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Young, deprived women are more at risk of testing positive for Chlamydia trachomatis: Results from a cross-sectional multicentre study in French health examination centres

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ABSTRACT

Objectives: Chlamydia Trachomatis (CT) is the most sexually transmitted infection in France. This study aimed to assess the feasibility of systematic screening for CT among people attending a preventive health examination in Health Examination Centres (HECs) and to compare positive CT cases according to deprivation.
Design: A cross-sectional multicentre study in thirteen HECs in France in January 2018.
Methods: Self-sampling CT screening was proposed among 18–25 years women and 18–30 years men, who were sexually active and without recent CT treatment. Related data and referred specimens were collected among attendees for the study, including deprivation and health status. CT positivity was estimated by genders. We explored association between CT infection and deprivation by univariate and multivariate modelling.
Results: The CT screening was proposed to 1701 eligible young people. 90.1 % [88.6–91.5] accepted and participated with 43.6 % being women, 54.3 % being deprived people. 75.4 % [72.1–78.6] screened women performed self-taken vaginal swabs and others took urinary tests. Screening was conducted in 1486 people. Overall prevalence of CT infection was 4.7 % [3.7%–5.9 %], significantly higher for women than men (6.4 % vs 3.4 %, $p=0.009$). Among women, being deprived increased the likelihood of CT positivity (aOR 4.95; 95 % CI 2.02 to 12.00) more than it did for men.
Conclusions: Individual deprivation was significantly associated with having a CT infection among women. The feasibility of CT screening in HECs was demonstrated, with a high acceptance, and led to the implementation of CT screening in all HECs. Promoting access to CT screening to deprived population might contribute to reduce social inequalities in health.

1. Introduction

Chlamydia trachomatis (CT) is the most frequently diagnosed bacterial sexually transmitted infection (STI) in 49 high-income countries [1]. Notwithstanding the widespread recommendations of sensitive and specific non-invasive testing techniques and cheap-effective therapy, CT remains a significant public health concern as it causes serious reproductive complications, especially in women (1). In 2020, the World Health Organization (WHO) estimated about 129 million people worldwide became newly infected with CT. In high-income countries, a meta-analysis of population-based surveys reported that CT was the most common bacterial STIs in young heterosexual adults, accounting for 4.3 % in women and 3.6 % in men 26 years or younger [1]. In France, the CT prevalence has increased and was reported high in screening centres, especially among young women [2,3], notably between 2015 and 2017, the number of CT-reported cases registered by the French Chlamydiosis Network (Rénachla) increased by 29 % in men and 9 % in women [4]. The positivity rate accounted for 6.5 % of men and women in 2015 within the network and the estimated CT incidence rate was 491 per 100,000 residents in 2016 [5]. Those aged 18–24 are the most affected: 3.6 % among women and 2.4 % among men.

CT is mostly asymptomatic and associated with pelvic inflammatory disease, ectopic pregnancy and infertility [6]. Systematic screening, early diagnosis, and treatment of infected individuals could help to

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reduce CT complications and prevent the spread of the disease [2,7].

The French Health Insurance oversees 131 Health Examination Centres (HECs), which provide evidence-based preventive interventions and perform preventive health examinations (PHE) to citizens with national health insurance, especially for deprived people (such as job seekers and young people just entering the job market) or people exposed to risk factors for health. This free medical examination is an opportunity to benefit from a prevention-focused consultation, complementary to the general practitioner. It also allows people to enrol or re-enrol in a health pathway.

French health authorities aim to control CT infection through early detection and treatment of asymptomatic infection, the prevention of sequelae, and onward disease transmission. Since 2003, the French National Agency for Accreditation and Evaluation in Healthcare recommended a systematic screening for CT for women under 25 years of age and men under 30 years of age, in anonymous and free STI screening centres and orthogenic centres. According to these recommendations [8], systematic screening should be offered to women aged 15–25 years and men aged 15–30 years who visit centres. In addition, the agency called for epidemiological studies before expanding screening to other health care facilities [8]. The study aimed to assess the feasibility and the acceptability of self-sampling screening (especially the self-taken vaginal swabs (SVS)) of CT infection among people attending a PHE in HECs. The specific objectives were to estimate the prevalence of CT infection in this population and to compare this prevalence of CT according to individual deprivation.

2. Methods

2.1. Study population

A cross-sectional multicentre survey was performed in thirteen volunteered HECs in France for one month (January 2018). Those experimental centres were diverse in terms of geographical location, size of the centre, some with a medical integrated laboratory. HECs are outpatient consultation centres which offer general prevention consultations. People are invited to HECs by mailing (based on health insurance databases queries) or are sent by partner associations. Therefore, the target population is determined on social criteria (vulnerability, frailty, …) and not on medical criteria. PHEs involve a contact between a health professional and a person that is not motivated by symptoms, and where several screening tests are performed to assess general health.

All young people presenting for PHE and met the eligibility criteria were offered screening: those were women 18–25 years old and men 18–30 years old, presenting for preventive health consultation at the HECs, sexually active and without recent treatment for CT (during the last 5 weeks). Informed consent was obtained from every participant. Reasons for refusing to participate were collected.

2.2. Laboratory procedures

Current diagnostic tests for CT require first-void urine self-sampling for men and SVS for women. If SVS was impossible (pregnancy or menstrual periods) or in case of refusal, a first-void urine testing kit was proposed for women. Women who required a speculum examination for other reasons, were screened using an endocervical swab.

Health professionals were provided with the sampling kit leaflet and demonstration kits to show the young people how to perform the procedure. An instruction leaflet explaining how to take the SVS was provided. They advised women who were still uncertain of how to take the sample. Self-sampling instructions were posted inside the restrooms.

We used a combined PCR test for CT/NG (*Neisseriagonorrhoea*) of swabs, but NG detection was not collected. People were supported in case of positive NG tests, in the same way as for CT. Detection of CT DNA was performed using nucleic acid amplification tests (NAATs). SVS are appropriate specimens to diagnose CT by NAATs and have many advantages over urine samples [9]. Reasons for declining to screen and for not performing self-samples were collected.

2.3. Process of delivery of results

Results were communicated to the participants later during a face-to-face clinical appointment in case of a positive test (or by phone-call if the participant was not able to come back to the HEC). Those participants were referred to a general practitioner or medical clinic for treatment and partner notification. People who tested negative received results by mail, together with a summary of the PHE.

2.4. Questionnaire

All included subjects were asked to answer an anonymous questionnaire about demographic information. Socioeconomic deprivation was assessed using the validated EPICES score to assess individual deprivation, based on answers to an 11-item questionnaire administered to all subjects undergoing preventive health examination [10]. The 11 salient items on which calculation of the EPICES score is based on marital status (one item), health insurance status (one item), economic status (three items), family support (three items) and leisure activity (three items) (Supplementary Appendix 1). The higher the score, the more deprived the patient is. A fixed threshold of 30 was recognized to determine deprivation.

2.5. Data analysis

The acceptance rate was defined as the proportion of the eligible population who accepted the test, the performance rate, the proportion of people accepting it who had the test performed, and prevalence of CT infection, estimated by the number of positive results in the total number of screened individuals. Rates and 95 % confidence intervals were calculated. Bivariate analyses were used to describe associations between CT infection and a covariate. Differences were tested for significance using Pearson's Chi square test and adjusted odds ratios (OR) for the prevalence of CT infection. Factors associated with a higher participation rate among eligible individuals, and factors associated with CT infection among participants, were identified for each gender in univariate analyses. A logistic regression model was developed to determine the variables associated with CT infection (exit p-value <0.05). The adjusted odd ratios (ORs) on age are presented. Analyses were carried out using SPSS V25.

3. Results

The flow chart of participants is presented in Fig. 1. During the study period (from January 22, 2018 to February 16, 2018), 1701 eligible young people attended HECs were invited to participate and received a screening proposal. The acceptance rate was 90.1 % (95 % CI 88,6–91.5, n = 1533): 91.5 % (95 % CI 89,6–93.2, n = 865) for men and 88,4 % (95 % CI 85,9–90.5, n = 668) for women.

Among women, 88.4 % (95 % CI 85.9–90.5, n = 668) accepted screening. Of these 75.4 % (95 % CI 72.1–78.6, n = 504) performed the SVS, 23.7 % (95 % CI 20.5–27.0, n = 158) chose urine sample and 0.9 % (95 % CI 0.4–1.8, n = 6) had an endocervical swab.

In the included population (n = 1533), among those completing the questionnaire: 668 (43.6 %) were women with a mean age of 21.4 years (SD = 2.3) and a mean age of 23.8 years (SD = 3.8) for men. 823 (54.3 %) were deprived. Only 25 (1.7 %) were symptomatic, and 102 (6.8 %) had a history of STI (Table 1).

The screening was finally performed on 1486 people (96.9 %). A positive CT test was found for 70 persons, with a prevalence of CT infection of 4.7 % (95 % CI = 3.7–5.9), and significantly higher for women than men (6.4 % *vs* 3.4 %, *p=0.009*). Women were more likely to have had a history of STI (9.1 % vs 5.0 %, *p=0.002*) and CT symptoms

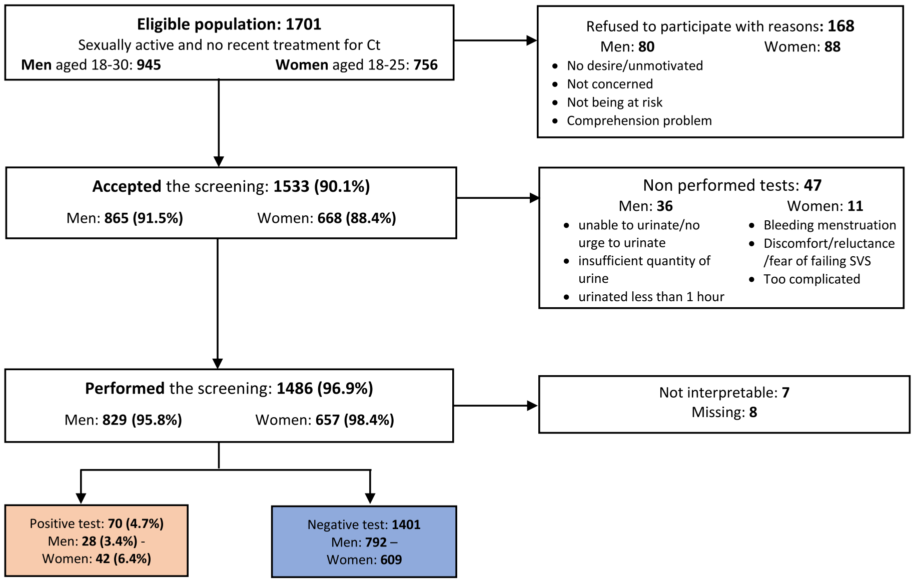

Fig. 1. Flow chart of participants in the study with reasons for rejection.

Table 1
Characteristics of participants (who accepted the screening).

	Overall			Men		Women		
	N	%	*missing*	N	%	N	%	Level of significance
Total	**1533**			**865**		**668**		
Age (years)			*40*					
18–21	614	41.1		263	31.4	351	53.5	
22–25	572	38.3		267	31.9	305	46.5	
26–30	307	20.6		307	36.7			
History of STI			*30*					
Yes	102	6.8		42	5.0	60	9.1	p = 0.002
No	1401	93.2		803	95.0	598	90.9	
CT symptoms			*40*					
Yes	25	1.7		9	1.1	16	2.4	p = 0.044
No	1468	98.3		830	98.9	638	97.6	
Social deprivation (EPICES score>30)			*17*					
Yes	823	54.3		459	53.7	364	55.0	p = 0,64
No	693	45.7		395	46.3	298	45.0	
CT Infection (if performed)								
Positive test	70	4.7		28	3.4	42	6.4	p = 0.009

(2.4 % vs 1.1 %, *p=0.044*) than men (Table 1). All 70 CT-infected people have been informed of their positivity and referred to make a medical appointment. Results were communicated to the participants about 3–5 days (min = 2 max = 8) later in case of a positive test. CT infection showed no association with age, history of STI, or CT symptoms. But women and deprived people were significantly overrepresented in the CT infected group (Table 2).

Note: no statistically significant difference in the positive rate was observed among the self-collected vaginal samples and the urine samples (respectively 7.4 % (95 % CI = 5.3 to 9.9) *vs* 3.4 % (95 % CI = 1.3 to 7.2) (probably due to the low number of positive tests); there was no positive test among the 6 endocervical swab samples.

We found evidence that gender modified the effect of deprivation (*P=0.025*) on CT positivity. Therefore, multivariate analysis is presented stratified by gender (Table 3). Among women, being deprived increased the likelihood of CT positivity (aOR 4.95; 95 % CI 2.02 to 12.00) more than it did for men, where the effect is not significant (aOR 1.39; 95 % CI 0.63 to 3.10). Logistic regression analysis showed that deprived women had a higher risk of CT infection.

4. Discussion

4.1. *Principal findings*

This study demonstrated the feasibility of CT screening in HECs with a high acceptance among youth, even via SVS. The overall prevalence in the targeted population, in our non-specialised STI centres, was 4.7 %, with a difference according to gender (6.4 % for women *vs* 3.4 % for men). Moreover, individual deprivation was associated with having a positive CT result, more specifically among young deprived women, who had almost five higher odds of prevalent infection of CT versus those non deprived.

4.2. *Strengths and limitations*

A strength of our study is the large sample size in a short period; this study is one of the few to provide a current description of the population of young people eligible for CT screening in France [2,3,11–13]. Moreover, a study conducted in a non-specialised STI clinic with access to self-testing was an appealing option for young people, as demonstrated in a recent systematic review of STI testing services [14]. But, no

Table 2
Participant variables according to Chlamydia infection.

	Yes (n = 70)	No (n = 1401)	P-value	OR (95 % CI)
Sex			*0,006*	
Women	42 (60.0 %)	615 (43.4 %)		1.95 (1.20–3.19)
Men	28 (40.0 %)	801 (56.6 %)		Ref
Age (years)			*NS (0,262)*	
18–21	34 (48.6 %)	557 (40.5 %)		Ref
22–25	26 (37.1 %)	526 (38.2 %)		0.81 (0.48–1.37)
26–30	10 (14.3 %)	294 (21.4 %)		0.56 (0.27–1.14)
History of STI			*NS (1.000)*	
Yes	4 (6.0 %)	95 (6.8 %)		0.87 (0.31–2.44)
No	63 (94.0 %)	1299 (93.2 %)		Ref
CT symptoms			*NS (1.000)*	
Yes	1 (1.5 %)	24 (1.7 %)		0.87 (0.12–6.55)
No	65 (98.5 %)	1362 (98.3 %)		Ref
Social deprivation (EPICES score>30)			*< 0.001*	
Yes	52 (75.4 %)	746 (53.1 %)		2.71 (1.55–4.73)
No	17 (24.6 %)	660 (46.9 %)		Ref

Chi square test or Fisher test; OR obtained univariate logistic regression.

European study was referenced in this review [14], hence the importance of communicating about screening in HECs in France.

However, there were some weaknesses. We were unable to link the treatment of positive cases to ensure treatment compliance. During the experiment, professionals at the centres encouraged infected people to seek treatment through their general practitioner and inform their partners of the importance of getting tested. Now, developments are underway to allow professionals to prescribe antibiotic treatment. The screen-and-treat approach recommended by WHO would be the best strategy for young deprived people [15]. In a study of CT screening among asymptomatic men in STI clinics in Paris, 80 % came back for their follow-up appointment and were treated [12]. People under 18 have not been included in this study due to French law, although younger people may be at risk. Another limitation is due to a necessarily restricted choice of questionnaire items. Some characteristics were not asked such as the number of partners or lifetime number of sexual partners, sexual orientation, men having sex with men (MSM) or ethnicity. At last, there were some missing data at each step and no data was available to characterise the refusing population [16].

4.3. To compare with other results

Our results were consistent with previous publications [9,13,17,18]. The acceptance rate was high compared to other studies where rates were 13 % or 70–80 % [2,9,15,17]. Reasons given for declining screening were consistent with those found in the study by Doshi &al [9].: previous/future GU appointment, menstruating, felt not to be at risk, no time, another time. In a part of the National Chlamydia Screening Program in England, 78.8 % of women accepted screening, 90.4 % of them with SVS [9] and 7.3 % tested positive. In a study of a nationally representative sample of French students, CT infection affected 6.3 % of asymptomatic students but with a much lower acceptance rate of 13.3 % [17]. In Chlamywebstudy II, CT positivity (6.8 %) was similar to that observed in STI clinics [13]. In NatChla (national French study), an overall participation rate of 52 % has been observed [2] with a prevalence of CT estimated at 2.5 % for men and 3.2 % for women (aged 18–29 years) [2]. In other French medical settings such as STI and family planning clinics, prevalence rates of around 8–12 % have been reported for subjects between 18 and 24 years old [19]. Lower levels of positive diagnoses of CT and gonorrhoea were found in users of online service (home-collected samples) compared to use clinics services (4.4 % vs 14.4 %) [18]. We found a marked difference in the CT diagnosis rate by sex, as previously published [3,9,13,16]. CT infection is the only STI where women predominate among diagnosed cases. This may reflect the higher prevalence of CT in young women or it may highlight a need to encourage screening among men [20]. The prevalence rate observed in our study was not biased by reason of consultation.

CT screening in HECs seems to be cost-effective since a systematic review published by Honey et al. showed screening to be cost effective at prevalences of 3.1–10.0 % [19,21]. However another review from Roberts et al. raised the issue of methodological flaws in most economic evaluations based on results of studies that used restricted outcomes [22]. Since 2013, Public Health England recommended that each local authority achieve a CT diagnosis rate of ≥2.3 cases per 100 residents aged 15–24 years per year [20].

In many studies deferred in the Gan et al. review [14], self-testing was viewed as an appealing option due to its convenience and ability to reduce embarrassment and maintain privacy. Performance and acceptability of self-collecting genital samples were slightly higher than urine or physician sampling and with higher sensitivity [3,23,24].

Few studies have used an individual level of deprivation as a risk factor. Associations between educational level and CT have already been

Table 3
Proportions and factors associated with Chlamydia infections in men and women.

	Men				Women			
	n/N	Per cent	aOR	CI 95 %	n/N	Per cent	aOR	CI 95 %
Total	28/829	(3.4)			42/657	(6.4)		
Age (years)								
18-21	8/247	(3.2)	1		26/344	(7.6)	1	
22-25	10/253	(4.0)	1.31	(0.50–3.40)	16/301	(5.3)	0.75	(0.39–1.46)
26-30	10/302	(3.3)	1.14	(0.43–3.03)	–			
p Value		*0.889*				*0.249*		
Social deprivation (EPICES score>30)								
Yes	17/436	(3.9)	1.39	(0.63–3.10)	35/362	(9.7)	**4.95**	(2.04–12.00)
No	11/386	(2.8)	1		6/291	(2.1)	1	
p Value		*0.408*				*< 0.001*		

For men, 795 observations were included in the regression from the 829 observations of the study (4.1 % missing values).
For women, 641 observations were included in the regression from the 657 observations of the study (2.4 % missing values) and one woman with a CT positive test and EPICES score missing. aOR adjusted odd ratio.

explored [2,25,26]. In NatChla study, the level of education was strongly associated with CT infection in women only [2]. CT prevalence was lowest among women graduates (1 %) whereas it was very high among women with a low level of education (12.5 %) [2,26]. Lower educational levels were independent determinants of STI. Sexual health centres could facilitate STI testing and care among lower educated people by prioritizing their access [25]. In our study, deprivation measured at an individual level was significantly associated with the risk of having a positive test. This is consistent with a French population of students where two risks factors are independently associated with CT infection (a lifetime number of sexual partners >2 and a deprivation score EPICES≥48.5), although the study had a small sample size [17]. Living in more deprived areas has been significantly associated with prevalent infection after adjusting for socio-demographic and behavioural factors [16,26–28]. A review provides evidence of a consistent association between socioeconomic disadvantage and a higher risk of CT infection [29]. This association may reflect several factors including social variation in engagement with Chlamydia control programs. CT screening could therefore reduce or increase health inequalities, depending on service provision and uptake by different socioeconomic groups [29].

The success of the experiment could also be explained by the attitudes of health professionals in HECs. Employing staff were trained to provide quality counselling (upstream training by CeGIDD, a STI clinic). They have been competently trained with sexual approaches with young people and non-judgemental attitudes. Many studies observed that the attitudes of the testers also influenced young people's willingness to seek STI testing [14]. Other favourable tester characteristics were friendliness, respect, compassion, and being culturally competent [14]. During counselling young people received information on the diagnosis, prevention, screening, and treatment of STIs and diseases. PHE was carried out with an educational approach and with a profound understanding of the patient, respecting patient confidentiality and taking into consideration the person "as a whole". Others barriers to young people seeking STI testing were stigma and embarrassment associated with it and young people were worried that their parents would find out about their sexual activity [14]. In HECs, privacy, confidentiality and anonymity are respected.

4.4. Implications for CT control in France

HECs offer a comprehensive assessment of STI risk factors to determine, with the patient, which screenings to performing. HIV, hepatitis B and C infections as well as CT and Neisseria Gonorrhoea infections are proposed. HECs need to be involved in screening because they receive young deprived people, who do not benefit from occupational medicine or university medicine services. This population should therefore be targeted by appropriate and specific social and medical services [30]. The HECs have signed agreements with the Local Social Centres, which provide social, health and educational support to young deprived people (without qualification, to be integrated into the workplace) [30]. Since 2018, the French National Authority for Health (HAS) recommends screening for asymptomatic women under 25 years and targeted opportunistic screening for sexually active men and women over 25 with risk factors [3]. Practitioners can play a key role in primary prevention by encouraging sexually active young people to be regularly screened and counselling about lifestyle changes. In the context of increasing STI diagnoses, improvement of the testing offered and its diversification toward most exposed and deprived populations remain crucial to control these epidemics. Services should be designed to ensure that the groups with the highest need are aware of and are easily able to access CT screening services [26].

Our study is largely consistent with the attributes of STI testing services listed in the recent review [14].

- study population included young deprived people even with lower access to healthcare services, so targeted subpopulation with a higher burden of STIs,
- high levels of confidentiality and privacy,
- employment of friendly and non-judgemental staff,
- fast processing of tests and results.

The screening strategy based on counselling and self-testing contributed to the successful high acceptance rate. Our study provides evidence of the importance of screening programs in the HECs and increases awareness among the population at risk of positive CT (young women in deprivation). So, increased screening and prevention efforts among deprived people or who are not regularly accessing screening may reduce the prevalence of undiagnosed infection and decrease transmission [27]. It is getting major to mitigate the pandemic's negative consequences on STI control, as it is likely to be an increase in the incidence of STIs related to the undiagnosed cases during the Covid-19 pandemic [31,32].

This feasibility led to the implementation of CT/NG screening in all HECs (131 centres). Since 2021, the 8 laboratories of the French Health Insurance serving the HECs perform Chlamydia and Gonorrhoea screening. This implementation might allow high-risk subgroups (like deprived people) to be reached more easily, and those people seen in HECs are certainly more captive to be prompted for CT testing. This might contribute to reducing social inequalities in health.

What this study adds

The feasibility of CT screening in HECs has been demonstrated. The prevalence of CT infection in the young population in HECs was higher than in the general population and quite similar in STI clinics. Deprivation (measured by the individual level EPICES score) is a risk factor for CT infection in women.

Implications for policy and practice

HECs are a good place to implement screening programs as the centres are specifically targeted at deprived people. Deprivation measured at an individual level is a risk factor for having a positive CT test in women. These findings could be used for more specific targeting or outreach activities.

Ethical approval

This study was approved by an institutional review board (Ethical Committee of Saint-Etienne University Hospital, Ref IRBN842023/CHUSTE), which examined the documents and interviewed the research project representative and issued an agreement to perform the study.

Author's contribution

IV and EA designed the study. EA and LG contributed to the literature search and wrote the study protocol with a working group of HECs staff. LG coordinated the data collection and contributed with EA to the planning execution. EL cleaned, analysed and interpreted data. EA assisted in the data analyses. EL undertook the main contribution to the paper with MO. MO, LG, IV, EA contributed to the interpretation of the findings and revised the paper for intellectual content. EA and IV are responsible for the overall content. All authors read and approved the final manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhip.2024.100554.

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