

RESEARCH PAPER
ARTIGO DE INVESTIGAÇÃO

Nursing and vaccination: evolution of the compliance with the combined measles-mumps-rubella (MMR) vaccine

A enfermagem e a vacinação: evolução do cumprimento da vacina combinada contra o sarampo, parotidite e rubéola

La enfermería y la vacunación: evolución del cumplimiento de la vacuna combinada contra el sarampión, la parotiditis y la rubeola

João Manuel Graça Frade*; Maria de Fátima Graça Frade**; Carolina Miguel Graça Henriques***; Armando Silva****; Guilherme Gonçalves*****

Abstract

Background: Immunization is an important activity performed by primary health care nurses in Portugal.

Objectives: This study aims to assess the evolution of the compliance with the immunization strategy for the combined measles-mumps-rubella (MMR) vaccine.

Methodology: A study was conducted with 411 individuals, born after 1970 in Portugal, by consulting immunization records (IRs) and health booklets (HBs).

Results: The vaccination coverage rate was 38.88% in cohorts born before 1977 and higher than 95% in cohorts born after 1990. The administration according to the age criteria recommended by the Directorate-General for Health (DGS) was associated with the participants' birth generation and improved over time ($r = -0.239$, $p = 0.001$).

Conclusion: In this sample, the MMR vaccine strategy complied with the objectives of the World Health Organization and DGS concerning the vaccination coverage rate and the adequacy of the immunization schedules according to the recommended age criteria.

Keywords: nurses; vaccination; Portugal; MMR

Resumo

Enquadramento: Em Portugal a vacinação é uma importante atividade dos enfermeiros que trabalham nos cuidados de saúde primários.

Objetivos: Este estudo pretende avaliar a evolução do cumprimento da estratégia vacinal da vacina combinada contra o sarampo, parotidite e rubéola (VASPR).

Metodologia: Estudo realizado a 411 indivíduos, nascidos em Portugal depois de 1970, através da consulta da ficha individual de vacinação (FIV) e do boletim individual de saúde (BIS).

Resultados: A taxa de cobertura vacinal foi de 38,88% nas coortes nascidas antes de 1977. Nas coortes nascidas depois de 1990 atingiu valores superiores a 95%. O respeito pelas idades recomendadas pela Direção-Geral de Saúde (DGS) esteve associado à geração de nascimento a que os indivíduos pertencem e foi melhorando à medida que o tempo passou ($r = -0,239$; $p = 0,001$).

Conclusão: Na amostra estudada verifica-se o cumprimento dos objetivos da Organização Mundial de Saúde e da DGS, na aplicação da estratégia VASPR, no que diz respeito à taxa de cobertura vacinal e à adequação dos esquemas vacinais às idades recomendadas.

Palavras-chave: enfermeiros; vacinação; Portugal; MMR

Resumen

Marco contextual: En Portugal la vacunación es una actividad importante de los enfermeros que trabajan en la atención primaria.

Objetivos: Este estudio pretende evaluar la evolución del cumplimiento de la estrategia de la vacuna combinada contra el sarampión, la parotiditis y la rubeola (VASPR).

Metodología: Estudio realizado a 411 individuos nacidos en Portugal después de 1970, mediante la consulta de la ficha individual de vacunación (FIV) y del boletín individual de salud (BIS).

Resultados: La tasa de cobertura relativa a la vacuna fue del 38,88 % en las cohortes nacidas antes de 1977. En las cohortes nacidas después de 1990 alcanzó valores superiores al 95%. El respeto por las edades recomendadas por la Dirección General de Sanidad (DGS) estuvo asociado a la generación de nacimiento a la que los individuos pertenecen y fue mejorando a medida que pasó el tiempo ($r = -0,239$; $p = 0,001$).

Conclusión: En la muestra estudiada se verifica el cumplimiento de los objetivos de la Organización Mundial de la Salud y de la DGS en la aplicación de la estrategia VASPR, en lo que se refiere a la tasa de cobertura de la vacuna y a la adecuación de los esquemas de la vacuna a las edades recomendadas.

Palabras Clave: enfermeros; vacunación; Portugal; MMR

*Ph.D., Adjunct Professor, School of Health of the Polytechnic Institute of Leiria. Member of the Health Research Unit of the School of Health of the Polytechnic Institute of Leiria and the Unit for Multidisciplinary Research in Biomedicine, Abel Salazar Institute of Biomedical Sciences of the University of Porto. jmfrade@ipleiria.pt. Contribution to the article: literature search, data collection, data treatment, analysis and discussion, article writing. Address for correspondence: Campus 2, Morro do Lena, Alto do Vieira, Apartado 4157, 2411-90, Leiria, Portugal.

**Ph.D., Adjunct Professor, School of Health of the Atlântica University. Member of the Center on Society, Organizations, and Well-Being (CSOB), Atlântica University, and of the Center for Public Policy and Administration (CAPP), Institute of Social and Political Sciences, University of Lisbon, 2780-096, Portugal. jfrade@uatlantica.pt. Contribution to the article: literature search, article writing, overall article revision.

***Ph.D., Adjunct Professor, School of Health of the Polytechnic Institute of Leiria. Member of the Health Research Unit of the School of Health of the Polytechnic Institute of Leiria, 2411-901, Leiria, Portugal. carolina.henriques@ipleiria.pt. Contribution to the article: literature search, article writing, overall article revision.

****MPh., Adjunct Professor, Nursing School of Coimbra. Member of the Health Sciences Research Unit: Nursing, 3008-051, Coimbra, Portugal. armandos@esnuc.pt. Contribution to the article: literature search, article writing, overall article revision.

*****Ph.D., Associate Professor with Aggregation, Abel Salazar Institute of Biomedical Sciences of the University of Porto. Member of the Unit for Multidisciplinary Research in Biomedicine, University of Porto. ggoncalves@icbas.up.pt. Contribution to the article: data treatment, analysis and discussion, overall article revision.

Received for publication: 04.01.17

Accepted for publication: 09.03.17

Introduction

In Portugal, the five decades of implementation of the National Vaccination Program (*Programa Nacional de Vacinação*, PNV) have been a success, also due to the major contribution of nurses who manage the PNV and put their efforts and commitment into its systematic and consistent implementation over time.

This study will assess the evolution of the compliance with the measles-mumps-rubella (MMR) vaccine strategy among users of the Local Health Unit (*Unidade Local de Saúde*, ULS) of Guarda and the Cluster of Healthcare Centers (*Agrupamento de Centros de Saúde*, ACES) of Pinhal Litoral, with a view to showing nurses' importance in achieving the PNV objectives regarding disease control and elimination.

It aims to assess the evolution of the compliance with the MMR vaccine strategy, since its introduction until today, concerning the fulfilment of the following objectives of the Directorate-General for Health (DGS) and the World Health Organization (WHO): adherence to vaccination, immunization according to the recommended age criteria, and immunization schedules used. The study also aims to check in what year did the vaccination coverage rate exceeded 95% in the study sample, and how the immunization schedules evolved from then on.

Background

In Portugal, nurses play a key role in achieving the PNV objectives, and vaccination is an important activity of primary health care nurses (Subtil, 2011). In the field of vaccination, nurses have shown to possess the necessary technical, scientific, ethical, and deontological skills to effectively and efficiently implement the PNV in Portugal, managing and administering it in an exemplary way and achieving a higher vaccination coverage rate than in most countries (Loureiro, 2004; Subtil, 2011). In practice, these skills translate into the administration of vaccines according to the DGS plan and guidelines, the maintenance of adherence to vaccination behaviors,

the implementation of reliable vaccination records, the epidemiological surveillance of PNV implementation, and the management of stocks (Loureiro, 2004; Subtil, 2011).

It is scientifically proven that vaccination coverage rates above 95% are a guarantee of control and possible elimination of some vaccine-preventable diseases, including measles, mumps, and rubella (DGS, 2016; Plans, 2010; Tharmaphornpilas, Yoocharuan, Rasdjarmrearnsook, Theamboonlers, & Poovarawan, 2009; WHO, 2011). Vaccination coverage rate represents the number of vaccine doses administered to the target population. As it was previously mentioned, in the case of measles, mumps, and rubella, vaccination coverage rates above 95% produce the so-called herd immunity effect that ensures protection for the entire population without 100% immunization coverage due to the difficulty of virus circulation among immunized individuals. In addition to vaccination coverage rates above 95%, it is equally important that vaccines are administered at the recommended ages in order to ensure the efficacy and effectiveness of the immune response to vaccination (Cutts, Lessler, & Metcalf, 2013; DGS, 2016; WHO, 2011).

In Portugal, the MMR vaccine was introduced to the PNV in 1987, replacing the monovalent measles vaccine that had been introduced in 1973. Initially, this vaccine (MMR I) was administered at the age of 15 months (DGS, 1990) and was later brought forward to the age of 12 months in 2012 (DGS, 2013a). A second MMR dose (MMR II) between the age of 10 and 13 years was introduced in 1990 and brought forward to the age of 5-6 years in 1999 (DGS, 1990). The cohorts of children born in 1992-1993 were the last ones to follow the MMR-II recommendation at the age of 10-13 years and the cohorts of children born in 1994-1995 were the first to follow the recommendation currently in force.

The history of the introduction of the measles vaccine in Portugal allows identifying five different, but complementary, vaccination generations. The first generation of immunized individuals was born before 1977 and did not have the opportunity to be vaccinated with two MMR doses at the

ages recommended by the DGS (1990). The second generation was born between 1977 and 1984 and had the opportunity to be vaccinated with two measles vaccine doses at the ages recommended by the DGS (DGS, 1987, 1990). This generation first received the monovalent measles vaccine and then the combined MMR vaccine, if the individuals were initially vaccinated at the age recommended by the DGS (DGS, 1987, 1990). The third generation was born between 1985 and 1990 and met the criteria to be vaccinated with two doses of the trivalent MMR vaccine, both at the recommended age for both doses. However, since these schemes were not always complied with, this generation has very heterogeneous vaccination statuses (DGS, 1987). The fourth generation was vaccinated with two measles vaccine doses, followed by the administration of the second MMR dose at the age of 10-13 years. However, this generation has more homogeneous vaccination statuses. Finally, the fifth generation is similar to the previous one, except that the second MMR dose was brought forward to the age of 5-6 years (DGS, 2011a, b, c).

Research questions

Does the sample meet the DGS guidelines for the administration of the MMR vaccine concerning adherence to vaccination, recommended ages, and immunization schedules used?

Was the MMR vaccination coverage rate in the generation born after 1990 higher than 95% and did it remain above this percentage from then on?

Methodology

This study was developed based on the consultation of the immunization records (IRs) and health booklets (HBs) of patients born after 1970 that were part of the ACS and the ULS of Guarda. Data were collected between 2012 and 2013. Through the convenience sampling method, users were selected among the individuals who attended these health units in 2012-2013. However, only users

who agreed to participate by signing the informed consent form were included in the study and only these patients' IRs and health booklets (HBs) were consulted. Individuals without their HB at the time of signing the informed consent form were asked to photocopy it and send it later by mail in pre-paid envelopes. Only individuals who were registered as users of the respective health units and whose vaccine information was recorded in at least one of the two documents (HB or IR) were included in the study. All individuals without updated vaccine information in their vaccination records were encouraged to update their immunization status.

Data processing

Data on the vaccination history were inserted into a database to be treated using the Statistical Package for the Social Sciences, version 23.0.

First, the most important variables in the study – Birth generation as independent variable and Vaccination status as dependent variable – were descriptively analyzed. Confidence intervals were set at 95%. Spearman's correlation coefficient was used to measure the degree of association between variables. Odds ratio was used in the variables where an association was found with the purpose of assessing its strength and direction, followed by the estimation of the 95% confidence intervals.

Ethical-Legal considerations

All ethical considerations inherent to a research study were followed. The Coordination of the Public Health Unit of the ACES Pinhal Litoral and the Ethics Committee of the ULS of Guarda gave their ethical approval for the development of study. All subjects gave their informed consent for participation in this study. Data were collected and analyzed by maintaining the study participants' anonymity.

Results

Due to the great heterogeneity of the vaccination statuses of the different vaccination generations identified in this study, and in

order to facilitate data analysis and interpretation, results are shown in two major groups: individuals born before 1990 and those born after this year.

Vaccination information and its source

The vaccination records of 423 male and female individuals born in mainland Portugal after 1970 were consulted. In a first analysis, 12 subjects were excluded from the

analysis because there was no vaccination information in their IRs or HBs. Thus, the final sample was composed of 411 individuals. The vaccination coverage rate was very similar to that recorded in the region and in mainland Portugal, where the rate only became exceeded 95% in at least one vaccine dose after the generation of individuals born after 1990 (DGS, 2012b,c; DGS, 2013b,c; Table 1).

Table 1
Vaccination information and its source (n = 423)

HBs	IRs		
	Yes	No	Total
Yes	159	93	252
No	159	12	171
Total	318	105	423
Vaccination coverage rate (1 dose)	Sample	Region (2013)	Portugal (2013)
Born before 1990	< 95%	< 95% ^b	< 90% ^a
Born after 1990	≥ 95%	≥ 95% ^b	≥ 95% ^a

^a DGS, 2012a; ^b DGS, 2013b, 2013c.

Vaccination status of individuals born before 1990 (n = 206)

The analysis of the vaccination status of individuals born before 1990 (Table 2) showed that, out of the 206 individuals with vaccination information, 54 (26.2% of the total sample) had no information on the measles vaccine in their vaccination records. Out of these 54 individuals, 51 (94.4%) were born between 1970 and 1984 but were not vaccinated, although the Portuguese vaccination schedule already included a dose of measles vaccine by that time (Table 2).

In this sample, 62 individuals (30.09%) had records of having taken only a single dose of the vaccine. Most of them (47; 75.8%) were born between 1977 and 1984, when the Portuguese PNV only included a single dose of

measles vaccine (Table 2).

Ninety individuals (41.3% of the total sample) had records of two doses of the measles vaccine. All of them were born after 1977, which means that they could have taken two vaccine doses by that time (Table 2).

The analysis of the evolution of the vaccination history showed that the vaccination coverage rate was 38.88% in the generation born before 1977, 76.03% in the generation born between 1977 and 1984, and 93.88% in the generation born between 1985 and 1990 (Table 2).

With regard to the age at the first dose of measles vaccine, only 3/152 (1.97%) took it before the age of 12 months, and most of them (98/152; 64.47%) took it at the age recommended by the DGS, that is, at the age of 12 to 24 months. However, 51/152 (33.55%)

took the vaccine after the age of 24 months (Table 2).
 With regard to the age at the second dose,

74/90 individuals (82.22%) took the second vaccine dose at the age recommended by the DGS in the PNV (10-13 years; Table 2).

Table 2

Distribution of the study subjects' MMR vaccination status according to year of birth and age at first and second vaccine doses

Variables	Groups	No. of measles doses			Total	Vaccination coverage rate
		0	1	2		
Years of birth	Before 1977	22	14	0	36	38.88%
	1977-1984	29	47	45	121	76.03%
	1985-1990	3	1	45	49	93.88%
	Total	54	62	90	206	
Age of 1 st dose	Before 12 months		0	3	3	
	12 to 24 months		29	69	98	
	After 24 months		33	18	51	
	Total		62	90	152	
Age of 2 nd dose	Before 10 years			12	12	
	Between 10-13 years			74	74	
	After 13 years			4	4	
	Total			90	90	

Analysis of the evolution of the compliance with the vaccination schedule in the sample of the generation born between 1970 and 1990

Over time (cohorts born more recently), the age at first dose drew closer to the time interval between 12 and 24 months ($r = - 0.239$; $p = 0.001$; see Table 3). However, it seems that there were no changes over time in terms of the compliance with the age at the second dose of measles vaccine in this sample, since the recommended age at second dose was always complied with throughout this period ($r = 0.162$; $p = 0.122$; Table 3).

On the other hand, the vaccination schedule was strongly associated with the birth cohort ($r = 0.684$; $p = 0.038$). Most of the individuals born before 1977 complied with the vaccination schedule: Measles I 13/14 (92.85%). Most of those born between 1977 and 1984 took the Measles I 22/92 (23.91%), others took the MMR I 25/92 (27.1%), and others the Measles I - MMR I 39/92 (42.39%). Most of individuals born after 1984 took the MMR I - MMR II 35/46 (76.08%; Table 3), which corresponds to the recommendations of the PNV in force for each of these generations.

Table 3
Compliance with the MMR vaccination schedule in the sample over time

Variables	Groups	Birth cohorts			p^a r^b	Total
		Before 1977	1977-1984	1984-1990		
Age of 1 st dose	Before 12 months	0	1	2	0.001^a - 0.239^b	3
	12 to 24 months	10	52	36		98
	After 24 months	4	39	8		51
	Total	14	92	46		152
Age of 2 nd dose	Before 10 years	0	7	5	0.122^a 0.162^b	12
	Between 10-13 years	0	38	36		74
	After 13 years	0	0	4		4
	Total	0	45	45		90
Immunization schedule used	Measles I	13	22	0	0.038^a 0.684^b	35
	MMR I	1	25	1		27
	Measles I and Measles (II) MMR I	0	39	10		49
	MMR I and MMR II	0	6	35		41
	Total	14	92	46		152

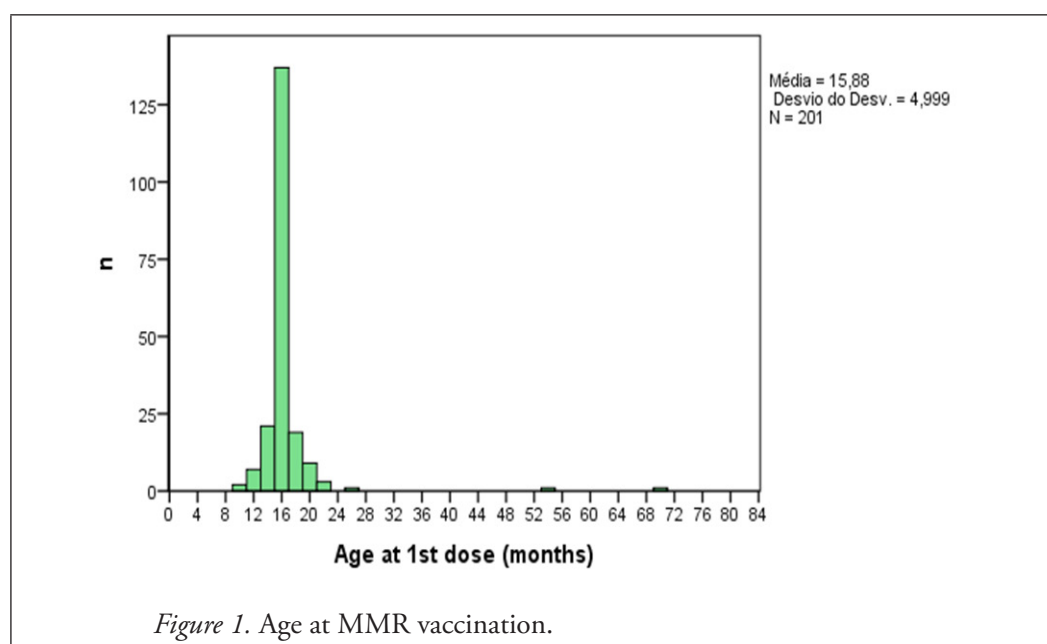
^a p of Spearman's correlation coefficient; ^blevel of significance of Spearman's correlation coefficient.

Vaccination status of individuals born after 1990 ($n = 205$)

In this group, all subjects were vaccinated with the MMR vaccine. Table 4 describes in detail the distribution of the groups of individuals according to the vaccination schedule (age at first and second doses) and the vaccination coverage rate.

Age at first dose

In the group of individuals born after 1990, both in the generations born before and after 1993, most individuals 196/205 (95.61%) took the MMR I at the age recommended by the DGS (12 to 24 months of age; Figure 1). The vaccination coverage rate for the first dose was 95.51% in the cohort born before 1993, and 100% in the cohort born after 1993 (Table 4).



Age at second dose

Most individuals born before 1993 took the MMR II at 10-13 years of age 67/89 (75.28%) and those born after 1993 took the MMR II at 5-6 years of age 106/116 (91.38%). However, 12 individuals born before 1993 and one born after 1993 took the

vaccine between 7 and 9 years of age, which does not correspond to any vaccination strategy. The vaccination coverage rate for the second dose of the measles vaccine was 91.01% in the generations born between 1990 and 1993, and 95.68% in the generation born after 1993 (Table 4).

Table 4

Age at MMR-I and MMR-II vaccination according to the vaccination generation

Variable	Age at MMR vaccination:	Vaccination generation		Total
		Born in and before 1993	Born after 1993	
Age at 1 st dose	< 12 months	0	2	2
	12 to 24 months	84	112	196
	≥ 24 months	1	2	3
	Not vaccinated	4	-	4
Total		89	116	205
Vacc. cov. rate (%)		95.51%	100%	
Age at 2 nd dose	5-6 years	2	106	108
	7-9 years	12	1	13
	10-13 years	67	4	71
	Not vaccinated	8	5	13
Total		89	116	205
Vacc. cov. rate (%)		91.01%	95.68%	

Discussion

Vaccination status of individuals born before 1990

Over time, the vaccination coverage rate of the MMR strategy increased in this sample from just over 30% to more than 95%, since the introduction of the measles vaccine in 1973 (DGS, 2016).

Age was associated with the vaccination coverage rate. Younger generations have a higher number of vaccine doses, having taken the doses at the ages recommended by the DGS. These data are similar to other regions in Portugal and abroad, where the measles vaccine has been systematically applied since its introduction (DGS, 2016; Plans, 2010; Tharmaphornpilas et al., 2009).

The vaccination schedules in force for individuals born before 1977 recommended one dose of the monovalent measles vaccine in the second year of life; the MMR was not part of the recommended schedule for this age group. This group has the highest proportion of non-vaccinated individuals 22/36 (61.11%) and none of them received two vaccine doses. Of the 14 individuals who took the measles vaccine, 10 were vaccinated in the second year of life, four after that age, and 13 took the former measles vaccine. Based on the schedule recommended at the time, individuals born between 1977 and 1984 would have received the former measles vaccine in the second year of life and the MMR in adolescence; 29 of these individuals were not vaccinated 29/121 (23.9%).

In the group of individuals born between 1977 and 1984, 92/121 (76.03%) took at least one vaccine dose. The four possible vaccination schedules were complied with, beginning with the measles vaccine or the MMR. The ages at first and second doses depend on this schedule. Although the vaccines were administered at the recommended ages in most cases, this generation has the highest proportion of *late* first doses (after 24 months of age). The late doses may correspond to additional vaccination campaigns and efforts carried out by health professionals with the purpose of increasing adherence to vaccination (Subtil, 2011).

Among individuals born after 1984 (based

on the recommended schedule, they would have taken two vaccine doses, beginning with the measles vaccine or MMR, before or after 1987), only three were not vaccinated at all and one took a single dose. Most of them took two vaccine doses 45/49 (91.84%) based on two possible combinations: Measles vaccine and MMR, or MMR I and MMR II, depending on the vaccine available at the time in the PNV. In most cases, both doses were administered at the recommended ages.

Vaccination status of individuals born after 1990

Almost all individuals born after 1990 are vaccinated with two doses of MMR (vaccination coverage rate is very close to 100% for the first and second MMR doses), which indicates a compliance with DGS (2011a,b,c) and WHO (2011) guidelines with the purpose of eliminating measles by maintaining vaccination coverage rates above 95% in the entire population.

In comparison to those born before 1990, the individuals in this group are more and better vaccinated. In other words, the vaccination coverage rates are higher and complied better with the ages of vaccination recommended by the DGS.

DGS data (DGS, 2012b) confirm that the measles vaccination coverage in Portugal is above 95% for the first dose since at least 1990 and 95% for the second dose since at least 2006.

With regard to the compliance with the recommended ages for the administration of the first and second vaccine doses, a large percentage of individuals born after 1990 complied with the ages recommended by the DGS (DGS, 2012a,b,c), with an age average of 15 months for the first dose, and 5-6 years and 10-13 years for the second dose in groups born after 1993 and before 1993, respectively.

In 1990, when the DGS recommended the administration of a second vaccine dose (MMR II) at the age of 10 to 13 years, individuals born between 1990 and 1993 should have followed this strategy. Indeed, most of them followed 66/81 (81.5%); however, two individuals born in this cohort antici-

pated this dose and took it at 5-6 years of age, and 13 individuals took it at the ages of 7 to 9 years, which does not correspond to any of the DGS guidelines. In the first case, this anticipation can be explained by the fact that both individuals were vaccinated outside of Portugal, namely in Brazil and Canada, where the second vaccine dose was probably taken at 5-6 years of age in those birth cohorts. In the second case, it may be related with vaccination opportunities, since the vaccine was administered very close to 10 years of age – of the 13 subjects, 11 took the vaccine at the age of 9 and two took it at 8.42 and 8.46 years of age, which is very close to the age of 10. These children probably attended healthcare center for another reason and took the opportunity to take the vaccine.

Individuals born after 1993 should have been the first ones to take the second vaccine dose at 5-6 years of age. In fact, in this sample, the majority of individuals born between 1990 and 1993 took the second vaccine dose at the age of 10 to 13 years, and individuals born after 1993 took the second vaccine dose when they were 5-6 years old, which is in line with the DGS guidelines in its various notices (DGS, 1987, 1990, 1999, 2001). However, three individuals born after 1993 still took the vaccine according to the old strategy (at the age of 10 to 13 years) and one individual took it at 9 years of age, probably because they lost the first opportunity to be vaccinated when they were 5-6 years old and were then vaccinated in their second vaccination opportunity at the age of 9 to 13 years.

The data in this study are in line with data from the region where the sample was selected (DGS, 2013b,c) and from mainland Portugal (DGS, 2012a). The main limitations of this study relate to the fact that the convenience sample is not representative of the entire population. For this reason, these results should be generalized to the Portuguese population with caution. However, it should be noted that the results obtained in this sample were similar to the national statistics, namely regarding the vaccination coverage rates and the general characteristics of the sample. In addition, the vaccination

information resulted from the consultation of reliable and detailed vaccination records (IRs and HBs).

Conclusion

In this sample, which covers 20 years of vaccination history, the measles vaccination coverage rate increased from just above 30% for the first dose in the generations born in the 1970s to above 95% for the first and second doses in the generations born after 1993. Individuals' age and the corresponding years of birth influenced their vaccination status. Younger generations are more and better vaccinated. As the MMR strategy was applied in Portugal, the vaccination coverage rate increased for both vaccine doses, as well as the compliance with the ages for the first and second vaccine doses in accordance with the several DGS guidelines in its various notices. The immunization of older generations (born before 1984) started with the monovalent measles vaccine, whereas the newer generations (born after 1984) started to be vaccinated with the trivalent MMR vaccine. However, some individuals born before 1984 were vaccinated with MMR, which represents an additional effort to raise the vaccination coverage rate to the extent that most of these individuals were vaccinated at the age of 15 months or older. This was a result of the complementary strategies to fight measles which were developed in Portugal over time. The vaccination coverage rate above 95% for both vaccine doses found in the younger groups (born after 1990) indicates the country's compliance with the goals of eliminating measles, mumps and rubella by maintaining the vaccination coverage rate above 95%.

The levels of health promotion and disease prevention achieved in Portugal through the high adherence to vaccination have turned the country into a worldwide example of implementation of vaccination programs, with results that are only comparable to the distribution of drinking water to the populations. This objective was only achieved thanks to the contribution of the nurses working in the immunization area in Primary Health

Care in Portugal. Besides vaccinating people, nurses have also encouraged high levels of adherence to vaccination by administering vaccines at the ages recommended by the DGS and performing epidemiological surveillance in the application of the PNV. The importance of this study is evidenced in the retrospective analysis of the compliance with the objectives of the DGS and WHO for the implementation of the vaccine to protect against measles, mumps, and rubella in Portugal, and also in the study of nurses' contributions towards the achievement of those goals. At a time when anti-vaccination movements begin to emerge all over the world, the development of interventions, activities, and strategies to promote the adequate maintenance of high vaccine coverage rates is essential, because vaccination coverage rates above 95%, along with the administration at the recommended ages, seem to be the best method to control and eliminate the diseases targeted in the PNV. Within this scope, nurses have been and will certainly continue to be essential in maintaining this goal.

References

- Cutts, F. T., Lessler, J., & Metcal, C. J. (2013). Measles elimination progress: Challenges and implication for rubella control. *Expert Review of Vaccines*, 12(8), 917-932. doi: 10.1586/14760584.2013.814847
- Direção-Geral da Saúde. (1987). *Programa de vacinação contra a parotidite epidémica* (Norma de Serviço / DTP, 12/2/1987). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (1990). *Normas de vacinação do programa nacional de vacinação* (Circular Normativa 10 DTF, 04/09/1990). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (1999). *Programa nacional de vacinação 2000: Orientações técnicas* (Circular Normativa Nº 09/DT, 21/12/1999). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2001). *Programa nacional de vacinação*. Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2011a). *Recomendações para a prevenção da transmissão de sarampo nas unidades de saúde* (Circular Normativa 01/2011 de 07/06/2011a). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2011b). *Vacinação complementar contra o sarampo* (Circular Normativa 011/2011 de 07/06/2011b). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2011c). *Normas de vacinação: Reforço da vigilância epidemiológica e controlo do sarampo* (Circular Normativa 012/2011 de 07/06/2011c). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2012a). *Programa nacional de vacinação: Normas de vacinação* (Circular Normativa 04/2011 de 26/01/2012). Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2012b). *Programa nacional de eliminação do sarampo 2012*. Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2012c). *Boletim de vacinação*. Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2013a). *Programa nacional de eliminação do sarampo 2013*. Lisboa, Portugal: Autor.
- Direção-Geral da Saúde. (2013b). *Sistema de informação nas unidades de saúde (SINUS)*. Pinhal, Portugal: Agrupamento de Centros de Saúde do Pinhal Litoral, Centro de Saúde Arnaldo Sampaio.
- Direção-Geral da Saúde. (2013c). *Sistema de informação nas unidades de saúde (SINUS)*. Guarda, Portugal: Unidade Local de Saúde da Guarda, Centro de Saúde do Sabugal.
- Direção-Geral da Saúde. (2016). *Programa nacional de vacinação: Avaliação 2015*. Lisboa, Portugal: Autor.
- Loureiro, H. (2004). Eficácia em vacinação: Elementos essenciais na prática de enfermagem. *Referência*, 12, 62-72.
- Plans, P. (2010). Prevalence of antibodies associated with herd immunity: A new indicator to evaluate the establishment of herd immunity and decide immunization strategies. *Medical Decision Making*, 30(4), 438-443. doi: 10.1177/0272989X09353453
- Subtil, C. L. (2011). Os primórdios da organização do Programa Nacional de Vacinação em Portugal. *Revista de Enfermagem Referência*, 3(4), 167-174. doi: 10.12707/RIII11HM2
- Tharmaphornpilas, P., Yoocharean, P., Rasdjarmrearnsook, A., Theamboonlers, A., & Poovarawan, Y. (2009). Seroprevalence of antibodies to measles, mumps, and rubella among Thai population: Evaluation of measles/MMR immunization programme. *Journal of Health Population and Nutrition*, 27(1), 80-86. doi: 10.3329/jhpn.v27i1.3320
- World Health Organization. (2011). *Measles outbreaks: Regions of the Americas, Europe and Africa*. Retrieved from http://www.who.int/csr/don/2011_10_07/en/