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Vaccination coverage in French 17-year-old young adults: an assessment of mandatory and recommended vaccination statuses

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SUMMARY

We aimed to assess vaccination coverage (VC) in 17-year-old French young adults (YAs) participating in one mandatory Day of Defence and Citizenship (DDC). Between June 2010 and May 2011, YAs participating in 43 randomly selected mandatory sessions of the DDC programme in Poitou-Charentes (France) were asked to provide their personal vaccination record. Tetanus, diphtheria, polio, hepatitis B, *Haemophilus influenzae* b, pertussis, measles, mumps and rubella vaccination status were assessed at ages 2, 6, 13 and 17 years. Of 2610 participants, 2111 (81%) supplied documents for evaluation. Of these, 1838 (87%, M:F sex ratio 0·96) were aged 17 years (9% of the global population of this age in the area). The assessment of the 17-year-olds demonstrated the following rates of complete vaccination: diphtheria-tetanus-polio 83%; measles, mumps and rubella 83%; pertussis 69%; *H. influenzae* b 61%; human papillomavirus 47%; and hepatitis B 40%. At age 6 years, only 46% had received two doses of the vaccine against measles. The YAs were not aware of their status but were in favour of vaccination. VC in YAs is insufficient, particularly for hepatitis B, pertussis and measles. Combined vaccines and the simplification of vaccination schedules should improve VC. Preventive messages should focus on YAs.

Key words: Coverage, vaccination, young adults.

INTRODUCTION

In France, vaccination guidelines distinguish between mandatory vaccinations, such as diphtheria, tetanus and poliomyelitis vaccines (DT-IPV), and recommended vaccinations, including *Haemophilus influenzae* b (Hib), hepatitis B, human papillomavirus (HPV), measles, mumps and rubella (MMR), pertussis, meningococcal and *Streptococcus pneumoniae* vaccines. The reimbursed infant vaccines available in France include trivalent (DT-IPV), tetravalent (adding pertussis) and pentavalent (adding Hib) vaccines. A hexavalent vaccine (adding hepatitis B) has been added to the reimbursed list in recent years, but has only been used on a large scale since 2008.

A recent and large measles outbreak has highlighted that the low vaccination coverage (VC) rates

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in adolescents and adults accounted for more than half of the cases [1]. Young adults (YAs) do not frequently consult general practitioners (GPs) for reasons other than specific diseases, certificate establishment and contraception. This population is considered to be difficult to reach for vaccination. It is important to target this age group in order to update vaccinations before they leave their parents' home and change their way of life.

While available data on VC rates in YAs concern wide age groups, specific data focusing on 17-year-olds are limited [2]. Moreover, these data have typically been produced via surveys that did not use random sampling designs [3] as required in order to provide sample representativeness; thus, the findings may not be generalizable to the target population of YAs.

In France, each 17-year-old YA is required to participate in a day of the Day of Defence and Citizenship (DDC) programme. These DDCs appear to be good opportunities to obtain generalizable data regarding VC rates in this population. The DDCs recruit all YAs of a specific age range over a 1-year period. Thus, surveys performed during these DDCs allow for the coverage of the entire age group, regardless of gender, socioeconomic, educational or occupational characteristics. The data concerning VC collected during these DDCs appears therefore to be generalizable to the entire regional 17-year-old YA population.

The main objective of this regional random survey was to assess the VC rates for mandatory and recommended vaccinations in YAs. The secondary objective was to assess the YAs' knowledge about and perception of vaccination.

MATERIAL AND METHODS

Each military area organizes several DDCs each year on military grounds. These DDCs are mandatory. There is a 90% participation rate. Participants receive information about national defence, civic duties and first aid, and their basic education is evaluated. The source population included every 17-year-old YA who participated in a DDC from June 2010 to May 2011 in the Poitou-Charentes region of France. The sampling was designed to obtain significant accuracy and optimal representativeness of the collected data, particularly with regard to VC. Based on the size of the 17-year-old target population (20 556 people) and the desired accuracy (±2%), the number of subjects required was estimated to be 2150 YAs. Representativeness of all of 17-year-olds in the region was achieved by stratification according to the 10 geographical DDC recruitment areas. Thus, according to the number of young people recruited for the DDCs, it was possible to define the number of inclusions required for each DDC site in order to obtain a representative sample. The DDCs at which the data collection was performed were randomly sampled from the programme established by the Office of the National Service (ONS) of Poitiers.

A letter was sent to every YA through the ONS a few days before the DCCs, asking them to provide their health records or a copy thereof. Data regarding vaccination status and immunization date were collected from the health records. A structured questionnaire collected data on the YAs' sociodemographic characteristics as well as their beliefs and knowledge about vaccination. This questionnaire was completed by each YA and recovered 20 min after the participants began completing the questionnaire, regardless of whether it was completed or not.

The bacillus Calmette-Guérin, DT-IPV, pertussis, Hib, MMR, hepatitis B and HPV vaccination statuses were analysed. HPV VC was assessed only in girls, as French guidelines recommend this vaccination only for the female population. VC status was assessed at age 17 years for all of the vaccines studied. A 17-year-old YA was considered up-to-date on vaccination status when s/he had received the full number of doses recommended by the immunization schedule, regardless of when the vaccinations were performed (Table 1). The available data also allowed the retrospective establishment of a chronological account of VC and the determination of VC status at ages 2, 6 and 13 years. The data collection was performed with the approval of the director of the National Health Service.

Descriptive statistics and 95% confidence intervals are given according to the type of vaccine. The χ^2 test was used to identify statistically significant differences according to sex and geographical area. Approval for this study was given by the French Commission for Data Protection (Commission Nationale de l'Informatique et des Libertés).

RESULTS

Between June 2010 and May 2011, 43 DDCs were randomly selected from the 300 annually organized DDCs. In total, 2610 YAs participated in the 43 selected DDCs; 2111 (81%) supplied the documents necessary for the evaluation, and of these participants, 1838 (87%, M:F sex ratio 0·96) were aged 17 years. VC was

Table 1. *Recommended immunization schedule (France, 2010–2011)*

	Age			
	2 years	6 years	13 years	14 years
Bacillus Calmette-Guérin	1 dose			
Haemophilus influenzae b	4 doses			
Pertussis	4 doses		5 doses	
DT-IPV	4 doses	5 doses	6 doses	
Measles, mumps, rubella	1 dose	2 doses		
Hepatitis B	3 doses			
Human papillomavirus				3 doses

DT-IPV, Diphtheria, tetanus, poliomyelitis.

Table 2. *Vaccination coverage rates in 17-year-old young adults*

	Coverage rate (%)	95% CI
Bacillus Calmette-Guérin	92·7	91·4–93·8
Haemophilus influenzae b	61·1	58·8–63·3
Pertussis	73·5	71·4–75·5
DT-IPV	88·3	86·7–89·7
Measles, mumps, rubella	84·8	83·0–86·4
Hepatitis B	42·0	39·7–44·2
Human papillomavirus	47·3	44·1–50·6

CI, Confidence interval; DT-IPV, diphtheria, tetanus, poliomyelitis.

assessed in 1838 YAs who represented 9% of the general population of this age in the Poitou-Charentes region.

The documents provided were original health records ($n = 1090$, 59%), copies ($n = 609$, 33%), or other documents ($n = 139$, 8%). These YAs were born between 1993 and 1994. The distributions of gender and area of residence were very similar to those of the entire population.

The VC rates are reported in Table 2.

Mandatory vaccinations

The VC rates for DTPolio were all about 90% (Table 2). While the VC rates were about 90% in 2-year-old children and 17-year-old YAs, the evaluation of 6-year-olds revealed a decreased VC (Fig. 1).

Recommended vaccinations

The VC rates for the non-compulsory vaccinations were as follows: MMR (84·8%); Hib (61·1%); and hepatitis B (42·0%). No differences based on sex or geographical area were observed. HPV vaccination was introduced in France in 2007 and is recommended for 14-year-old girls or during the first year following the initiation of sexual activity. Thus, these 17-year-old YAs were targeted for this type of vaccination. The VC rate against HPV was 47·3%.

Awareness regarding vaccination

Eighty-six percent of YAs had a favourable opinion about vaccination, and 38% were wary of the side-effects of vaccination. While the VC rates for tetanus, diphtheria and poliomyelitis were equal and about 90% because these vaccines are included in the same vaccination, only 76% and 15% of YAs stated that they had been vaccinated against tetanus and diphtheria, respectively.

DISCUSSION

We report a full assessment of VC in 17-year-old YAs. This study includes a large representative sample of a homogenous regional population and provides original data that suggest that VC rates are largely insufficient regarding many vaccines, particularly the hepatitis B vaccine.

Despite methodological and target population differences, the vaccination rates observed in our study are in accordance with most previous results [4–6].

In 17-year-old YAs, the tetanus VC rate was highest, although it was still below the expected level. Pertussis remains a concern in France. These YAs should receive a complete schedule for this preventable disease in order to protect infants and the elderly. The hepatitis B VC rate is very low. In countries in which school-based programmes are utilized, VC against hepatitis B is elevated to 80% [7]. This result should interest healthcare professionals and YAs because hepatitis B remains frequent in Europe, particularly in southern and southeastern countries, and in intravenous drug users [8]. This low VC rate can be explained by the debate that took place in France in the 1990s which suggested that vaccines might be linked to the occurrence of multiple sclerosis. Although no data have confirmed any statistical link between the hepatitis B vaccine and multiple sclerosis, healthcare professionals do not widely recommend this vaccination. Moreover, school-based vaccination programmes were interrupted in 1998. A recent study demonstrated that the VC rates for hepatitis B

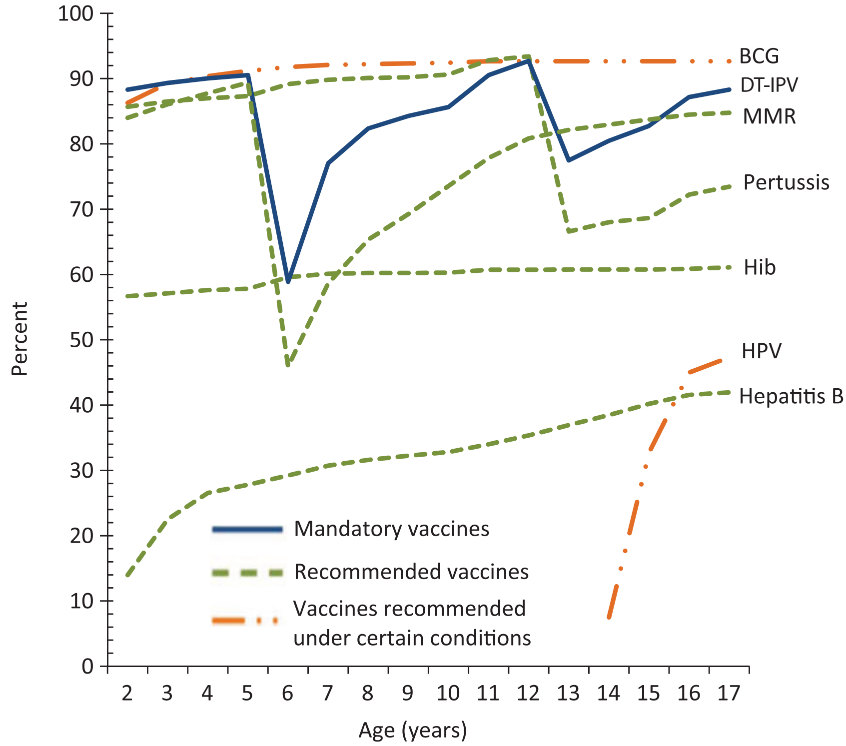

Fig. 1. Retrospective follow-up of vaccination coverage rates by age (%). BCG, Bacillus Calmette-Guérin; DT-IPV, diphtheria, tetanus, poliomyelitis; MMR, measles, mumps, rubella; Hib, *Haemophilus influenza* b; HPV, human papillomavirus.

are very low (38%) in 6-year-old children in France; these rates exceed 50% in only two areas and are <30% in seven of 26 areas [5]. Moreover, hepatitis B VC depends on social context. The VC rates are lower in rural areas and higher in cities with >20 000 inhabitants [8]. Increasing the use of these vaccines thereby improving VC rates would be helped by reimbursement for combined vaccines, including hepatitis B vaccine. A trend of increasing VC rates has been noted between 2003–2004 and 2006–2008 in 6-year-old children [5]. Recent data in the United States demonstrate that even in states where no debate occurred concerning immunization against hepatitis B, VC remains low (25%) in adults aged 19–49 years [9].

The measles VC rate was 83%. Given that herd immunity requires a 95% VC rate, the observed measles VC was able to at least partially explain the large outbreak that recently occurred in Europe and particularly in France. The resurgence of measles in Europe is the result of the accumulation of a susceptible population over the last few decades. In 2-year-old European children, the percentage of infants who have been vaccinated with the first dose against MMR increased from 84% in 2000 to 90% in 2010 [10]. A recent study suggests that in German YAs, VC is largely below the 95% objective defined by WHO [11].

In France, MMR coverage (two doses) increased from 66% in 2004 to 84% in 2009 in 15-year-old children [1]. VC rates have been assessed in French healthcare students (median age 23 years, range 21–24) and found to be 79·3% for one injection and 49·6% for two injections [12]. More than 23 000 cases were observed in France during the 2008–2011 measles outbreak, and half of the patients were teenagers and adults. This resurgence was due to the absence of the second dose of measles vaccine, which has been recommended in France since 1997. The VC for a single dose is < 90% at 24 months, and < 65% for the second dose in 15-year-olds [13]. Our results suggest that efforts to increase vaccination should focus on adolescents and YAs to meet the 2015 measles elimination target.

The rubella VC rate was higher than that for measles and mumps. This result suggests that some YAs, particularly girls, benefit from rubella immunization assessments and, when necessary, from rubella vaccinations before pregnancy. The availability of monovalent vaccines for rubella is likely to be responsible for

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this difference. Simultaneous assessments of the status of measles and pertussis immunizations might improve the MMR and pertussis vaccination rates, and this information could be made available to GPs.

The HPV VC rate has increased over the years, and the observed rate is similar to or even higher than those that have previously been reported. In the United States, coverage in girls aged 13–17 years was 32% in 2010 [14]. Canada's school-based HPV vaccination programme is associated with an encouraging upward trend, although coverage remained below the benchmark of 80% within 2 years of the implementation of the programme [15]. Coverage estimates in European countries in which HPV is included in the national immunization schedules range from 17% in Norway to 81% in the UK [16]. In southeastern France, only 35% of girls aged 14–16 years have received one dose of HPV vaccine and 69% of this age group have received the three recommended doses [17]. Recent data suggest that even in states that have the recommended HPV vaccination for both the male and female population, disparities may exist in HPV immunization levels depending on the area of residence [18]. Nevertheless, higher rates have been observed in countries with school-based vaccination programmes [19].

The VC rates in YAs are insufficient, especially those for hepatitis B, Hib, and measles. Combined vaccines should improve VC. Health insurance reimbursements should also improve VC, particularly for the hepatitis B vaccine.

The VC rates were high and adequate in 2-year-old children. This is primarily due to the compulsory nature of clinical assessments from birth to age 2 years, and the fact that children cannot be admitted to day nurseries if they have not received compulsory vaccines (i.e. DT-IPV). In contrast, VC rates declined in 6-year-old children. These data suggest that GPs and parents are aware of the need for vaccination in pre-school children when the vaccinations are performed during clinical examinations, which are systematically performed until age 2 years. Nevertheless, after the age of 2 years, VC is not sufficient. The simplification of the vaccination schedule introduced in 2013 should improve VC rates in children and adolescents aged 6–15 years.

Data regarding vaccination awareness confirm that, despite national information campaigns, YAs are not aware of their VC status. Moreover, the YAs did not know that vaccines were available. Other studies have suggested that parents and YAs believe that GPs are in charge of VC. By contrast, even if side-effects remain a concern for many YAs, no precise barrier against vaccination was perceived, as 86% of the YAs were in favour of vaccination. These data emphasize the fact that YAs are a receptive population for messages concerning vaccination. The data also underline the necessary role of GPs who should be the driving force behind an increase in adolescent and YA vaccinations. GPs should be aware of the interest in updating vaccinations among YAs. They should leverage each opportunity to update vaccinations, e.g. certification for sports, trauma, contraception, etc., before these YAs change their lifestyle and leave their parents' homes. Continued medical education should emphasize the importance of vaccination in this population. School-based vaccination programmes should also be promoted, since YAs do not regularly consult their GPs.

The main strength of our study is that it provided data regarding a large representative sample of 17-year-old YAs. Very few studies have provided precise population-based estimates of VC in YAs [20]. The high response rate (81%) of our study increases the value of these data, even if the 20% of YAs who did not supply health records might have the lowest VC rates. Nevertheless, the VC rates that were retrospectively assessed at age 2 years were similar to those reported in previous studies [5, 21]. This finding suggests that an information bias was unlikely in this study. Moreover, the data collected in this study were proven by certified documents rather than being based only on patients' statements, which excluded memory errors.

DDCs are a major opportunity to survey VC in YAs and to deliver messages related to vaccination and preventive measures. Regional health agencies intend to use the same methods to extend this survey to the entire national territory. VC rates are largely insufficient in the 17-year-old population, although these YAs are willing to accept vaccinations; thus, preventive messages from health authorities and measures for vaccination updates should target this population of adolescents and YAs, as they are on the verge of changing their lifestyle and becoming fully-fledged adults.

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DECLARATION OF INTEREST

None.

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