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Assessment of participation biases for a confidential non-anonymous adolescent study: A based population study

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ABSTRACT

A prospective study often receives a low participation rate that may alter the results quality. This study assessed the participation bias for a confidential non-anonymous adolescent survey among 1559 middle-school adolescents from north-eastern France (mean age 13.5 ± 1.3). They completed an anonymous questionnaire gathering demographic/socioeconomic features as well as school, behavior and health-related difficulties, and adolescent's assent to participate with perceived parents' consent (APC) if they were contacted for a confidential non-anonymous survey at home. Such a survey received an APC of 60%. The logistic model including all socioeconomic factors and school, behavior and health-related difficulties showed that the adolescents with APC were less often male (adjusted odds ratio = 0.77, $p = 0.014$), non-European immigrant (0.48, $p = 0.016$), living with a single parent (0.72, $p = 0.046$), in manual-worker families (0.69, $p = 0.007$), had less often low parents' education (0.70, $p = 0.002$), body-mass-index measurement refusal (0.60, $p = 0.010$), no regular physical/sports activity (0.70, $p = 0.035$), poor social relationships (0.73, $p = 0.046$) and poor living environment (0.63, $p = 0.007$). The percentage of subjects with APC steadily decreased with the number of these criteria: from 74% for 0 criterion to 19% for 6–8 criteria. Because of these possible strong participation biases the construction of adolescent cohorts and the results interpretation should be made with prudence.

1. Introduction

Early adolescence (10–16 years) is a crucial period of physical, mental and cognitive development, and a transition period from the total social and economic dependence to relative independence with more contacts and exchanges with others and more access to substance use. It corresponds to the mean age of onset of school, behavior and health-related difficulties (Chau et al., 2016, 2018; Dishion et al., 2010; Hibell et al., 2004; Mayet et al., 2012; Swahn et al., 2012) and the risk is higher in the adolescents living in non-intact families and low socioeconomic background (Chau et al., 2013; Choquet et al., 2008; Legleye et al., 2012). Hence, it is important to assess various problems and their determinants in early adolescents.

Cross-sectional adolescent studies generally receive a high participation rate (>80%) when they were conducted in adolescent collective environments such as schools and used anonymous questionnaires (Legleye et al., 2011, 2012; Hibell et al., 2004; Swahn et al., 2012). However, the association between risk factors and outcome variables cannot be interpreted in terms of causal relationship. Prospective studies with longitudinal follow-up may include self-administered questionnaires at home. Although, the study protocol can guarantee the confidentiality and the anonymity of data, the adolescents and their parents could be mistrustful, and the adolescents may fear that their parents know their responses. Furthermore, a longitudinal follow-up asks more efforts from the participants and their parents. In the literature, prospective population-based studies would be rare in adolescents contrarily to those in adults. Hence, the participation risk patterns and biases may remain unknown.

In France, studies in adolescents under 18 years should receive parents' consent while adolescent's assent to participate is also necessary (Baines, 2011). The participation rate may be insufficient and may lead to strong participation biases. Regarding parents' consent, some strong biases may be expected. Indeed, some adult studies (in 30-39-year-old Swedish people from the Göteborg (Bergstrand et al., 1983), 40-46-year-old Norwegian people from the Hordaland County (Knudsen et al., 2010) and in 45-46-year-old individuals in the United States (Shahar et al., 1996)) found a participation rate of 63-68% while some others (in Danish women (Jacobsen et al., 2010), Finnish

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working-aged population (Korkeila et al., 2001), 16^{+}-year-old people in north-eastern France (Lemogne et al., 2012) and in 25-74-year-old people in West Sweden (Strandhagen et al., 2010)) a participation rate of 30–44%. These studies (Bergstrand et al., 1983; Jacobsen et al., 2010; Knudsen et al., 2010; Korkeila et al., 2001; Shahar et al., 1996; Strandhagen et al., 2010) and two other studies (in 35-50-year-old employees of the national electricity and gas company in France (Goldberg et al., 2001) and in 35-64-year-old people in 21 countries (Tolonen et al., 2005)) reported that the non-participation was not a random event but associated with a wide range of factors including male gender, older ages, low educational level, being unmarried, divorced or widowed, living alone, low socioeconomic status, unemployment, being non-European immigrant, low income, substance use, poor physical activity, higher body mass index, mental disorders, personality disorders, sick leave, being on disability pension. Two studies found a higher participation rate in men (Jacobsen et al., 2010; Goldberg et al., 2001). A birth cohort study in infants in Paris showed that the mothers with a low socioeconomic status were less likely to participate (Clarisse et al., 2007).

Because behavior and health-related difficulties in early adolescents often continue or are aggravated into late adolescence (Dishion et al., 2010; Legleye et al., 2011, 2012; Hibell et al., 2004; Swahn et al., 2012) and then into adulthood (Bevilacqua et al., 2018; Castellvi et al., 2017; Piehler et al., 2012), we hypothesize that adolescents' non-participation in cohort studies may include some similar determinants than those in adult studies. However, early adolescents and adults would not experience similarly various problems. In absence of available data, we hypothesize that potential barriers may include a wide range of socioeconomic adversities and school, behavior and health-related difficulties (such as low academic performance, school dropout ideation without qualification, substances use, obesity, lack of physical/sports activities, poor physical health, poor psychological health, poor social relationships, poor living environment, sexual abuse, depressive symptoms, suicide ideation, and suicide attempt). Indeed, these difficulties may alter brain development, attention, memory, processing speed, visuospatial functioning and executive functioning, cognitive ability and work performance (Cross et al., 2017; Harvey et al., 2005; Meruelo et al., 2017; Suhrcke et al., 2011).

This study led in north-eastern France aimed at to explore the associations between the previous socioeconomic factors and school, behavior and health-related difficulties and the participation in a study using confidential questionnaires and home contact information, where their identity was known but protected. The participation was defined by both adolescent's assent to participate (AAP) and parents' consent as perceived by the adolescent (PCPA). We hypothesize that, the adolescents cumulating a high number of the previous issues were much less likely to take part in such a study. The findings may help understand the participation risk patterns which may be useful when designing an adolescent prospective study or interpreting its results.

2. Methods

2.1. Study design and population

The study population included all middle schools' students (exhaustive population) from a geographical area including 38,000 inhabitants in the Nancy urban area (410,000 inhabitants). The geographical area included two public and one private middle schools (63 classes) and 1666 students. Nancy is the capital of Lorraine region (2.3 million inhabitants) in north-eastern France. The study population was chosen as it may reflect a social gradient because various social categories were represented.

This study was a part of a survey on adolescent school and health-related difficulties (Chau et al., 2015, 2016). The study was approved by the *Commission Nationale de l'Informatique et des Libertés* (national review board) and the regional education authority. Written informed consent was obtained from the parents.

The study protocol included an invitation to participate in a survey entitled ``Health and social environment in adolescents" transmitted to parents/guardians (by letter explaining the objective of the study transmitted via the schools and adolescents, April 2010) and data collection (May–June 2010) using an anonymous self-administered questionnaire over a one-hour teaching period, under research-team supervision with teacher assistance (for surveillance, with no influence on the survey). Respondents could ask the two research-team members if they did not understand a question, but these had been instructed not to say anything that might influence the response (they rarely did so). Adolescents were invited to put their completed questionnaires in a sealed envelope and then in a closed box.

For two students, the parents refused because they did not understand the objectives and the protocol of the study (as reported by the students). It should be noted that, because data collection was made during a teaching period, all participants and non-participants should be present. During data collection, 11 students (0.7%) were absent for other school trainings, sports tournaments or care at school health centre; 78 (5%) were absent with unknown motives. Sixteen completed questionnaires were excluded: 10 were of unknown gender/age, and 6 were not completed appropriately. Finally, 1559 questionnaires (94%) were retained for statistical analysis. Hence, the participants were the adolescents who gave their assent to participate (by completing the questionnaire) with the consent of their parents/guardians.

The behaviour and health-related difficulties of the study population were similar to those of France *(European School Survey Project on Alcohol and Other Drugs (ESPAD) survey; coordinated in France by Marie Choquet at Institut National de la Santé et de la Recherche Médicale and François Beck at Observatoire Français des Drogues et des Toxicomanies; the French study covered all grades from 6 to 12)* (Swahn et al., 2012) (Supplementary material, Table S1).

2.2. Measures

We studied a wide range of school, behavior and health-related difficulties including: low academic performance, school dropout ideation without qualification, substances use (alcohol, tobacco, cannabis, and other illicit drugs (OID)), body mass index (BMI), lack of physical/sports activities, poor health-related quality of life (poor physical health, poor psychological health, poor social relationships and poor living environment), sexual abuse, depressive symptoms, suicide ideation, and suicide attempt. The demographic/socioeconomic features considered included: gender, age (determined by birth month and year), nationality, family structure, parents' education, parents' occupation, and insufficient family income. Details of the investigation are provided in the Supplementary material.

2.2.1. Adolescent's assent to participate (AAP) and parents' consent as perceived by the adolescent (PCPA) in a study using confidential questionnaires and home contact information, where their identity was known but protected

The AAP and PCPA were assessed with the questions: `We would like to perform a similar survey in adolescents in the whole France using self-administered questionnaires sent to their home. The participants will be randomly selected among the adolescents in France. Your opinion will help us in assessing the feasibility of the survey. The survey will be confidential but the identity of participants will be known and protected'. `If you were chosen, would you agree to participate?' (yes/no or no opinion). 'According to you, your parents or guardians would agree to participate?' (yes/no or no opinion). The AAP was defined as the positive response to the 1st question, and the PCPA as the positive response to the 2nd question. We focused on AAP with PCPA, e.g. the positive responses to both questions (noted APC). It should be noted that, in the present study, the participants had received the consent of their parents/guardians and may know their opinion. We thought that

Table 1
Characteristics of subjects with and those with no adolescent's assent to participate (with parents' consent as perceived by the adolescent) (APC)[a]: *N*(%) or mean (standard deviation).

	All sample (*N* = 1559)	*Subjects with no APC* (*N* = 624)	*Subjects with APC* (*N* = 935)	*p*-value [b]
School, behavior and health-related difficulties				
School difficulties				
Poor academic performance (<10/20)	8.2	68 (10.9)	60 (6.4)	0.002
School dropout ideation	3.8	37 (5.9)	23 (2.5)	<0.001
Measured body mass index				<0.001
Normal weight	54.8	324 (51.9)	530 (56.7)	
Underweight	1.2	6 (1.0)	13 (1.4)	
Overweight	25.5	150 (24.0)	247 (26.4)	
Obese	10.6	74 (11.9)	92 (9.8)	
Measurement refusal	7.9	70 (11.2)	52 (5.6)	
No regular physical/sports activity	11.7	97 (15.5)	85 (9.1)	<0.001
Last-30-day substance use				
Alcohol, number of drinks				0.050
0	64.8	404 (64.7)	606 (64.8)	
1–5	28.3	166 (26.6)	276 (29.5)	
6 or more	6.9	54 (8.7)	53 (5.7)	
Tobacco, number of cigarettes/day				0.134
0	88.8 [c]	548 (87.8)	837 (89.5)	
1–5	6.7	40 (6.4)	64 (6.8)	
6 or more	4.5	36 (5.8)	34 (3.6)	
Cannabis	5.6	46 (7.4)	41 (4.4)	0.012
Other illicit drugs	2.8	25 (4.0)	18 (1.9)	0.014
Poor general health status	8.2	59 (9.5)	69 (7.4)	0.144
Health related quality of life				
Poor physical health	14.2	100 (16.0)	121 (12.9)	0.087
Poor psychological health	9.6	64 (10.3)	86 (9.2)	0.487
Poor social relationships	16.1	133 (21.3)	118 (12.6)	<0.001
Poor living environment	12.6	116 (18.6)	81 (8.7)	<0.001
Sexual abuse	3.7	32 (5.1)	25 (2.7)	0.011
Depressive symptoms	13.3	75 (12.0)	133 (14.2)	0.210
Suicidal ideation	11.7	87 (13.9)	95 (10.2)	0.023
Suicide attempts	9.9	62 (9.9)	92 (9.8)	0.950
Demographic/socioeconomic factors				
Male gender	49.9	333 (53.4)	445 (47.6)	0.026
Age (mean (standard deviation)), year	13.5 (1.3)	13.5 (1.2)	13.4 (1.3)	0.348
Range	9.9 to 18.8	9.9 to 16.9	10.5 to 18.8	
Nationality				<0.001
French	93.0	563 (90.2)	888 (95.0)	
European immigrants	3.5	27 (4.3)	27 (2.9)	
Non-European immigrants	3.5	34 (5.5)	20 (2.1)	
Family structure				<0.001
Intact family	63.0	372 (59.6)	610 (65.2)	
Divorced/separated parents and reconstructed family	25.1	155 (24.8)	236 (25.2)	
Single parent and others	11.9	97 (15.5)	89 (9.5)	
Low parents' education (baccalaureate or lower)	48.7	359 (57.5)	400 (42.8)	<0.001
Parents' occupation				<0.001
Managers, professionals, and intermediate professionals	54.0	300 (48.1)	542 (58.0)	
Craftsmen, tradesmen, and firm heads	13.1	80 (12.8)	125 (13.4)	
Service workers and clerks	7.1	48 (7.7)	62 (6.6)	
Manual workers and other occupations	19.9	158 (25.3)	152 (16.3)	
Not working (unemployed or retired)	5.9	38 (6.1)	54 (5.8)	
Insufficient family income	17.7	140 (22.4)	136 (14.5)	<0.001

[a] In a study using confidential questionnaires and home contact information, where their identity was known but protected.
[b] Chi^2 test or t-Student's test (for age that was a continuous variable).
[c] Among the 1385 subjects with zero cigarette/day, 93.0% never consumed tobacco and 7.0% had consumed at least once (66.0% of them for one or 2 days only) during the last 30 days. These two groups had the same APC (60.3 and 61.9%, $p = 0.766$). So, these two groups were grouped to alleviate the analysis.

the subjects with assent to participate may accept similar surveys over time.

2.2.2. Parents' occupational category and insufficient family income

For parents' occupation (best of parents), five categories were considered following the international standard classification of occupations (ISCO): managers, professionals, and intermediate professionals; craftsmen, tradesmen, and heads of firms; service workers and clerks; manual workers and other occupations; and not working (unemployed and retired) (Chau et al., 2013; Legleye et al., 2012; Lemogne et al., 2012). For perceived family income, subjects were asked whether the financial situation of their family was: coping but with difficulties/getting into debt vs. comfortable/well off/earning just enough (Lemogne et al., 2012).

2.2.3. School, behavior and health-related difficulties

To focus on potential use of alcohol, tobacco, cannabis, and OID, we investigated the use initiation with current use (at least once during the last 30 days). BMI was defined as weight/height^2 (kg/m^2). It was measured during questionnaire completion by the same research-team trained physician. Obesity was defined according to the threshold values recommended for male and female French adolescents at different ages (Rolland-Cachera et al., 1991). Lack of regular sports/physical activity was assessed with the question: `During the last 12 months, have you practiced sports and physical activities (inside and *outside* the school)?' (rarely/never vs. regularly/sometimes). Low academic

Table 2
Associations between adolescent's assent to participate (with parents' consent as perceived by the adolescent) (APC)[a] and school, behavior and health-related difficulties (N = 1559): odds ratio and 95% CI.

	gaOR	95% CI	sefOR	95% CI	%[b]
School, behavior and health-related difficulties					
School difficulties					
Low academic performance (<10/20)	0.57**	0.39–0.82	0.75	0.51–1.11	42
School dropout ideation	0.42**	0.25–0.72	0.52*	0.30–0.91	17
Measured body mass index					
Normal weight	1.0		1.0		
Underweight	1.30	0.48–3.46	1.45	0.54–3.90	–
Overweight	1.02	0.80–1.30	1.14	0.89–1.47	–
Obese	0.78	0.56–1.09	0.90	0.64–1.28	–
Measurement refusal	0.46***	0.31–0.68	0.55**	0.37–0.82	17
No regular physical/sports activity	0.54**	0.40–0.74	0.62**	0.45–0.85	17
Last-30-day substance use					
Alcohol	1.04	0.83–1.30	1.00	0.80–1.26	–
Tobacco	0.85	0.62–1.18	0.94	0.67–1.32	–
Cannabis	0.60*	0.39–0.93	0.64	0.41–1.02	10
Other illicit drugs	0.49*	0.26– 0.91	0.60	0.31–1.14	22
Poor general health status	0.76	0.52–1.09	0.84	0.58–1.23	–
Health related quality of life					
Poor physical health	0.76	0.57–1.02	0.97	0.71–1.32	–
Poor psychological health	0.86	0.62–1.22	0.99	0.69–1.42	–
Poor social relationships	0.53***	0.40–0.70	0.60***	0.45–0.79	15
Poor living environment	0.41***	0.31–0.60	0.53***	0.38–0.73	20
Sexual abuse	0.50**	0.29–0.86	0.63	0.36–1.10	26
Depressive symptoms	1.17	0.86–1.60	1.30	0.94–1.79	–
Suicidal ideation	0.68*	0.50–0.93	0.76	0.55–1.06	25
Suicide attempts	0.97	0.69–1.36	1.14	0.80–1.63	–

gaOR, odds ratio adjusted for gender and age; sefOR, odds ratio adjusted for demographic/socioeconomic factors; CI, confidence interval.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

[a] In a study using confidential questionnaires and home contact information, where their identity was known but protected.

[b] Contribution (%) of demographic/socioeconomic factors computed with the formulae: 100x(gaOR–sefOR)/(gaOR–1) (when gaOR was significant only).

performance was defined as an average below 10/20 of all school marks during the last trimester. School dropout ideation was defined as wish not to continue the study after middle school. Sexual abuse was assessed with the question: 'In the course of your life, have you been victim of a sexual abuse?' (any/none). Physical health, psychological health, social relationships, and living environment were defined by the four domains of the World Health Organization's health-related quality of life (WHOQOL-BREF) (Skevington et al., 2004). In the present study, these domains had a good internal consistency (Cronbach's alpha coefficients of 0.72, 0.70, 0.62, and 0.78, respectively). We used the 25th percentile as a cut-off value which appears appropriate for most subjects with health-related issues. Depressive symptoms were measured with the Kandel scale (Brunet et al., 2014; Kandel and Davies, 1982). These symptoms had a satisfactory Cronbach's alpha (0.84) allowing a single score to be calculated (range 6–18). They were defined by a score above the 90th percentile value (≥17). For suicide behaviors, we studied the presence of suicide ideation(s) during the last 12 months and that of suicide attempt(s) during the life course (at least once). Details are provided in Supplementary material.

2.3. Statistical analysis

The associations between the APC and socioeconomic factors were assessed using the Chi^2 independence test or the t-Student's test. The associations between the APC and school, behavior and health-related difficulties were assessed with the Chi^2 independence test, then with logistic regression models to compute gender-age-adjusted odds ratios (gaOR) and 95% confidence interval (95% CI). To evaluate the contribution of socioeconomic factors to these associations, the odds ratios with further adjustment for socioeconomic factors (sefOR) were computed. The contribution of socioeconomic factors to these associations was computed with the formulae (gaOR–sefOR)/(gaOR–1) (Lynch et al., 1996). To identify the main factors associated with the APC, was used the logistic regression model including all socioeconomic factors and school, behavior and health-related difficulties significantly associated the APC ($p < 0.05$) in bivariate analyses or based on $_{ga}$OR. The stepwise backward procedure was used to retain significant factors only. For the factors retained, their unidimensionality was verified by factor analysis and their internal consistency by Cronbach's alpha. Thereafter, a risk score was defined as the cumulated number of these criteria. Absence of multicollinearity and goodness-of-fit (Hosmer–Lemeshow) were verified. All tests were two-sided with a probability of <0.05 considered as significant. Data statistical analyses were performed using Stata SE 12.0 (StataCorp, College Station, TX, USA).

3. Results

The characteristics of subjects were shown in Table 1. Among the 1559 participants (mean age 13.5 (SD 1.3) years, 98% under 16 years), the subjects with AAP and PCPA represented respectively 65.7% (refusal 28.2% and no opinion 6.1%) and 71.4% (refusal 19.9% and no opinion 8.7%). The AAP and PCPA showed a strong agreement (same positive or negative response 82.8%, kappa = 0.60) (Supplementary material, Table S2). The AAP and PCPA were similarly associated with socioeconomic factors as well as with school, behavior and health-related difficulties (Supplementary material, Table S3). The subjects with APC represented 60.0%.

3.1. Associations between the APC and school, behavior and health-related difficulties

Table 1 shows that, compared with the subjects with no APC, those with APC had less often low academic performance, school dropout ideation, BMI-measurement refusal, no regular physical/sports activity, alcohol use (6+ times), cannabis use, OID use, poor social relationships, poor living environment, sexual abuse and suicidal ideation.

Compared with the subjects with no APC, those with APC were less often male, non-European immigrant, living with a single parent or in manual-worker families, and less often had low parents' education, and insufficient family income (Table 1). These factors remained significant when using multivariable logistic model including all socioeconomic factors (Supplementary material, Table S4).

Table 2 shows that, based on gaOR, the APC was reduced among the early adolescents with low academic performance (gaOR 0.57), school dropout ideation (0.42), BMI-measurement refusal (0.46), no regular physical/sports activity (0.54), cannabis use (0.60), OID use (0.49), poor social relationships (0.53), poor living environment (0.41), sexual abuse (0.50), and suicidal ideation (0.68). Table 2 also shows that further adjusting for socioeconomic factors reduced the odds ratios by 10% to 42%, stating that these factors played a moderate confounding role in the associations between the APC and school, behavior and health-related difficulties.

When considering simultaneously all socioeconomic factors and school, behavior and health-related difficulties, nine factors were found to be negatively associated with APC: male gender (adjusted odds ratio = 0.77, $p = 0.014$), non-European immigrant (0.48, $p = 0.016$), living with a single parent (0.72, $p = 0.046$), living in manual-worker families (0.69, $p = 0.007$), low parents' education (0.70, $p = 0.002$), body-mass-index measurement refusal (0.60, $p = 0.010$), no regular physical/sports activity (0.70, $p = 0.035$), poor social relationships (0.73, $p = 0.046$) and poor living environment (0.63, $p = 0.007$) (Table 3). These criteria were one-dimensional (factors analysis showed

Table 3
Factors associated with adolescent's assent to participate (with parents' consent as perceived by the adolescent) ($N = 1559$): adjusted odds ratio and 95% confidence interval (CI).

	Adjusted odds ratio	*p*-value	95% CI
Logistic model including socioeconomic factors and school, behavior and health-related difficulties[a] with stepwise backward procedure retaining significant factors ($p < 0.05$) only			
Male gender	0.77	0.014	0.62–0.95
Non-European immigrants	0.48	0.016	0.27–0.87
Living with a single parent	0.72	0.046	0.52–0.99
Low parents' education	0.70	0.002	0.56–0.88
Manual-worker family (parents' occupation)	0.69	0.007	0.52–0.90
Body mass index measurement refusal	0.60	0.010	0.40–0.88
No regular physical/sports activity	0.70	0.035	0.51–0.98
Poor social relationships	0.73	0.046	0.54–0.99
Poor living environment	0.63	0.007	0.45–0.88
Pseudo R^2		*0.0459*	

[a] Which were significantly ($p < 0.05$) associated adolescent's assent to participate with perceived parents' consent (APC): male gender, non-European immigrant, living with a single parent, low parents' education, manual worker family, insufficient family income, low academic performance, school dropout ideation, body mass index measurement refusal, no regular physical/sports activities, 6+ alcoholic drinks, use of cannabis, use of other illicit drugs, poor social relationships, poor living environment, sexual abuse, and suicide ideation (Table 1).

that the 1st eigenvalue (0.94) was much higher than the 2nd eigenvalue (0.33)). The Cronbach alpha was 0.43; these criteria were thus complementary. From the above, a risk score was defined as the cumulated number of these criteria. Fig. 1 shows that the frequency of APC steadily decreased with this number of criteria, from 74% for 0 criterion to 19% for 6–8 criteria.

The Hosmer–Lemeshow goodness-of-fit test showed that the various logistic models were correct ($p > 0.34$).

4. Discussion

4.1. Main findings

The present population-based study in early adolescents shows that the subjects with APC may represent 60% and the APC may be reduced by a wide range of socioeconomic adversities and school, behavior and health-related difficulties. Furthermore, cumulating several of these issues strongly reinforce the APC refusal. However, since the percentage of variance explained by the multivariable models was modest (4.6%), other untested factors may be involved. These novel findings may help understand the risk patterns of APC and may be useful when designing an adolescent study using home contact information (which could be cross-sectional, repeated and become a longitudinal survey) and when interpreting the obtained results. In contrast to national studies (Hibell et al., 2004; Legleye et al., 2012; Mayet et al., 2012; Swahn et al., 2012) we focused on a population from an urban area such that the adolescents were thus in the same socioeconomic context, without variations across geographical regions. This study was a part of a survey on adolescent school and health-related difficulties (Chau et al., 2015, 2016).

In the present study, the frequency of the APC was 60%. In absence of data concerning adolescent studies, we may assume that the frequencies found of adolescent's assent to participate (66%) and perceived parents' consent (71%) were consistent with the participation rate reported by some adult studies (63–68%) (Bergstrand et al., 1983; Knudsen et al., 2010; Shahar et al., 1996). A birth cohort study in infants also found a similar participation rate of mothers (63%) (Clarisse et al., 2007).

4.2. Nine factors strongly reduced the APC

The present study reveals nine potential factors that may reduce the APC for a confidential non-anonymous study using home contact information. These factors were male gender, non-European immigrant, living with a single parent, living in manual-worker families, low parents' education, body-mass-index measurement refusal, no regular physical/sports activity, poor social relationships, and poor living

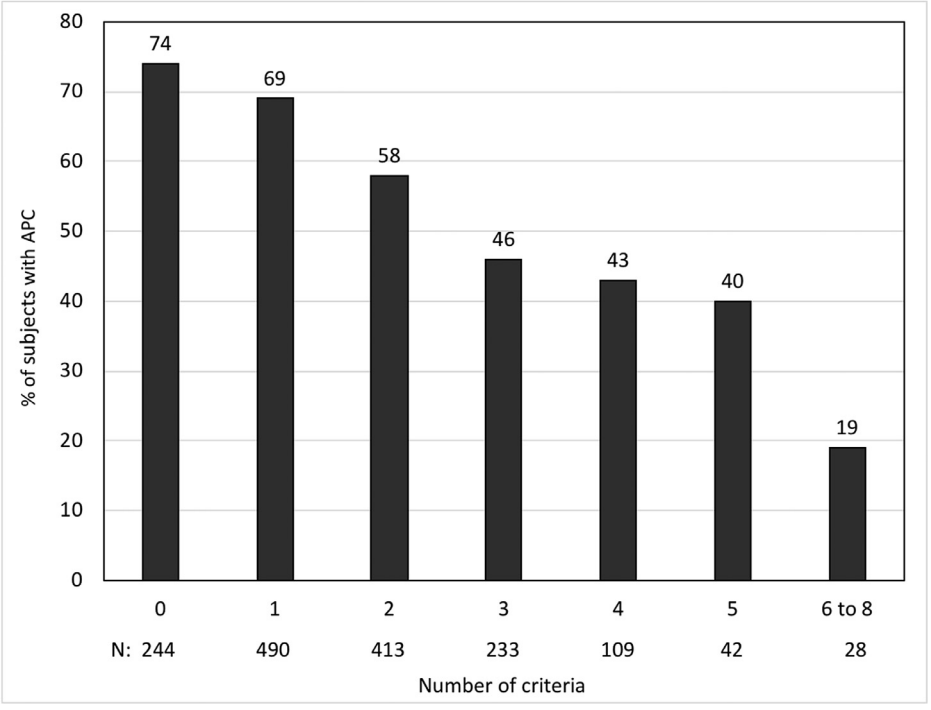

Fig. 1. Percentage of subjects with assent to participate (with parents' consent as perceived by the adolescent) (APC) according to risk score (number of positive criteria[a], range 0 to 8) ($N = 1559$).
[a]The criteria were: male gender, non-European immigrant, living with a single parent, low parents' education, manual-worker family, body-mass-index measurement refusal, no regular physical/sports activity, poor social relationships and poor living environment.

environment. These findings support our hypotheses that potential predictors reducing the APC are related to socioeconomic adversities and behavioral factors. Indeed, poor social relationships and BMI measurement refusal were somewhat behavioral features. Lack of physical/sports activity is a lifestyle factor which may be associated with lower socioeconomic status (Stalsberg and Pedersen, 2010), especially due poor living environment, poor equipment around the residence, and lower opportunities to practice the activity. Non-European immigrants are more frequently from single-parent families and lower social backgrounds and have more often poor social relationships and poor living environment (Baumann et al., 2014). Our results also suggest that a non-anonymous study may under-estimate the prevalence of these socioeconomic adversities and behavior difficulties.

We observed that the percentage of subjects with APC steadily decreased with the cumulated number of the previous nine criteria: from 74% for 0 criterion to 58% for two criteria, 46% for three criteria, and to 19% for 6–8 criteria. It should be noted that 26% of early adolescents cumulated 3 or more criteria. These findings highlight that a high proportion of adolescents cumulate several of the previous criteria and they would be excluded from confidential non-anonymous studies using home contact information. Consequently, the adolescents concerned may be less considered in preventive measures and interventions based on the results obtained by such studies.

According to our knowledge, adolescent studies on the participation bias for a confidential non-anonymous study using home contact information are rare. Our results appeared to be in line with those of adult studies which reported that the participation could be reduced by being male, unmarried, non-European immigrant, divorced, widowed, living alone, low educational level, low socioeconomic status, poor physical activity and personality disorders (Bergstrand et al., 1983; Clarisse et al., 2007; Goldberg et al., 2001; Jacobsen et al., 2010; Knudsen et al., 2010; Korkeila et al., 2001; Shahar et al., 1996; Strandhagen et al., 2010; Tolonen et al., 2005). The agreement between our results and those in adult studies may be explained by the fact that behavior and health-related difficulties starting in early adolescents may continue and may become more severe in adulthood (Bevilacqua et al., 2018; Castellvi et al., 2017; Piehler et al., 2012). Socioeconomic adversities were found to similarly affect the participation among early adolescents and adults. This knowledge may be important when designing population studies including the individuals of all ages.

4.3. Other factors also prevented the APC

The present study shows that the APC may also be reduced by insufficient family income, low academic performance, school dropout ideation, last-30-day substance use (6+ alcoholic drinks, cannabis or OID), sexual abuse and suicidal ideation. Hence, a non-anonymous study may under-estimate the prevalence of these issues. It should be noted that these issues are frequent in early adolescents (Chau et al., 2016, 2018; Dishion et al., 2010; Hibell et al., 2004; Mayet et al., 2012; Swahn et al., 2012). They may alter brain development, attention, memory, processing speed, visuospatial functioning and executive functioning, cognitive ability and work performance (Cross et al., 2017; Harvey et al., 2005; Meruelo et al., 2017; Suhrcke et al., 2011) and may consequently reduce the APC. Affected adolescents may also have a lack of interest in taking part in a non-anonymous study using home contact information. The role of low academic performance and school dropout ideation may be explained by that affected subjects may have a lower mental and cognitive performance and a lack of interest in school and in such a study. However, because of the interdependence with the previous nine factors, these factors were not significant in multivariable logistic model including all socioeconomic factors and school, behavior and health-related difficulties.

Our results were somewhat consistent with those of adult studies which found that the participants less often had low income, substance use, poor lifestyles, poor health profile, and mental disorders (Bergstrand et al., 1983; Jacobsen et al., 2010; Knudsen et al., 2010; Korkeila et al., 2001; Shahar et al., 1996; Strandhagen et al., 2010; Tolonen et al., 2005). While a non-participation of one third in an adult survey was not considered as a strong bias for prevalence estimation (Shahar et al., 1996), our results do not support this conclusion in early adolescents. Our findings are thus useful for adolescent epidemiological studies.

4.4. Limitations and strengths

This study was cross-sectional and based on self-reported data, but a self-administered anonymous questionnaire is often used and a good tool to study adolescent behavior and health problems (Hibell et al., 2004; Mayet et al., 2012; Swahn et al., 2012). The questionnaire was simple and would not be influenced by adolescent's intellectual performance. Adolescents may know the socioeconomic situations of their family, especially their financial problem. An adolescent study on family factors and substance use reported that self-reported data were corroborated by independent teacher reports (Wills et al., 2001). In the present study, we considered parents' consent as perceived by the adolescents. However, the participants should have exchanged with their parents/guardians about their consent and may know their opinion. Despite our findings were consistent with those in adult studies, they need to be confirmed by other adolescent population studies. The participation could be influenced by the thematic of the survey. For both adolescent's assent to participate and parents' consent as perceived by the adolescent, the response no also included that no opinion, but similar results were obtained by excluding the subjects with no opinion (142 subjects, 9.1%) (Supplementary material, Table S5). Given the large number of statistical tests carried out, type I error may be a concern, but most tests were significant at the 0.001 level, with high odds ratios estimates.

Our study had some strengths. The participation rate was high (with only two adolescents had parents' refusal). The proportion of subjects absent with unknown motives was small (5%) but a fraction of them may be due to a not recognized refusal to participate. The data collection was made under the research-team supervision with no influence on the survey. All were made to guarantee the respondents' anonymity. For this purpose, the questionnaire excluded the birthday, the birth place, and the residential town. Data collected and the respondents' identification number do not allow the determination of school and the precise class. Some students needed however a confirmation about the anonymity when filling in the questionnaire. The different instruments were reliable and used in adolescent studies in many countries (Hibell et al., 2004; Kandel and Davies, 1982; Legleye et al., 2012; Lemogne et al., 2012; Mayet et al., 2012; Swahn et al., 2012). The behavior and health-related difficulties of the sample were similar to those of France.

5. Conclusion

This original study shows that a confidential non-anonymous adolescent study using home contact information (which could be cross-sectional, repeated and become a longitudinal survey) may receive an APC of 60%. It demonstrates that the adolescents with APC were less likely male, non-European immigrants, living with a single parent or in manual-worker families, to have low parents' education, BMI measurement refusal, no regular physical/sports activity, poor social relationships and poor living environment. The APC was also negatively associated with insufficient family income, low academic performance, school dropout ideation, last-30-day substance use (6+ alcoholic drinks, cannabis or OID), sexual abuse and suicidal ideation. These findings may help understand participation risk patterns which may be useful when designing a confidential non-anonymous adolescent study using home contact information and interpreting the results obtained. Despite our findings are consistent with those in adult studies, they

need to be confirmed by other adolescent population studies.

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Conflict of interest

The authors declare that they have no conflict of interest.

Authors' contributions

LH carried out the study, statistical analysis, and wrote the manuscript. KC conceived the survey, carried out the study and statistical analysis, and had the main responsibility for writing the manuscript. JMB and PDP participated in writing the manuscript. The authors read and approved the final manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.154.

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