of specific distributions for people with DS. The objective of this study is to assess the agreement between three different classifications of the W/A and H/A indexes of children and adolescents of both sexes with DS: two developed specifically for individuals with DS (in the United States[6] and in Spain[8,9]) plus the reference distribution recommended by the World Health Organization (WHO).[20,21]

Methods

A cross-sectional study was carrried out in children (aged 2 to 9.9 years) and adolescents (aged 10 to 17.9) with DS from both sexes, assisted at selected philanthropic institutions and selected from four cities in the state of Rio de Janeiro, Brazil: Niterói, São Gonçalo, Duque de Caxias and Rio de Janeiro. Pretest and pilot studies were carried out for all fieldwork procedures at similar institutions in the same state (Petrópolis, RJ).

All children and adolescents registered at these institutions that met the inclusion criteria were examined: clinical or genetic (karyotype) diagnosis of DS and no physical disability that could prevent anthropometric assessment.

The sample was characterized according to data on family income and parents' educational level obtained by a structured questionnaire. Monthly *per capita* family income was calculated by dividing the total family income by the number of people living in household and then categorized into multiples (or fractions) of the monthly minimum wage that was effective at the collecting data period (R$ 300.00/US$ 125.00). The parents' educational level was recorded as the highest grade concluded with approving.

Measurements were taken with the children and adolescents wearing minimum clothing, no shoes, and no ornaments or jewelry. They were weighed using a Kratos-Cas portable electronic scale with 150 kg capacity and 50 g precision. Height was measured twice using a Seca® (model 206) stadiometer accurate to 0.1 cm, if the difference between measurements was greater than 0.5 cm the mesurements were repeated. The mean of the two measurements was used in the analysis.

The statistic analysis included the estimation of absolute and relative frequencies for the variables describing the sample characteristics as well weight and height means (and respective 95% confidence interval – 95%CI).

The indexes analysed were W/A and H/A, since the reference distributions specific for individuals with DS from the United States[6] and from Spain[8,9] only presented data for these indexes. The same indexes were also estimated according to the distributions proposed by the WHO,[20,21] which are the references used by the Brazilian Ministry of Health to assess the growth of children and adolescents in the general population.[22]

The distributions were compared taking into account the following cutoff points: for the W/A index, below the 5th percentile (P5), between P5 and the 95th percentile (P95) and above P95; for the H/A index the cutoff was above or below P5. These cutoff points were chosen since they are provided by the adopted distributions and are used as indicators of possible underweight (P5, W/A), overweight (P95, W/A), and stunting (P5, H/A). It is expected that 5% of the children and adolescents would be classified below P5 and 5% above P95 according to each distribution.

The W/A index was utilized only for the DS-specific distributions comparison for adolescents. This index is not recommended for evaluation of adolescents, at this phase of development, which can lead to misleading interpretations. The body mass index (BMI) = weight/height-for-age^2 is the indicator of choice for adolescents because they can be at different stages of pubertal maturity and consequent changes in the body composition, even at the same cronological age.

Table 1 - Characteristics of the children and adolescents with Down syndrome (Rio de Janeiro, 2005)

Variables	Frequency	%
Sex (n = 138)		
Male	72	52.2
Female	66	47.8
Age (n = 138)		
2.0-9.9 years	98	71.0
10.0-17.9 years	40	29.0
Family income *per capita* *† (n = 130)		
< 0.5 minimum wage	63	48.5
> 0.5 minimum wage	67	51.5
Educational level of fathers‡ (n = 116)		
Up to 4th grade of elementary school	86	74.1
From 5th to 8th grades of elementary school	30	25.9
Educational level of mothers§ (n = 132)		
Up to 4th grade of elementary school	32	24.2
From 5th to 8th grades of elementary school	63	47.8
High school	37	28.0

*Expressed as fractions or multiples of the minimum wage prevailing at the time of data collection, which was R$ 300.00 (three hundred reais) or about US$ 125.00 (one hundred and twenty five dollars).
† This information was not obtained for eight (5.8%) individuals.
‡ This information was not obtained for 22 (16%) individuals.
§ This information was not obtained for six (4.3%) individuals.

The weighted Kappa (and 95%CI) was estimated in order to evaluate agreement between the classifications of W/A and H/A indexes according to the three distributions. The Kappa values were interpreted according to following: Kappa < 0.40, weak agreement; Kappa 0.40 - 0.75, good agreement; Kappa > 0.75, excellent agreement. If Kappa is zero, any agreement observed can be explained by chance. Negative values for Kappa means that the observed agreement is less than would be obtained by chance. Finally, Kappa value equal to one means that the agreement is excellent.[24] Statistical significance was considered for $p < 0.05$.

This project is in compliance with Ministry of Health resolution 196/96[25] and has been approved by the Research Ethics Committee at the Hospital Universitário Antônio Pedro/ Medical Faculty/Universidade Federal Fluminense (hearing number 142/04). The children and adolescents were authorized to participate by parents or guardians, who signed free and informed consent forms after receiving information on all of the procedures used in the investigation.

Results

The philanthropic institutions studied had a total of 157 children and adolescents with DS enrolled (83 boys and 74 girls) in the age group of interest. It was not possible to obtain information on19 (12.1%) subjects either because their parents or guardians refused permission or because they were not able to undergo anthropometric measurement. A total of 138 individuals were examined (72 boys, 52.2%; 66 girls, 47.8%), of whom 98 (71.0%) were children aged 2 to 9.9 years (46 boys and 52 girls) and 40 were adolescents (26 boys and 14 girls) (Table 1).

The median monthly family income *per capita* was 0.5 minimum wage. Educational level of the fathers showed that 74% studied up to the fourth grade of elementary school. In contrast, 24% of the mothers had 4 years or less at school and 28% had completed the high school (11 years' study) (Table 1).

Table 2 lists the characteristics of the group investigated in terms of weight and height (means and 95%CI) broken down by age group.

The proportion of children below P5 for the W/A index varied from 1.0%, according to the distribution from the United States,[6] to 18.4%, according to the Spanish distribution.[8,9] The Spanish[8,9] and the WHO distributions [20] classified 4.1% of the children above P95 for W/A, whereas, according to the distribution from the United States,[6] 16.3% were above this limit and none of the children were below P5 for H/A. However, according to the Spanish distribution[8,9] and to the

Table 2 - Means (95%CI) of the anthropometric measurements of children and adolescents with Down Syndrome, by age group (Rio de Janeiro, 2005)

Age group (years)	n	Weight (kg)	Height (cm)
2-4.99	56	14.5 (13.6-15.4)	92 (90-94)
5-9.99	42	22.4 (20.6-24.2)	110 (108-112)
10-13.99	27	37.0 (33.3-40.7)	134 (126-138)
14-17.99	13	51.3 (44.6-56.0)	151 (147-156)

WHO,[20] 20.4 and 55.1%, respectively, were considered to be below the P5 for the H/A index (Table 3).

According to the distribution from the United States,[6] 5.0% of the adolescents were classified as below P5 for W/A, whereas the Spanish[8,9] distribution defined 2.5% as below this level. Adolescents were only classified above P95 for W/A in relation to the distribution from Spain[8,9] (17.5%). The H/A index analyzed according to the DS-specific distributions revealed that 2.5% of the adolescents were classified as below P5. On the other hand, the WHO distribution,[21] classified 60.0% of the adolescents below the P5 for the H/A index.

For the children, there was little agreement (Kappa = 0.29; 95%CI 0.20-0.37; p < 0.01) between W/A classifications according to the three distributions. The same degree of agreement was observed between the classifications based on the distributions from the United States[6] and Spain[8,9] (Kappa = 0.16; 95%CI -0.03-0.34; p < 0.01). The same was also observed with relation to the comparison of the W/A classification according to the distribution from the United States[6] and the WHO[20] (Kappa = 0.26; 95%CI 0.04-0.48; p < 0.01). Good agreement was observed between the W/A classification according to the distribution from Spain[8,9] and the WHO classification[20] (Kappa = 0.50; 95%CI 0.29-0.72; p < 0.01) (Table 4).

The H/A classifications according to all three distributions taken together had agreement close to zero (Kappa = 0.02; 95%CI -0.09-0.13; p > 0.05). When the distributions were compared in pairs, no agreement whatsoever was detected (United States[6] vs. Spain[8,9] and United States[6] vs. WHO:[20] Kappa = 0.00; p > 0.05; Spain[8,9] vs. WHO: Kappa = 0.00; 95%CI -0.15-0.05; p > 0.05) (Table 4).

For the adolescents, weak agreement was observed in the comparison of the W/A classified according to the DS-specific distributions (Kappa = 0.16; 95%CI -0.15-0.48; p > 0.05). Similarly, no agreement was observed for the H/A index when all three distributions were considered (Kappa = -0.13; 95%CI -0.30-0.04; p > 0.05). For H/A, excellent agreement was observed (despite a wide confidence interval) for the classifications by the DS-specific distributions (Kappa = 1.00; 95%CI 0.23-1.00; p < 0.01) and no agreement when these classifications were compared with that estimated according to the distribution adopted by the WHO[21] (Table 4).

Discussion

The results demonstrate high proportion of children classified below P5 for W/A according to the distribution from

Table 3 - Weight-for-age and height-for-age indexes of children and adolescents with Down syndrome classified according to three different reference distributions (Rio de Janeiro, 2005)

	Children (2 to 9.99 years) (n = 98)*			Adolescents (10 to 17.9 years) (n = 40)†		
Index	United States	Spain	WHO‡	United States	Spain	WHO§
W/A index						
< P5 (%)	1.0	18.4	9.2	5.0	2.5	-
Between P5 and P95 (%)	83.7	77.6	86.7	95.0	80.0	-
> P95 (%)	16.3	4.1	4.1	0.0	17.5	-
H/A index						
< P5 (%)	0.0	20.4	55.1	2.5	2.5	60.0

H/A = height for age; WHO = World Health Organization; W/A = weight for age.
* Weighted Kappa for weight-for-age = 0.29 (95%CI 0.20-0.37); p = 0.000; Weighted Kappa for height-for-age = 0.02; (95%CI -0.09-0.13); p = 0.33.
† Weighted Kappa for height-for-age = -0.13; (95%CI -0.30-0.04); p = 0.92.
‡ WHO, 2006.
§ WHO, 2007.

Table 4 - Agreement between classifications of the W/A and H/A indexes of children and adolescents with Down Syndrome according to three different reference distributions (Rio de Janeiro, 2005)

	Kappa (95%CI)			
	Weight-for-age		Height-for-age	
Distributions	Children	Adolescents	Children	Adolescents
United States/Spain	0.16 (-0.03-0.34)	0.16 (-0.15-0.48)	-	1.00 (0.23-1.00)
United States/WHO 2006/07	0.26 (0.04-0.48)	-	-	0.00* (-0.15-0.05)
Spain/WHO 2006/07	0.50 (0.29-0.72)	-	0.00 (-0.15-0.15)	0.00* (-0.15-0.05)

* Kappa index negative (approximately 0.00).

Spain[8,9] and the distribution developed for healthy individuals.[20] Conversely, the distribution from the United States[6] resulted in an elevated proportion of children categorized above P95. In contrast with the results for the children, the Spanish distribution[8,9] classified a higher proportion of the adolescents above P95 than did the distribution from the United States,[6] indicating that the Spanish distribution possibly has greater sensitivity in the detection of overweight among adolescents with DS. These data suggest that the adolescents studied here possibly do not present underweight.

Analysis of the H/A index showed divergent results for children according to the three reference distributions. Whereas for the adolescents the data analyzed according to the specific distributions indicated that their growth did not differ substantially from that of adolescents with DS originating from other population groups (Spain and United States).

Despite recognizing the elevated prevalence of heart diseases among people with DS and their repercussions for nutritional status, in this study the effect of these conditions was not considered in analyses, since the study intended purely to compare how the individuals would be categorized by the different distribution references. Another limitation of this study is the reduced number of individuals in the age and sex categories, particularly among the adolescents.

These findings indicate the need to carefully evaluate the nutritional situation of adolescents with DS. If the adolescents in this study had been assessed solely using the distribution from the United States,[6] it would not have been possible to identify overweight among them. Assessment using the Spanish distribution,[8,9] in contrast, makes it possible to implement interventions to reduce the weight of those categorized above P95 for W/A, which could reduce the development of possible metabolic disturbances which would be caused by excess body fat.

Furthermore, the use of H/A distributions developed for healthy individuals is inappropriate for assessing the growth of people with DS; therefore, it is recommended the development of specific reference distributions to monitor the growht of individuals with the DS.

The weight-for-height and BMI-for-age indexes, which assess the harmony between the dimensions body mass and height, were not investigated in this article based on the fact that the two distributions developed for individuals with DS[6,8,9] do not provide data for these indexes.

The distribution published by Mustacchi et al.,[19] which was compiled in Brazil, was not used in this study because it only covers the age group from 1 to 8 years of age. Furthermore, for operational reasons, two other distributions[4,5] developed for individuals with DS were also not used in the analysis. A distribution developed in Sweden[4] does not present the curves in percentiles, whereas a distribution developed in the United Kingdom and Ireland[5] does not provide the 5th and 95th percentiles.

Myrelid et al.[5] also compared anthropometric data from Swedish children and adolescents with DS with the DS-specific distribution from the United States.[6] The authors observed discrepancies such as, for example, the mean height of the Swedish DS subjects at 18 years of age was greater than that of the individuals from the United States. In terms of weight, the authors observed the inverse relationship: the mean weight of the Swedish adolescents with DS at 18 years corresponded to the 50th percentile for boys and the 25th percentile for girls on the distribution from the United States.[6] The authors attributed these differences to ethnic diversity and the different sample sizes.

In Portugal, Fernandes et al.[10] examined 196 children aged 0 to 48 months with DS and 96 siblings of these children who did not have DS. When they compared their results with the DS-specific distribution from the United States.[6] The authors observed that the Portuguese children had a similar growth to those in the United States up to 24 months of age, but, from 24 to 48 months, they exhibited higher values for length and weight.

In a study carried out in Chile, Pinheiro et al.[16] conducted research with 116 children and adolescents with DS, aged from 3 months to 18 years. These authors assess agreement between diagnoses of W/A and H/A indexes according to the DS-specific distributions from the United States[6] and Spain[8,9]

and also with the National Center for Health and Statistics (NCHS) curves.[26] The authors observed that there was very little agreement between the distributions in terms of the indexes analyzed; nevertheless, they indicated that the distribution from Spain was more appropriate for assessing nutritional disorders among these children.

There is no consensus related to reference distributions and classification criteria to be used for assessing the nutritional status of children and adolescents with DS. Although specific distributions have already been developed in some countries,[3-6,8-10,12,13,18] there are no records of studies carried out in Brazil which have compiled weight and height distributions from a representative sample of individuals with DS. The need to use distributions produced specifically for this group is based on the recognition that their growth and development is different.

The weak agreement observed between the distributions analysed indicates that carrying out longitudinal studies with representative samples of individuals with DS in Brazil would be of great utility to understanding the process of growth and development in these children and adolescents and would allow the development of reference distributions specific to this population group. Such studies would make it possible to construct specific curves, which would be an aid in the identification of the weight alteration, primarily overweight, which are often observed in this group.

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References

1. Granzotti JA, Paneto IL, Amaral FT, Nunes MA. Incidência de cardiopatias congênitas na Síndrome de Down. J Pediatr (Rio J). 1995;71:28-30.
2. Nisihara RM, Kotze LM, Utiyama SR, Oliveira NP, Fiedler PT, Messias-Reason IT. Doença celíaca em crianças e adolescentes com síndrome de Down. J Pediatr (Rio J). 2005;81:373-6.
3. Farkas LG, Katic MJ, Forrest CR. Age-related changes in anthropometrics measurements in the craniofacial reginos and in height in Down's syndrome. J Craniofac Surg. 2002;13: 614-22.
4. Myrelid A, Gustafsson J, Ollars B, Anneren G. Growth charts for Down's syndrome from birth to 18 years of age. Arch Dis Child. 2002;87:97-103.
5. Styles ME, Cole TJ, Dennis J, Preece MA. New cross sectional stature, weight and head circumference references for Down's syndrome in the UK and Republic of Ireland. Arch Dis Child. 2002; 87:104-8.
6. Cronk C, Crocker AC, Pueschel SM, Shea AM, Zackai E, Pickens G, et al. Growth charts for children with Down syndrome: 1 month to 18 years of age. Pediatrics. 1988;81:102-10.
7. Chumlea WC, Cronk CE. Overweight among children with trisomy. J Ment Defic Res. 1981;25:275-80.
8. Pastor X, Corretger M, Gassio R, Seres A, Corretger JM. Parámetros somatométricos de referencia de niños y niñas con síndrome de Down visitados en el CMD (Centro Médico Down de la Fundació Catalana Síndrome de Down). SD-DS Revista Médica Internacional sobre el síndrome de Down. 1998;3:9-11.
9. Pastor X, Corretger M, Gassio R, Seres A, Corretger JM. Parámetros somatométricos de referencia de niños y niñas con síndrome de Down visitados en el CMD (Centro Médico Down de la Fundació Catalana Síndrome de Down). SD-DS Revista Médica Internacional sobre el síndrome de Down. 1998;4:9-12.
10. Fernandes A, Mourato AP, Xavier MJ, Andrade D, Fernandes C, Palha M. Characterisation of the somatic evolution of Portuguese children with Trisomy 21 - preliminary results. Downs Synd Res Pract. 2001;6:134-8.
11. Arnell H, Gustafsson J, Ivarsson SA, Anneren G. Growth and puberal development in Down syndrome. Acta Pediatr. 1996;85: 1102-6.
12. Piro E, Pennino C, Cammarata M, Corsello G, Grenci A, Lo Giudice, et al. Growth charts of Down syndrome in Sicily: evaluation of 382 children 0-14 years of age. Am J Med Genet Suppl. 1990;7: 66-70.
13. Cremers MJ, Tweel I, Boersma B, Wit JM, Zonderland M. Growth curves of Dutch children with Down's syndrome. J Intellect Disabil Res. 1996;40:412-20.
14. Luke A, Sutton M, Schoeller DA, Roizen NJ. Nutrient intake and obesity in prepubescent children with Down syndrome. J Am Diet Assoc. 1996;96:1262-7.
15. Prasher VP. Overweight and obesity amongst Down's syndrome adults. J Intellect Disabil Res. 1995;39:437-41.
16. Pinheiro FA, Urteaga RC, Canete SG, Atalah SE. Evaluación del estado nutricional en niños con síndrome de Down según diferentes referencias antropométricas. Rev Chil Pediatr. 2003; 74:585-9.
17. Dalpicolo F, Viebig RF, Nacif MA. Avaliação do estado nutricional de crianças com Síndrome de Down. Nutrição Brasil. 2004;3: 336-40.
18. Al Husain M. Growth charts for children with Down's syndrome in Saudi Arabia: birth to 5 years. Int J Clin Pract. 2003;57: 170-4.
19. Mustacchi Z. Curvas padrão pôndero-estatural de portadores de Síndrome de Down procedentes da região urbana da cidade de São Paulo [Tese]. São Paulo: Universidade de São Paulo; 2002.
20. World Health Organization (WHO). WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. Methods and development. WHO (nonserial publication). Geneva: WHO; 2006.
21. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85:660-7.
22. Ministério da Saúde. Coordenação Geral da Política de Alimentação e Nutrição. Vigilância Alimentar e Nutricional-SISVAN. Orientações para a coleta e análise de dados antropométricos em serviços de saúde. Norma Técnica. Material preliminar, 2008. http://www.saude.gov.br/nutricao/. Access: 10/03/2008.

23. World Health Organization (WHO). Physical status: the use and interpretation of anthropometry. WHO Technical Report Series n. 854. Geneva: WHO; 1995.

24. Fraile, BB. Epidemiología clínica aplicada a la toma de decisiones en medicina. Gobierno de Navarra. Departamento de Salud, 2008. http://cfnavarra.es/publicaciones. Access: 12/02/2008.

25. Conselho Nacional de Saúde. Normas envolvendo seres humanos. Res CNS 196/96. Bioética. 1996;4:7-27.

26. National Center for Health Statistics (NCHS). NCHS growth curves for children birth-18 years, United States. Washington DC: US Department of Health Education and Welfare; 1977.

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