



# Influence of kindergarten on numbers of multiple developmental delays in preschoolers: an analysis over 14 years

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## Abstract

**Objectives** The aim of the study was to calculate the impact that the duration of attendance and the location of the kindergarten (rural versus urban) has on the prevalence of multiple delays in preschool children.

**Methods** We analyzed data from 14,068 preschool children, over a period of 14 consecutive years (1997–2010) from the Bavarian Pre-School Morbidity Survey using software package SPSS 21.0. We assessed the incidence of multiple developmental impairments (twofold or above) in various developmental domains.

**Results** The highest prevalence for multiple delays in development existed for twofold impairments in the area of motor (7.9 %) and lowest in fivefold delays in cognition (0.4 %). A shorter duration of visiting a kindergarten (OR: 4.43) and an urban location (OR: 2.53) was associated with an increased risk of multiple delays in development.

**Conclusions** A shorter duration and an urban location of kindergarten attendance are associated with an increased risk for children having multiple developmental impairments. From a public health perspective, the setting and duration of kindergarten attendance may be an important

focus in preventive efforts to optimize health outcomes in children.

**Keywords** Kindergarten · Impact · Preschool children · Development · Delays · Public health

## Introduction

Over recent years, a number of authors have documented increasing rates of developmental delays in children living in industrialized countries (Flender 2005; Zimmer 2002). Children demonstrate increasing deficits in motor development, physical endurance and in coordination skills (Zimmer 2002). Usually, however, the majority of children assessed in such studies are free of impairment, or if they do demonstrate impairments show delay in only one area of physical, mental or psychosocial development (Stich et al. 2012). There appears to be a significant if smaller group of these children who demonstrate multiple, co-occurring, developmental delays in co-occurrence (Stich et al. 2014; Tervo 2003; Valtonen et al. 2004).

There are a variety of biological, behavioral and social factors influencing the developmental opportunities of preschool children. It is known that age at enrollment (Jäger-Roman 2000; Stich et al. 2012) and sex (Darrah et al. 2009; Wohlfeil 1991) significantly affects the development of such children. The so-called “health behavior” of families and children (physical activity, using of electronic medias etc.) also has an important influence on the chances of good health (Li and Atkins 2004; Sigmund et al. 2009; Zimmer 2002). Other social and environment circumstances (structure of family, professional background of parents, housing conditions, etc.) may

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also have a great influence on the development chances of preschoolers (Esser 1994; Mielck 2000). This suggests that there is a so-called “social gradient” in risks of children starting school suffering delays in their individual development (Elkeles and Mielck 1997).

One important social factor affecting development could be the setting of the kindergarten attended in terms of the opportunities for development that it provides (Magnuson et al. 2004; Schöler et al. 2004). The role of kindergarten attendance for the development of various childhood skills and abilities has been of particular interest for public health experts (Germino-Hausken 2006; NICHD Early Childcare Research Network and Duncan 2003: 1464). In this context, potential factors influencing the quality of developmental opportunities provided may include the duration of attendance and the location of each kindergarten. In previous research, we identified that a visit to a kindergarten for 1 year or longer was a protective factor against development delays, whereas the location of a kindergarten (i.e., rural or urban area) was unimportant for the incidence of single impairments in development (Caniato et al. 2010; Stich et al. 2006).

Our previous studies have primarily focused on the prevalence of single and multiple developmental delays (Caniato et al. 2010; Stich et al. 2006, 2012, 2016). The exact significance of these developmental delays and their long-term outcomes and trajectories remains uncertain. Children with multiple delays or impairments, however, may represent a special “high-risk” group for whom public health initiatives may be even more important. We wonder therefore whether there exists an association between the location and duration of kindergarten attendance on the occurrence of multiple developmental delays. To our knowledge, there are no data which have reviewed the effect of kindergarten attendance and location on the development of multiple or combined impairments in development. We hypothesized that children with multiple delays would represent a special and important focus of public health initiatives.

## Methods

### Study design and sample

By law, all children in the federal state of Bavaria, Germany, must be examined by experts of public health in a so-called school-enrollment examination, before entering primary school, (Law of Public Health Services 2003; Bavarian Law of Education and Instruction 2011). The data for these children were collected and documented over the last 14 years and forms the basis of our so-called “Bavarian Pre-School Morbidity Survey” (BPMS), which

remains ongoing. Since assessments are mandated by law, the data set is extremely comprehensive.

Examinations on all children were conducted by the members of the local “Department of Public Health Services”. All the clinical assessors of the team remained unchanged during the 14 year period. The methodology of the examination of the children remained unchanged over the 14-year period and has been documented in a previous publication, which utilized the same data set (Stich et al. 2016). The examination was based on a modified manual for school entry examinations (Task Force “School and Youth Health in Public Health Services” 1997) and assessed four defined domains of development: motor, speech, cognitive and psychosocial functioning. Each area of developmental domains is further subdivided into specific subareas (Table 1). The inability to pass two or more standardized tests for motor or to pass one test for speech, cognition and psyche was defined as an impairment in the specific area of development.

The results of the examinations for all children in the district of Dingolfing-Landau were analyzed retrospectively with a pooled data set of 14 vintages. If there was a presence of a severe disease with respect to vision or hearing, this child was not considered for standardized school entry examination and not included in the sample. We included in the analysis all other children participating in school entry examinations in the years 1997–2010 who had primary residence in the Lower Bavarian District Dingolfing-Landau ( $N = 14,068$ ).

### Statistical analysis

All single delays of each subarea in individual development were encoded binary (no delay versus delay). Based on the prevalence of single impairment, we further calculated the prevalence of multiple delays from twofold to threefold impairments for motor and speech, twofold to fivefold for cognition and onefold for delays in psychosocial development. Examination of psychosocial delays was based on the Denver Development Screening Test (Frankenberg and Dobbs 1967). The duration of kindergarten attendance was calculated (none or up to 1 year with kindergartners versus time over 1 year or more). In addition, the location of the visited kindergarten was documented as either rural or urban (urban: location in one of two cities versus rural: location outside the cities).

The modification by age (youngest children versus middle-aged versus older), sex (reference: boy versus girl) and nationality (reference: non-German versus German) on outcome variables was calculated by multinomial (motor, speech and cognition) and binary regression (psychosocial) models.

**Table 1** Domains and subareas of developmental functioning assessed and corresponding standardized tests procedures in the District of Dingolfing-Landau, Germany, during 14 consecutive years (1997–2010)

Domains of development	Subareas	Standardized test procedures
Motor	Gross motor skills	Standing on one leg; jumping on one leg; going like a rope dancer; going with clapping hands
	Fine body coordination Grapho-motor coordination	Finger opposition test; drawing different figures; drawing a person
Speech	Pronunciation	Repeating words
	Grammar	Retelling a short story; retelling a short picture story; explaining rules of a well-known game
Cognition	Rhythm of speech	Repeating sentences
	Memory and concentration	Repeating sentences with 7–10 words including three adjectives; repeating four single numbers in the correct sequence
	Perseverance	Capacity to attend during the whole examination
	Abstraction	Building pairs; finding out an object from various objects belonging together
	Visual perception	Perception and knowledge of simple geometric figures or silhouettes of figures and animals
	Arithmetic and amount detection	Counting from 1 to 10 in the correct sequence; distinction and designation of frequencies between two different colored ball quantities
Psyche	Behavior	Erratic; overly bonded with mother (no separation possible during examination); hostility toward examiner
	Emotionality	Major mood swings; crying
	Psychomotor	Agitation; unable to sit calmly for a few minutes

The crude odds ratio (cOR) was calculated by unifactorial regression models, and adjusted odds ratios (aOR) for age, sex and nationality by multifactorial regression models.

All statistical analysis was made under a level of significance  $\alpha \leq 0.05$ .

## Results

### Socio-epidemiology of the study population

The average age of all preschoolers was 5.92 years (standard deviation  $\pm 0.39$ ) with a minimum of 4.26 years and a maximum of 7.91 years (percent in stratification: 14 %: 4.26–5.49 years; 79.6 %: 5.50–6.50 years; 6.4 %: 6.51–7.91 years). There was a slightly larger percentage of boys (51.6 versus 48.4 % girls), and mostly German preschool children (88.2 versus 11.8 %: non-German) were represented in the study cohort.

### Prevalence of multiple impairments

Most of the preschool children had no delays in their individual development (Fig. 1). On average, in every seventh preschool children, we found a single delay in speech. In the domains of motor skills, cognitive and

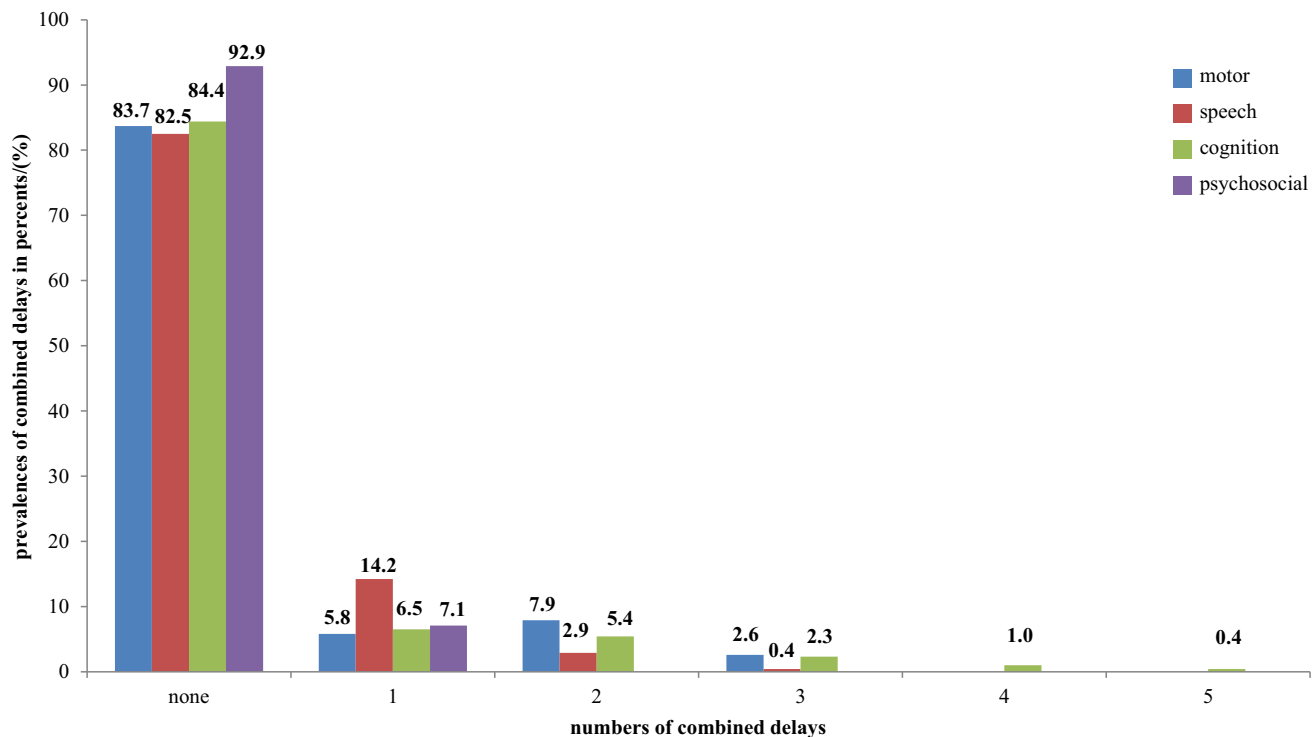
psychosocial development, the rates of single delays were much lower (Fig. 1) and significantly less onefold developmental delays could be detected. Moreover, every 12th preschooler had twofold delays in the domain motor development, and at least twofold delays could be found in speech development. The highest prevalence in threefold impairment existed in the areas of motor and cognition, and was significantly lower in the area of speech. The lowest prevalence was found in fourfold and fivefold delays in the domain of cognition (Fig. 1).

### Duration and localization of kindergartens

In the study area, almost all preschool children attended kindergarten for a 1 year or longer (94.2 %), with only a small number of children (5.8 %) attending kindergarten for less than a year. The majority of the kindergartens were located in a rural area (71.3 %), with the rest based in one of two towns of the District of Dingolfing-Landau (28.7 %).

### Associations of duration and location of kindergarten with numbers of delays in the development of unifactorial analysis

Adjusted by age, sex and nationality singular delays of motor function had an increasing risk over 40 % in case of



**Fig. 1** Numbers of co-occurrence of delays in the four domains of development in the District of Dingolfing-Landau, Germany, during 14 consecutive years (1997–2010)

shorter visiting a kindergarten. This specific association had not been confirmed by the crude risk estimator (Table 2). However, for two motor disorders a 43 % increase of risk in the non-adjusted model and a further increasing of risk to a longer visiting a kindergarten in the adjusted model was seen (Table 2). It was noticeable that the numbers of delays in the linguistic area were not affected by the duration of the kindergarten attendance, while they exerted a significant influence on the cognitive and psychosocial development (Table 2). Apart from the two duplicate cognitive delays (risk reduction of 10 % in the adjusted model), risk increased with increasing numbers of cognitive delays from 50 % to a maximum of 299 % when attending a kindergarten for only 1 year or less. And risks reduced under the influence of defined factors with increasing numbers of deficits from 13 to 73 % (Table 2). Similarly, a shorter kindergarten attendance was a significant risk (87 %) for psychosocial problems, which increased under adjustment even by almost 10 % (Table 2).

A small increase in risk (27 %) was observed for urban kindergartens for singular developmental delays. In this context, for threefold delays in movement ability, the risk was 78 % with a risk reduction of 12 % under adjustment by age, sex and nationality (Table 3). In contrast to motor, no risk association was found between simple language delays and location of kindergarten, whereas for children in

an urban kindergarten the risk increases significantly (98 and 160 %) under moderate increase in the adjusted model (101 and 170 %) for multiple language impairment (Table 3). In the area of cognition risks with more numbers of developmental delays (22–248 %) increased significantly for children in municipal kindergartens (Table 3). In adjusted models, this risk could be confirmed for three-, four- and fivefold developmental delays under a significant risk reduction between 42 and 48 % (Table 3). The risk in psychosocial disabilities was significantly lower (43 %), and in the adjusted model this risk was reduced significantly to about nearly a half (Table 3).

#### Multifactorial analysis

In the domain of motor development, attending an urban kindergarten (versus rural) increased the risk for a single delay by 24 % and by more than 50 % for threefold delays (Table 4). A shorter kindergarten attendance was associated with an increase in risk of almost 40 % for twofold developmental impairments in motor, and in the adjusted model this risk increased up to 56 % (Table 4).

In the area of linguistic development, we found a significant increasing risk of 93 and 161 % for twofold and threefold impairments, respectively, in children attending municipal kindergartens. These risks increased a little bit when adjusting for age, sex and nationality (Table 4).

**Table 2** Unifactor multivariate regression duration of attending a kindergarten (until 1 year versus longer than 1 year) in the District of Dingolfing- Landau, Germany, during 14 consecutive years (1997–2010)

Areas of delays	Numbers of delays	Crude			Adjusted <sup>a</sup>		
		OR	95 % CI	Level of significance	OR	95 % CI	Level of significance
Motor	1	1.35	0.99–1.84	0.058	1.43	1.04–1.97	0.030
	2	1.43	1.09–1.87	0.009	1.58	1.19–2.09	0.002
	3	1.50	0.97–2.34	0.070	1.57	1.00–2.47	0.050
Speech	1	0.95	0.75–1.19	0.634	1.00	0.79–1.28	0.984
	2	0.93	0.57–1.53	0.781	0.891	0.53–1.49	0.891
	3	1.29	0.40–4.15	0.671	0.64	0.36–1.12	0.116
Cognition	1	1.50	1.11–2.02	0.008	1.50	1.11–2.04	0.009
	2	2.25	1.71–2.97	≤0.0001	2.35	1.77–3.14	≤0.0001
	3	2.59	1.76–3.82	≤0.0001	2.46	1.64–3.68	≤0.0001
	4	4.29	2.62–6.92	≤0.0001	3.88	2.35–6.40	≤0.0001
	5	4.99	2.42–10.30	≤0.0001	4.26	2.00–9.05	≤0.0001
Psychosocial <sup>b</sup>	1	1.87	1.45–2.40	≤0.0001	1.96	1.52–2.54	≤0.0001

References: “no delays of development” and “attending a kindergarten for longer than 1 year”

OR odds ratio, 95 % CI 95 % confidence interval

<sup>a</sup> With age of children, sex, and nationality<sup>b</sup> Binary logistic regression**Table 3** Unifactor multivariate regression localization of a kindergarten (rural versus urban) in the District of Dingolfing-Landau, Germany, during 14 consecutive years (1997–2010)

Areas of delays	Numbers of delays	Crude			Adjusted <sup>a</sup>		
		OR	95 % CI	Level of significance	OR	95 % CI	Level of significance
Motor	1	1.27	1.09–1.48	0.002	1.13	0.96–1.33	0.131
	2	1.09	0.95–1.25	0.216	0.90	0.78–1.05	0.184
	3	1.78	1.44–2.21	≤0.0001	1.66	1.32–2.08	≤0.0001
Speech	1	1.05	0.95–1.18	0.334	1.04	0.93–1.17	0.460
	2	1.98	2.63–3.42	≤0.0001	2.01	1.62–2.48	≤0.0001
	3	2.60	1.49–4.53	≤0.0001	2.70	1.52–4.80	0.001
Cognition	1	1.22	1.06–1.42	0.007	1.02	0.87–1.19	0.807
	2	1.38	1.18–1.61	≤0.0001	1.13	0.95–1.33	0.167
	3	2.14	1.71–2.68	≤0.0001	1.72	1.35–2.18	≤0.0001
	4	2.65	1.90–3.72	≤0.0001	2.10	1.47–2.99	≤0.0001
	5	3.48	2.04–5.94	≤0.0001	3.00	1.71–5.25	≤0.0001
Psychosocial <sup>b</sup>	1	1.43	1.24–1.63	≤0.0001	1.23	1.06–1.42	≤0.0001

References: “no delay of development” and “rural area”

OR odds ratio, 95 % CI 95 % confidence interval

<sup>a</sup> With age of children, sex, and nationality<sup>b</sup> Binary logistic regression

In the domain of cognition, the risks for the appearance of combined delays was higher when preschoolers attended a kindergarten for a shorter duration of until 1 year (OR: 1:44–4:43) and when the kindergarten was located in a city (OR: 1.75 until 2.53) (Table 4). The same trend of

associations could be identified when adjusting for age, sex and nationality.

For psychosocial impairments, a shorter kindergarten attendance (87 %) and an urban location of kindergarten (47 %) were risk factors in the multifactorial model, but

**Table 4** Multifactor multivariate regression duration and location in the same model in the District of Dingolfing-Landau, Germany, during 14 consecutive years (1997–2010)

Areas of delays	Numbers of delays	Independent factors	Crude			Adjusted <sup>a</sup>		
			OR	95 % CI	Level of significance	OR	95 % CI	Level of significance
Motor	1	duration	1.30	0.95–1.79	0.107	1.41	1.01–1.96	0.042
		Location	1.24	1.07–1.45	0.006	1.11	0.94–1.31	0.208
	2	duration	1.39	1.05–1.83	0.021	1.54	1.15–2.06	0.004
		Location	1.06	0.92–1.22	0.429	0.88	0.76–1.03	0.114
	3	duration	1.37	0.87–2.15	0.174	1.51	0.95–2.39	0.081
		Location	1.47	0.91–1.85	≤0.0001	1.56	1.23–1.97	≤0.0001
Speech	1	duration	0.91	0.72–1.16	0.453	0.97	0.76–1.24	0.803
		Location	1.02	0.92–1.14	0.694	1.01	0.90–1.14	0.825
	2	duration	0.87	0.53–1.43	0.579	0.88	0.52–1.47	0.019
		Location	1.93	1.57–2.37	≤0.0001	1.94	1.56–2.40	≤0.0001
	3	duration	1.14	0.35–3.69	0.827	1.19	0.36–3.92	0.773
		Location	2.61	1.49–4.55	0.001	2.70	1.52–4.79	0.001
Cognition	1	duration	1.44	1.06–1.95	0.021	1.47	1.07–2.02	0.017
		Location	1.21	1.04–1.41	0.012	1.02	0.87–1.20	0.790
	2	duration	2.22	1.68–2.94	≤0.0001	2.40	1.80–3.21	≤0.0001
		Location	1.34	1.14–1.57	≤0.0001	1.10	0.92–1.30	0.305
	3	duration	2.42	1.64–3.58	≤0.0001	2.48	1.65–3.71	≤0.0001
		Location	2.13	1.69–2.69	≤0.0001	1.75	1.37–2.23	≤0.0001
	4	duration	3.49	2.10–5.82	≤0.0001	3.44	2.04–5.81	≤0.0001
		Location	2.49	1.76–3.53	≤0.0001	2.01	1.39–2.91	≤0.0001
	5	duration	4.43	2.14–9.21	≤0.0001	4.15	1.95–8.85	≤0.0001
		Location	2.94	1.70–5.10	≤0.0001	2.53	1.42–4.50	≤0.0001
Psychosocial <sup>b</sup>	1	duration	1.87	1.45–2.40	≤0.0001	1.42	1.24–1.63	≤0.0001
		Location	1.47	1.24–1.63	≤0.0001	1.23	1.07–1.42	≤0.0001

References: “no delay of development” and “rural area”

OR Odds Ratio, 95 % CI 95 % confidence interval

<sup>a</sup> With age of children, sex, and nationality<sup>b</sup> Binary logistic regression

significantly lower under adjustment (45 and 24 %) (Table 4).

## Discussion

The Bavarian Pre-School Morbidity Survey represents an ongoing and long-term effort to explore important developmental influences in preschool children in Germany. Using this information, we designed a pooled data set of 14 consecutive years of school entry examinations to retrospectively study the impact of duration at the kindergarten and its location on the numbers of multiple delays in preschool children.

The rates of kindergarten attendance have increased in the Federal Republic of Germany almost every year since 1955 (Roßbach 2003) and in the USA between 1991 until 2005

(U.S.Department of Education and National Centre for Education Statistics 2006). This trend was reinforced in the Federal Republic of Germany by the “Right to a kindergarten place” (Social Code VIII 1990), so more and more parents accepted this offer and sent their children to kindergartens. Our results confirm this as almost all preschool children attended a kindergarten within the examined district. Furthermore, it was observed that about 94 % of all the children in the District Dingolfing-Landau had attended kindergarten for longer, which was a strong indication for the great acceptance of kindergarten care among parents.

Kreyenfeld (2004) noted that maternal employment and higher education of the mother had a positive effect, but a non-German nationality and a higher number of siblings a negative effect on the probability of visiting a kindergarten. These factors might lead to a pre-selection of study populations in statistical analyses, which is excluded in our



study due to the large and widespread acceptance of the kindergartens. The dominance of rural kindergartens is primarily due to the socio-geographical structure of the District of Dingolfing-Landau with the prevailing agricultural sector; so by definition, over 70 % of children visited the nearest kindergarten in a rural area.

The impact of kindergarten to multiple developmental delays in preschool children has not been quantitatively described in the literature in-depth. The International Primary School Reading Literacy Study (PIRLS) is a large multinational study, with a cohort of 10,571 European fourth graders in 246 elementary schools with an additional survey of children, parents and teachers (Bos et al. 2003). In a sample of the German subgroup, the authors observed that children who visited a kindergarten longer than 1 year had a significantly better average in reading performance than in children with a shorter duration. This effect was especially stronger in children from families with low socio-economic status. Similar results were obtained by Rohling (2002) in a study with children in Dortmund, in terms of so-called school readiness. In his analysis, preschool children who attended a kindergarten for more than 1 year had a significantly lower risk for unclear assessment of school readiness and for recommending a deferral. According to the analysis of Rohling (2002), it seemed that a linear relationship existed between the duration of the kindergarten attendance and school capacity. Similarly, the results of a bivariate analysis by Schöler et al. (2004) showed an association between linguistic abilities and time periods in former attendance to Kindergarten. The data suggest that the duration of kindergarten attendance for over a year brings significant advantages to an intact development in preschool children, whereas a shorter kindergarten attendance does not improve the development opportunities. These cited results were the reason to choose the cutoff point for the operationalization of the variable “duration of attending a kindergarten” like that used in our present study.

In a previous study in the same district, this cutoff point was applied in terms for calculating the effect of attending a kindergarten to singular developmental delays (Stich et al. 2006). In 6420 preschool children in this district of Lower Bavaria, children with kindergarten attendance of 1 year or less (versus longer than 1 year) had an increased risk for developmental delays in motor skills (OR: 3.95 for “fine motor skills” and OR: 4.60 for “graphomotor”) and in all five subareas of cognition (OR: 2.32 for “concentration and memory” to OR: 4.66 for “endurance”). No significant associations with the duration of attending a kindergarten and the risk for speech abnormalities and abnormalities of psychosocial development could be identified. Some years later, Caniato et al. (2010) showed that in 4005 children starting school in the same district, the overall prevalence and specific sex prevalence

decreased in motor and cognitive developmental delays with increased period of attending a kindergarten. A similar tendency was observed for the sum variable from more than one developmental delay, while for the language and psychosocial development not so clear patterns in time trends could be identified.

In reviewing these studies, which all focused on single delays in development, associations between the duration of attending a kindergarten and the numbers of combined developmental delays could be expected. In particular, in case of a shorter attendance of kindergarten, a very strong risky influence on combined delays in cognition could be postulated. In addition, these risky associations could be much weaker for combined delays in motor, speech and psychosocial development in the case of a longer stay in the kindergarten.

To our knowledge only a small number of studies investigated the influence of kindergarten attendance as an indicator for the social living circumstances of children (Cochran 1977; Olechowski et al. 2002; Sammons et al. 2004). The location of kindergarten was included in the analysis in a previous investigation by our group in the same district (Stich et al. 2006). In the time period 1997–2002, we documented a higher risk for delays in motor (OR for “rough motor skill”: 1.63 and for “fine motor coordination”: 1.23), in speech (OR: minimum with 1.20 and maximum with 2.17 in three subareas), cognition (OR: minimum with 1.27 and maximum with 2.17 in five subareas) and psychosocial development (OR: 1.31) for children attending kindergarten in an urban location. In contrast, in the present investigation we saw a significantly stronger association between multiple development delays and the risk on attending an urban kindergarten, while risks in case of attending a kindergarten in a city increased with the numbers of delays. Overall, the strength of the association between development delay with the location (rural versus urban) and duration of attendance moved in all regression models within narrow limits. This observation could be interpreted as indicating that these two investigated influence factors might have a very strong and independent impact on child development and can be only modified in narrow limits by other factors like age, sex and nationality.

The socio-demographic structure of the study area must be considered when interpreting these observed associations. We found it surprising that the differences between urban and rural location were so pronounced. We would have expected that the qualitative differences between urban and rural areas were small and for any observed associations to be minor. It may be that there is a far greater variety of behavioral and relationship-related determinants differentiating rural and urban locations. These factors have not been clearly identified or analyzed. Certainly, our

data indicate that there are significant differences in the risk factors for developmental problems between the rural and urban settings in our study area. Clearly identifying these factors and further exploring their role may have important public health implications. Further, it should be noted that the quality of care and the infrastructure of kindergartens are important factors influencing a child's development (Peisern-Feinberg et al. 2001). In our study, it is noted that we had no data on the quality and functioning of any influence factors of the kindergartens. The lack of this knowledge in our survey should be recognized.

A limitation of our analysis is that we documented only the presence or absence of delays, without assessing their severity. Also, the local nature of our data set might not necessarily be representative of other regions or countries. The strengths of our study were the complete and unselected population of preschool children utilizing consecutive vintages, a strong standardization of the instruments for school entry examinations and the same composition of the investigation team over the entire observation period, so that our results were unlikely to be affected by systematic errors.

## Conclusions

Kindergarten provides a seminal learning and developmental experience for children in the preschool period. We believe that children almost always benefit from quality kindergarten care provided over an extended period of time. Children with multiple developmental delays are likely to benefit from visiting a kindergarten in the right location, for at least a number of years to optimize their developmental opportunities. Seen from a view of public health, the setting and duration of kindergarten attendance for children with multiple delays should be an area of greater focus and attention in the future.

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## Compliance with ethical standards

**Ethical standards** The authors declare that the study comply with the current laws of the country in which the investigation was performed.

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