



Original Article

Age specific evaluation of sexual behavior, STI knowledge and infection among asymptomatic adolescents and young adults

A. Skaletz-Rorowski^{a,b,1}, A. Potthoff^{a,b,1}, S. Nambiar^{a,b}, J. Wach^{a,c}, A. Kayser^{a,d}, A. Kasper^{a,b}, N.H. Brockmeyer^{a,b,*}^a Walk In Ruhr (WIR), Center for Sexual Health and Medicine, Bochum, Germany^b Interdisciplinary Immunological Outpatient Clinic, Center for Sexual Health and Medicine, Department of Dermatology, Venereology and Allergology, Ruhr Universität Bochum, Germany^c Public Health Department Bochum, Germany^d Aidshilfe (Aids Service Organization Bochum) e. V., Germany

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ABSTRACT

Objectives: Adolescents and young adults account for 50% of new infections with sexually transmitted infection (STI), while representing only 25% of the sexually active population. An evaluation of sexual behavior, STI knowledge and infection among youth of different age groups is relevant to formulate effective sexual health strategies.

Methods: In this monocentric, open, prospective cross-sectional study, 268 asymptomatic subjects (14–30 years) were partitioned into three cohorts I: 14–19 ($n=42$), II: 20–25 ($n=147$) and III: 25–30 ($n=79$) years. A comparative analysis of their sexual behavior and STI knowledge was performed using a 21-item questionnaire at the WIR-Center for Sexual Health and Medicine. Prevalence of chlamydia and gonococcal infections were tested, using the Cepheid Xpert[®] CT/NG assay.

Results: The three age-specific cohorts showed statistically significant differences in their relationship status, their sexual contacts and the number of life-time sexual partners. Independent of age, men who have sex with men had greater number of sexual partners across all age groups. Although >95% of participants were aware of HIV in all age groups, the corresponding awareness of non-HIV STI was consistently lower in cohort I. The awareness of trichomonas, mycoplasma and candida in particular was <50% across all agedemographies. Chlamydia screening remains poor despite current chlamydia infection among cohort I, II & III being 7.1%, 5.4%, & 11.4% respectively.

Conclusion: Our study demonstrates a demographic divide in the knowledge on most frequent STI apart from HIV. Current education, screening and vaccination programs for STI among the younger demographic should be improved.

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Introduction

Adolescents and young adults account for 50% of new infections with sexually transmitted infections (STI), while representing only 25% of the sexually active population [1]. To formulate an effective

Abbreviations: STI, sexually transmitted infection; WIR, Walk In Ruhr; MSM, men having sex with men; HIV, human immunodeficiency virus; CT, Chlamydia trachomatis; NG, Neisseria gonorrhoeae; HPV, human papilloma virus.

* Corresponding author at: WIR – Walk In Ruhr, Center for Sexual Health and Medicine, Grosse Beckstrasse 12, 4478 Bochum, Germany.

E-mail address: n.brockmeyer@klinikum-bochum.de (N.H. Brockmeyer).

¹ Both authors contributed equally to this work.

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sexual health policy, especially for non-notifiable STI, representative data on the sexual behavior and knowledge across progressive age groups is a crucial pre-requisite. In Germany, only limited studies are available on sexual behavior [2–4] and non-notifiable STI, while such studies have been conducted in the US and the UK [5,6].

An increase in the incidence of non-HIV STI has been observed in developed countries including Germany. Chlamydia trachomatis (CT) is commonly regarded as the most frequent cause of female infertility and widespread in Germany [7,8]. Newly diagnosed cases of *Treponema pallidum* infections in Germany have risen more than 4-fold since 2000 [9,10], and *Neisseria gonorrhoeae* (NG) infections with increasing antibiotic resistance are an additional problem [11,12]. Furthermore, Human papilloma virus (HPV)-related neoplasia has become a growing concern, for instance, vulvar cancer

(often linked to HPV infection), has increased in Germany over the last decade [13]. A study of adults across Germany observed that a majority had never heard of syphilis, gonorrhoea, hepatitis, genital herpes, chlamydia, and HPV and only 6% were aware of HPV and 14% of chlamydia [14]. Another study amongst adolescents in Northern Germany observed that participants perceived likelihood of HIV infection much higher than the much more prevalent HPV [15]. Adolescents were largely ignorant of the existence of chlamydia, even in urban settings of high prevalence [16]. Similarly, a study among adolescents in Berlin observed that they suffer from suboptimal levels of knowledge on STI beyond HIV [17].

Hence, the current study aimed to (A) evaluate self-reported sexual behavior and knowledge on various STI using a 21-item questionnaire, (B) prevalence of CT and NG infections, among three age specific cohorts 14–19, 20–25 and 25–30 years respectively.

Methods

Study design and patient and public involvement

The current study is a monocentric, open, prospective cross-sectional study and was approved by the ethics committee Ruhr Universität Bochum (approval no. 15-5862). The questionnaire was designed in co-operation with Aidshilfe and visitors to the WIR. Subsequently, their help will be obtained for dissemination of the study results.

Between 12/2016 and 7/2018, 309 subjects asymptomatic of STI between 14 and 31 years of age were recruited from schools and universities and at the WIR. An informed consent was obtained. Specimens were obtained through self-collection: oral, vaginal, anal swabs in women, and oral, anal swabs and urine in men. Specimens were analysed using the Cepheid Xpert® CT/NG assay, on the GeneXpert® Instrument Systems as per the manufacturer's recommendations and protocols [18]. The assay is a 90 mins qualitative in vitro multiplex real-time PCR test for automated rapid detection and differentiation of genomic DNA from *C. trachomatis* and *N. gonorrhoeae*.

Thirty seven were excluded based on antibiotic treatment in the preceding 4 weeks to avoid false-negatives due to suboptimal detection of STI. Four were excluded based on age and 268 subjects (14–30 years) were analysed further by partitioning them into three age specific cohorts: I 14–19, II 20–25 and III 25–30 years. Study participants were administered a 21-item questionnaire exploring the following domains: sociodemographic characteristics; sexual behavior (sexual lifestyle and practices, condom use, number and gender of sexual partners); knowledge of sex and STI (knowledge on various STI and prevention strategies, prior STI testing, prior STI).

Data analysis

Categorical data were analysed using Chi-square or Fisher's exact tests when the cells had less than five expected cases. Metric variables were analysed using the Kruskal–Wallis test. A 95%-CI and a p -value $< .05$ were considered statistically significant. All statistical analyses used SPSS 25.0 (IBM).

Result

Sociodemographic features of the participants

In cohort I ($n=42$) 38.1% were female and 61.9% were male. Among these, 16.7% reported having attended college/university, 45.2% vocational training (mainly nursing) and 35.7% attended secondary school. Zero percent were unemployed/unemployed and

Table 1
Sociodemographic data of the three age-specific cohorts.

Socio-demographic data	Cohort I 14–19 ($n=42$)	Cohort II 20–24 ($n=147$)	Cohort III 25–30 ($n=79$)
Gender			
Male	26 (61.9%)	67 (45.6%)	38 (48.1%)
Female	16 (38.1%)	76 (51.7%)	40 (50.6%)
Transgender	0 (0%)	0 (0%)	0 (0%)
N.A.	0 (0%)	4 (2.7%)	1 (1.3%)
Age			
<i>Professional status</i>			
School	15 (35.7%)	0 (0%)	0 (0%)
Vocational training	19 (45.2%)	43 (29.3%)	5 (6.3%)
College/University	7 (16.7%)	92 (62.6%)	53 (67.1%)
Employed	0 (0%)	6 (4.1%)	17 (21.5%)
Unemployed	0 (0%)	1 (0.7%)	0 (0%)
N.A.	1 (2.4%)	5 (3.4%)	4 (5.1%)

N.A.: Not available; MSM: men who have sex with men; STI: sexually transmitted infection.

2.4% did not disclose their professional status. In cohort II ($n=147$) 51.7% were female, 45.6% were male and 2.7% did not disclose their gender. 62.6% reported having attended college/university, 29.3% vocational training and none were in secondary school. 4.1% were employed, 0.7% were unemployed and 3.4% did not disclose their professional status. In cohort III ($n=79$) 50.6% were female, 48.1% were male and 1.3% did not disclose their gender. None were transgender in all three cohorts. 67.1% reported having attended college/university, 6.3% vocational training and none were in secondary school. 21.5% were employed, 0% were unemployed and 5.1% did not disclose their professional status (Table 1).

Sexual behavior across age groups

To assess sexual behavior, participants were first asked to self-report their relationship status, their sexual contact with males/females/both, the number of life-time sexual partners, the number of sexual partners in the last two months, the use of condoms for contraception/STI prevention, use of contraceptive pills, use of any other contraception/STI strategies and if they engaged in unprotected sex. Cohort I, II and III showed statistically significant differences only in their relationship status ($V=0.221$, $p<0.01$), their sexual contacts ($V=0.236$, $p<0.01$) and the number of life-time sexual partners ($V=0.257$, $p<0.01$) (Supplementary Table 1).

Men reporting to have sex with men (MSM) among cohort I, II and III were 30.8%, 46.3% and 57.9% respectively. In cohort I, 45.2% used condoms as a contraceptive strategy, 54.8% used it for STI prevention, 26.2% engaged in occasional unprotected sex and 7.1% always engaged in unprotected sex. In cohort II 37.2% used condoms as a contraceptive strategy, 63.4% used it for STI prevention, 34.5% engaged in occasional unprotected sex and 4.1% always engaged in unprotected sex. In cohort III 48.7% used condoms as a contraceptive strategy, 73.1% used it for STI prevention, 38.5% engaged in occasional unprotected sex and 2.6% always engaged in unprotected sex.

79.7% of cohort III were currently in a relationship as opposed to 57.1% of cohort I and 65.3% of cohort II. Although greater percentage of participants in cohort III had >10 sexual partners in their life-time as opposed to cohort I and cohort II the percentage of MSM participants who had >10 sexual partners were substantially greater across all three age groups (Fig. 1a and b).

Knowledge of STI across age groups

To assess knowledge on STI, participants were first asked to self-evaluate their knowledge of the 11 most frequent bacterial and viral STI: HIV, syphilis, chlamydia, gonorrhoea, HPV as causative agent of

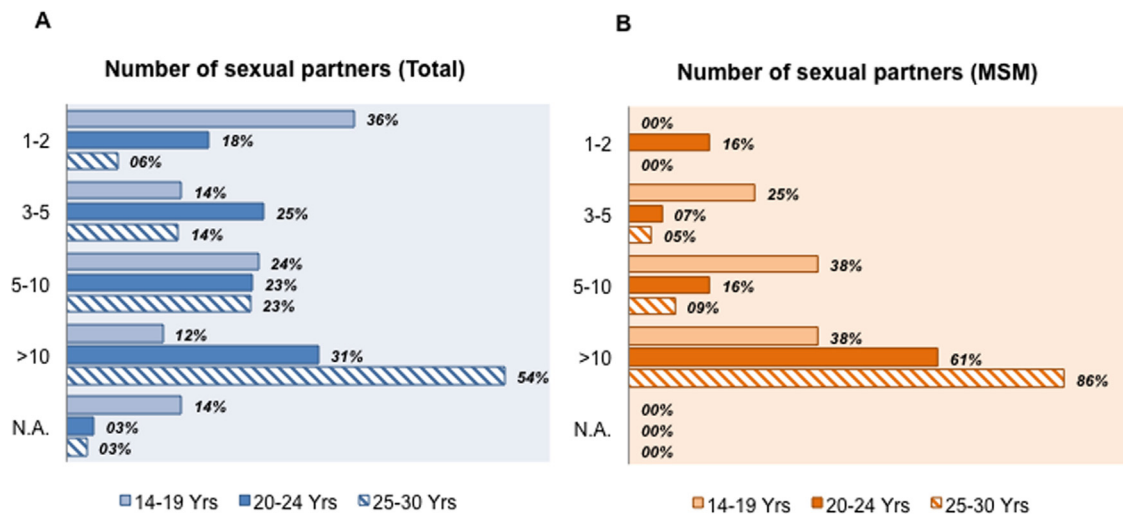


Fig. 1. Number of life-time sexual partners in general population and MSM. N.A.: Not available; MSM: men who have sex with men.

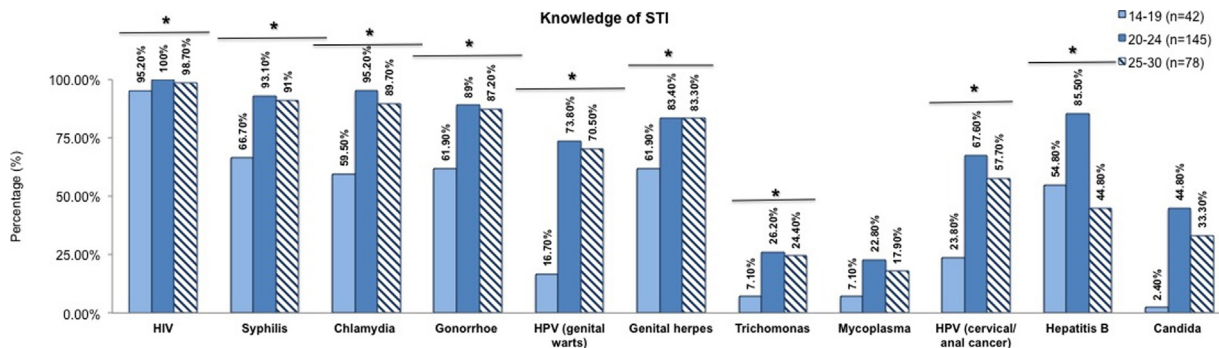


Fig. 2. Knowledge of STI among the three age-specific cohorts. HIV: human Immunodeficiency virus; HPV: human papillomavirus.

genital warts, genital herpes, trichomonas, mycoplasma, HPV as causative agent of cervical/anal cancer, hepatitis B, and candida (Fig. 1). Greater than 95% of participants were aware of HIV among all age groups. Greater than 80% of participants in cohort II and cohort III were aware of syphilis, chlamydia, gonorrhoea and genital herpes but the corresponding awareness among cohort I was relatively lesser (although never <50%). The awareness of trichomonas, mycoplasma and candida were <50% across all three age groups (Fig. 2).

HPV: Knowledge and vaccination

Greater than 70% of participants in cohort II and cohort III were aware of HPV as a causative of genital warts in contrast to 16.7% in cohort I (Fig. 2). Similarly, greater than 55% participants in cohort II and cohort III were aware of HPV as a causative of cervical/anal cancer in contrast to only 23.8% in cohort I (Fig. 2). Hence, the knowledge of HPV as a causative of genital warts or cervical/anal cancer was consistently lower among cohort I as opposed to other age cohorts. Among cohort I, II and III only 28.6%, 38.8% and 22.8% were vaccinated against HPV (62.5%, 67.1% and 45% of women).

Chlamydia: Knowledge, prior testing and infection

The knowledge (59.5%) and prior testing (16.7%) of chlamydia was the lowest among cohort I (Fig. 3a). Greater than 85% participants in cohort II and cohort III were aware of chlamydia, nevertheless, the corresponding prior testing among these groups were only 36.6% and 61.5% respectively (Fig. 3a). The self-reported

prior chlamydia infection was <10% among all age groups. The current chlamydia infection among cohort I, II & III was 7.1%, 5.4% and 11.4% (Fig. 3a), the corresponding gonorrhoea infection among cohort I, II and III was 2.4%, 4.1% and 8.9% (data not shown).

Among women, although the knowledge of chlamydia among cohort I, II and III was 75%, 97.4% and 87.5% respectively, the corresponding prior testing was only 25%, 39.5% and 67.5% (Fig. 3b). The self-reported prior chlamydia infection for women in cohort II and III were 7.9% and 17.5% while none of the women in cohort I reported any previous history of infection. The current chlamydia infection among women in cohort I, II and III was 6.3%, 5.3% and 12.5%, respectively (Fig. 3b). The corresponding gonorrhoea infection among women in cohort I and II were 0% while that among women in cohort III was 5% (data not shown).

Discussion

Despite ready availability of different effective strategies of primary and secondary prevention of STI, their uptake remains impeded by widespread lack of knowledge among adolescents and young adults, an age group that is particularly at risk of contracting an STI. Consistent with earlier reports from the Berlin area, our study shows a demographic divide in STI knowledge and that adolescents in Ruhr-area, Germany suffer from a low level of knowledge on all of the most frequent STI apart from HIV, too [17].

Our data demonstrated as expected that older individuals are more often in a stable relationship, have more sexual partners in the last months and a higher number of life-time sexual partners [19]. The services of the WIR [20] may have attracted a more

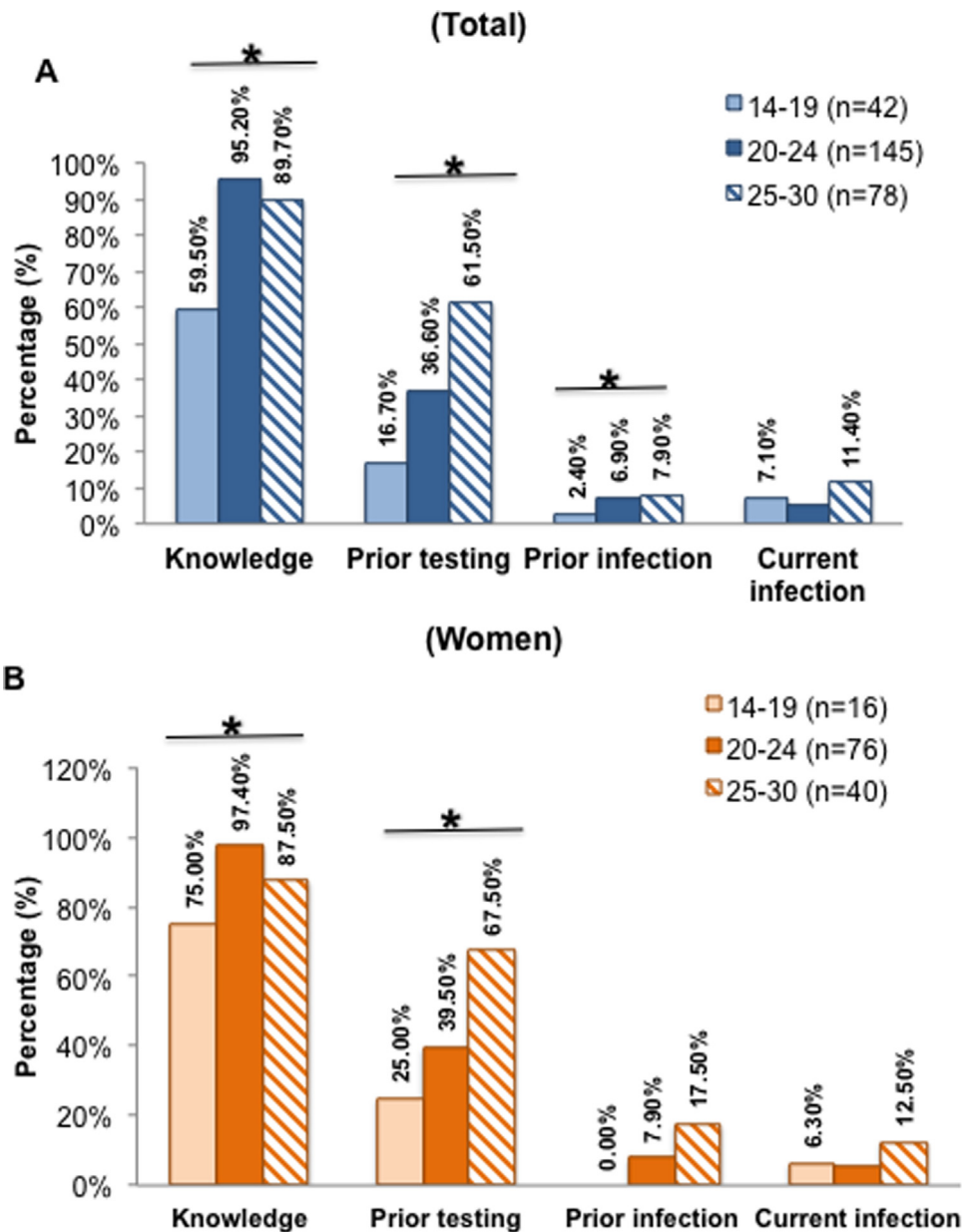


Fig. 3. Chlamydia: Knowledge, prior testing and infection in general population and among women.

than average number of MSM to participate in the study. Independent of age, MSM had greater number of life-time sexual partners across all three age groups. This is consistent with previous studies that demonstrate that MSM are more promiscuous with multiple, concurrent sexual partners and present higher STI infection rate despite substantial advances in testing and treatment [2,21,22].

The use of condoms for STI prevention was lowest among 14–19 years. These findings suggest that the effectiveness of STI prevention efforts among adolescents could be enhanced by increasing awareness to use condoms and by targeting social norms regarding condom use resistance [23].

In spite of HPV being the most common STI, only 16–24% of 14–19 year olds were aware of it as a causative agent of genital warts/cervical cancer/anal cancer. The Standing Committee on Vaccination stipulates that all girls and boys between 9 and 14 years should get HPV vaccination and should catch up on any missed HPV vaccinations latest by 18 [24]. Each year, around 4600 women in Germany develop a new cervical cancer and around 1600 die of it

[25]. Among men, around 600 new cases of anal carcinoma, at least 250 new cases of penile carcinoma, and at least 750 new cases of carcinoma of the oral cavity and pharynx are associated with HPV infection in Germany each year [4,25]. In our study, more women were vaccinated against HPV, than the reported vaccination rate of 45% observed among 17 year old girls in Germany during 2015 [26]. Despite that, the particularly poor knowledge of HPV among adolescents combined with suboptimal vaccination rate among all age cohorts show that more education on HPV is necessary in that age group. Since 2019, HPV vaccination for boys is covered by German health insurances as an additional strategy towards reduction of HPV-related diseases.

Among the non-HIV STI, chlamydia and genital mycoplasma infections represent the most important preventable causes of female infertility and adverse pregnancy outcomes [27,28]. In Germany, chlamydia screening is offered free of charge to pregnant women since 1995 and to women ≤ 25 years of age since 2008 and the testing is covered by statutory health insurance [29]. Yet,

as observed in our study, the self-reported prior testing among women was sub-optimal. Further, the current chlamydia infection was >5% among women of all age groups, and was even highly pronounced (12.5%) among women >25 years of age. Taken together, our data indicate that many women remain unscreened for chlamydia, leaving them both vulnerable to health problems that arise from untreated infection and increased likelihood of infecting others. Hence, we propose that a risk-based screening for chlamydia among sexually active men and women irrespective of their age may be superior to screening of women <25 years alone.

Collectively, these observations were consistent with previous studies among young individuals that indicated that most of them had heard about STI, but primarily HIV/AIDS rather than other types of STI [17,30]. It is imperative therefore that non-HIV STI and STI prevention are explicitly included in the school curriculum and non-HIV STI awareness campaigns such as the Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung/BZgA).

Our study had several limitations. First, participants' responses to questions concerning their STI knowledge, sexual behavior and history of testing/infection may have been inaccurately or incompletely reported due to social desirability bias and recall bias. Also, as subjects were asked to evaluate their knowledge regarding STI on a multiple choice questionnaire post an orientation lecture on STI, it might have led to the over-reporting of knowledge in comparison to that observed by BZgA [14]. Nevertheless, self-reports appeared to be the best method to investigate such issues in the current study. Second, our study was a monocentric study of an urban area namely Ruhr-area in Germany and a multicentric study may have been more desirable. However, with 5 million inhabitants, this area is cosmopolitan, both from the point of view of the population's ethno-regional background (21.3% of the population in the city of Bochum are of migrant background) and from their socio-economic stratification.

Despite the above limitations, as the first age-demographic dependent comparison of sexual behavior and STI knowledge among asymptomatic youth in Germany, the current study provide important pointers to both public health services and policy makers in the country.

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Competing interests

None declared.

Ethical approval

The study was approved by the ethics committee Ruhr Universität Bochum (approval no. 15-5862).

Patient consent

Obtained.

Conflict of interest

The authors declare that the study received funding and technical support from Cepheid Germany (Diagnostic) GmbH.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at <https://doi.org/10.1016/j.jiph.2020.04.005>.

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