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**SARS-COV-2 IgG antibody response in pregnant women at delivery.**

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### **Declaration of Interest**

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# **SARS-COV-2 IgG antibody response in pregnant women at delivery.**

## **ABSTRACT**

### **Background**

The prevalence of COVID-19 infection during pregnancy is not known. COVIPREG is a prospective French multicenter study to assess the seroprevalence at the time of delivery and the maternal and neonatal impact of COVID-19 infection during pregnancy. In order to study factors associated with poor outcomes after COVID-19 Infection during pregnancy and adapt the sample size of the study, a preliminary assessment of the prevalence of SARS-CoV-2 IgG was planned after 500 inclusions in a one perinatal center of Paris area.

### **Objectives**

To assess the prevalence of SARS-CoV-2 IgG antibody response in pregnant women at the time of delivery during the COVID-19 pandemic.

### **Study design**

A prospective observational study at Cochin hospital (Level III maternity). Patients admitted for delivery were offered to participate to the study. Each patient participating to the study was tested for anti-SARS-CoV-2-IgG antibodies using a commercially available ELISA.

### **Results**

Among the 529 patients included in the COVIPREG study between April 29 and June 26, 529 were assessed for SARS-CoV-2 IgG antibody response and 25 had a positive test, ie 4.7% with a confidence interval at 95% [3.0%-6.9%].

### **Conclusions**

Four months after the beginning of the infection in Paris, the seroprevalence of SARS-CoV-2 IgG in pregnant women at the time of delivery is low. Studies evaluating the impact of COVID-19 infection during pregnancy should take this information in account in order to adapt the sample size.

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34

35 **Keywords**

36 Pregnancy, COVID-19, SARS-CoV-2, seroprevalence

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## INTRODUCTION

SARS-CoV-2 is an emerging human coronavirus responsible for the disease called COVID-19 (1). These viruses are responsible for infections of the respiratory tract, gastrointestinal system and nervous system (1,2). Human-to-human transmission occurs mainly directly, by the respiratory route or indirectly via aerosols. Manual indirect transmission is possible. Contagiousness precedes symptoms (4). The incubation period is around 5 days (between 2 and 14 days) (4).

Following the rapid spread of SARS-CoV-2 since December 2019, and in view of the severity of the infection, the WHO declared COVID-19 as a global public health emergency on January 30, 2020 and as a global pandemic from March 11, 2020. By September 15<sup>th</sup>, there were more than 29 million infections worldwide and over 930,000 deaths. The majority of people infected with SARS-CoV-2 are asymptomatic or present mild symptoms of rhinitis, cough, fever and dyspnea (2). Digestive signs, anosmia, ageusia may also be present. However, more severe symptoms have been described as pneumonia or acute respiratory distress syndrome (ARDS) (3). The overall estimate of the mortality rate (including asymptomatic and symptomatic people) seems to be around 5% (5).

In pregnant women, the symptoms appear to be the same as those in the general population. During the third trimester patients are considered to be at risk of more severe symptoms such as pneumonia or ARDS like other at-risk populations (6, 7). Concerning the risks for the fetus and the newborn very limited information is available at the moment. Fetal infection after transplacental passage of the virus has been described but appears to be very rare (8). Neonatal infection is rare, and the majority of these infected newborns are asymptomatic even if few severe cases were described (9).

The antibody response after SARS-CoV-2 infection has recently been described. In symptomatic patients, antibodies against SARS-CoV-2 have been reported to be detected from a few days to 3 weeks after onset of symptoms (10,11), with the median of 6 days (12). High levels of neutralizing antibodies are induced about 10 days after onset of the disease (13). The presence of SARS-CoV-2 IgG antibodies is indicative of current or previous infection by SARS-CoV-2, however the extent and duration of protection conferred by SARS-CoV-2 IgG antibodies remain unknown (12,14).

The COVIPREG study was designed to study the COVID-19 seroprevalence in pregnant women at the time of delivery, the consequences of the infection for the women and their

newborns and the risk factors of severe disease (NCT04355234). It is a prospective study conducted in 10 perinatal centers of Paris area in France. Since no data was available regarding COVID-19 seroprevalence in pregnant women, a preliminary analysis was planned in the study protocol after 500 inclusions in order to adjust the sample size of the study to achieve the objectives. We present the results of this intermediate analysis.

## **2. METHODS**

### **2.1. Patients populations**

One perinatal center of Paris area, Cochin Hospital (Port-Royal Maternity, Paris, France) was considered for this preliminary analysis. Pregnant women were prospectively included in the study at the time of delivery between April 29, 2020 and June 26, 2020. All patients admitted to the delivery ward after 15 weeks of gestation (WG) were offered the possibility to participate to the study independently of the gestational age and pregnancy complications. Patients were not referred to our center specifically for COVID-19.

Exclusion criteria were age<18 years, refusal to participate to the study, patient unable to read or understand the study documents. After informed consent of the patient maternal blood was collected and serum samples were stored at -20°C for COVID-19 Elisa. All data (clinical, laboratory, ultrasonographic) for the mother and the newborns were prospectively collected.

The COVIPREG study was approved by an institutional review board, CPP SUD MEDITERRANEE (N° 2020-A00924-35) on April 23, 2020.

### **2.2 Serology testing for SARS-CoV-2 specific IgG**

Serum samples were tested using the SARS-CoV-2 IgG Architect assay (Abbott, Sligo, Ireland) according to the manufacturer's instructions. The SARS-CoV-2 IgG assay is a chemiluminescent microparticle immunoassay (CMIA) used for the qualitative detection of IgG antibodies to SARS-CoV-2 in human serum and plasma. The resulting chemiluminescent reaction was measured as a relative light unit (RLU). The presence or absence of IgG antibodies to SARS-CoV-2 in the sample (S) is determined by comparing the chemiluminescent RLU in the reaction to the calibrator RLU (C) and expressed as the S/C index. The results were considered negative if the IgG index was < 1.4, positive if  $\geq 1.4$ . This

commercial chemiluminescent immunoassay is validated for clinical use by the FDA with high analytical and clinical performances (15, 16).

### 2.3 Data analysis

Statistical analysis was performed by a dedicated statistician using the SAS 9.4 software. The main objective of this preliminary analysis was to estimate the seroprevalence of COVID 19 infection and its 95% confidence interval in the selected sample. We analyzed maternal characteristics (age, BMI, geographical origin, multiple pregnancy) and the outcome of the pregnancy (term of delivery, mode of delivery and vital status of the child) in positive and negative women. The distribution parameters were mean and standard deviation for quantitative data or number and frequency for qualitative data. For these comparisons, the appropriate tests will be used: Khi-2 or Fisher test.

## **RESULTS**

During the study period 529 patients were included in the study and were offered a SARS-CoV-2 IgG testing. Among those, 25 had a positive serology, ie 4.7% with a confidence interval at 95% [3.0%-6.7%]. None of the patients had symptoms of COVID-19 infection at the time of inclusion. The characteristics of the patients are summarized in table 1. Mean maternal age was 33.7 (+/- 4.8) and mean gestational age at delivery was 38.9 (+/- 3.3). Forty-one patients delivered preterm (7.7%). There were 12 fetal losses, 9 were termination of pregnancy for genetic abnormalities or fetal malformations and 3 were stillbirths. These patients were pregnant during peak of COVID-19 outbreak in Paris. Twenty-one patients had a SARS-CoV-2 RT-PCR test during pregnancy because of COVID-19 symptoms. The SARS-CoV-2 RT-PCR was negative for 11, and all these patients had a negative serology at delivery. The SARS-CoV-2 RT-PCR was positive for 10 and 8 patients had a positive serology whereas 2 had a negative serology at delivery. For one of these 2 patients the IgG index was in the grey zone at 0.8 (grey zone between 0.8 and 1.4 according to the manufacturer). This patient had symptoms of COVID 19 (anosmia) and a positive PCR test two months before delivery. The second patient had a PCR test in a private lab because of moderate fever (37.8°C) without any other symptom. The PCR test was not checked in our hospital. The IgG index was at 0.0.

One of the patients with a positive serology had a termination of pregnancy at 17WG for severe fetal malformation (ventriculomegaly, spine malformation and cleft feet) without abnormalities found at the genetic tests. SARS-CoV-2 PCR was negative on fetal tissues.

Maternal and neonatal characteristics were compared between the two groups of patients with positive and negative SARS-CoV-2 serology. No significant difference was found between the two groups concerning maternal age, maternal BMI, geographic origin, twin pregnancy, prematurity rate, mode of delivery nor the rate of fetal loss (Table 3).

## DISCUSSION

France is a country that was severely touched by COVID-19 outbreak in the first trimester of 2020. First cases were reported in France on January 24<sup>th</sup>, 2020 and general lockdown was declared by the French government for two months between March 17<sup>th</sup> and May 11<sup>th</sup>. At the present time, September 15, France totalizes 381,500 cases and 30,900 deaths due to COVID-19 infection. The study was performed in the Paris area which was particularly affected by the disease and totalized 40% of national deaths.

The current study shows that, three months after the first cases of COVID-19 infection, seroprevalence of SARS-CoV-2 in pregnant women at the time of delivery in our institution is quite low (4.5%). This seroprevalence is lower than the prevalence of 10.6% measured in the general population of the Paris area between April 6<sup>th</sup> and April 12<sup>th</sup> (17) and shouldn't be attributed to a low performance of the test. The test used is approved by the FDA and has been associated to high analytical performances with a sensitivity between 92.7 and 97.3% and a specificity >99% (18,19). This low seroprevalence is possibly explained by the fact that pregnant women were more accurate in accepting and applying national recommendations to limit the spread of the virus and the risk to be infected (social distancing, use of surgical masks, use of hydro-alcoholic solutions) compared to non-pregnant individuals. Moreover, according to national recommendations, pregnant women were advised to stop professional activities after 28 WG to limit the risk of maternal infection during the third trimester. Therefore, most of the patients of our cohort didn't have any professional nor social contacts even after the end of the lockdown.

In our study, two patients with a positive SARS-Cov-2 PCR had a negative serology. The first had clinical symptoms of COVID-19 (anosmia) and an IgG ratio of 0.8 in the grey zone of the test. Therefore, this case can be considered as a false negative result of the serology. For the

second patient, the PCR was a screening test performed in a private lab and the details of the results couldn't be obtained. The only symptoms were a temperature at 37.8°C. The patients delivered 6 weeks later with a negative serology (IgG index at 0.0). The sample was tested with another immunoassay (Euroimmune) and was also negative. Therefore, this case was possibly a false positive test of the PCR.

The result of our preliminary study is consistent with the recent report of SARS-CoV-2 seroprevalence among parturient women in Philadelphia (20). Among 1293 delivering women in two centers of Philadelphia between April 4<sup>th</sup> and June 3<sup>rd</sup> 2020, 6.2% had positive SARS-CoV-2 specific IgG and/or IgM. Another recent study performed in 3 university hospitals in Barcelona reported a higher seroprevalence of 14% among 502 parturients. This higher seroprevalence may reflect the critical situation of COVID-19 outbreak in Spain but could also be related to the fact that the authors tested for anti-SARS-CoV-2 IgG, IgM, and IgA antibodies (21).

Many studies are ongoing in different countries to evaluate the consequences (for the mothers, the fetuses and the newborns) of COVID-19 infection during pregnancy. All these studies were designed in emergency with very little information to calculate the number of patients to include in order to achieve sufficient statistical power. The low prevalence we report in this manuscript should help study-investigators to adapt the sample size of their study while the inclusions are ongoing.

This low prevalence will certainly increase with time as SARS-CoV-2 is still actively circulating in France. The COVIPREG study is ongoing and we will be able to evaluate the evolution of the SARS-CoV-2 seroprevalence over time.

## CONCLUSION

These results suggest that the seroprevalence of SARS-CoV-2 IgG in pregnant women at the time of delivery is quite low (4.7%) approximately 2 to 3 months after beginning of outbreak in our region. Studies evaluating the impact of COVID-19 infection during pregnancy should take in account this information in order to adapt their sample size.

## REFERENCES

1. Zhu N, Zhang D, Wang W, Li X, Yang B, et al. 2020. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med* 382:727-33
2. Berlin DA, Gulick RM, Martinez FJ. Severe Covid-19. *N Engl J Med*. 2020 May 15.
3. Gandhi RT, Lynch JB, Del Rio C. Mild or Moderate Covid-19. *N Engl J Med*. 2020 Apr 24.
4. Peeling RW, Wedderburn CJ, Garcia PJ, Boeras D, Fongwen N, Nkengasong J, Sall A, Tanuri A, Heymann DL. Serology testing in the COVID-19 pandemic response. *Lancet Infect Dis*. 2020 Jul 17:S1473-3099(20)30517-X.
5. Li LQ, Huang T, Wang YQ, Wang ZP, Liang Y, Huang TB, Zhang HY, Sun W, Wang Y. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. *J Med Virol*. 2020 Jun;92(6):577-583.
6. Dashraath P, Wong JIJ, Lim MXK, Lim LM, Li S, Biswas A, Choolani M, Mattar C, Su LL. Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. *Am J Obstet Gynecol*. 2020 Jun;222(6):521-531.
7. Kayem G, Lecarpentier E, Deruelle P, Bretelle F, Azria E, Blanc J, Bohec C, Bornes M, Ceccaldi PF, Chalet Y, Chauleur C, Cordier AG, Desbrière R, Doret M, Dreyfus M, Driessen M, Fermat M, Gallot D, Garabédian C, Huissoud C, Luton D, Morel O, Perrotin F, Picone O, Rozenberg P, Sentilhes L, Sroussi J, Vayssière C, Verspyck E, Vivanti AJ, Winer N, Alessandrini V, Schmitz T. A snapshot of the Covid-19 pandemic among pregnant women in France. *J Gynecol Obstet Hum Reprod*. 2020 Jun 4:101826.
8. Vivanti AJ, Vauloup-Fellous C, Prevot S, Zupan V, Suffee C, Do Cao J, Benachi A, De Luca D. Transplacental transmission of SARS-CoV-2 infection. *Nat Commun*. 2020 Jul 14;11(1):3572.
9. Hu X, Gao J, Luo X, Feng L, Liu W, Chen J, Benachi A, De Luca D, Chen L. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Vertical Transmission in Neonates Born to Mothers With Coronavirus Disease 2019 (COVID-19) Pneumonia. *Obstet Gynecol*. 2020 Jul;136(1):65-67.
10. Xiao AT, Gao C, Zhang S. Profile of specific antibodies to SARS-CoV-2: The first report. *J Infect*. 2020 Jul;81(1):147-178.
11. Zhao J, Yuan Q, Wang H, Liu W, Liao X, Su Y, Wang X, Yuan J, Li T, Li J, Qian S, Hong C, Wang F, Liu Y, Wang Z, He Q, Li Z, He B, Zhang T, Fu Y, Ge S, Liu L, Zhang J, Xia N, Zhang Z. Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease 2019. *Clin Infect Dis*. 2020 Mar 28.

227 12. Long QX, Liu BZ, Deng HJ, Wu GC, Deng K, Chen YK, Liao P, Qiu JF, Lin Y, Cai XF, Wang DQ,  
228 Hu Y, Ren JH, Tang N, Xu YY, Yu LH, Mo Z, Gong F, Zhang XL, Tian WG, Hu L, Zhang XX, Xiang  
229 JL, Du HX, Liu HW, Lang CH, Luo XH, Wu SB, Cui XP, Zhou Z, Zhu MM, Wang J, Xue CJ, Li XF,  
230 Wang L, Li ZJ, Wang K, Niu CC, Yang QJ, Tang XJ, Zhang Y, Liu XM, Li JJ, Zhang DC, Zhang F, Liu  
231 P, Yuan J, Li Q, Hu JL, Chen J, Huang AL. Antibody responses to SARS-CoV-2 in patients with  
232 COVID-19. *Nat Med.* 2020 Jun;26(6):845-848.

233 13. Wang Y, Zhang L, Sang L. Kinetics of viral load and Antibody Responses in relation to  
234 COVID-19 severity. *J Clin Invest.* 2020; 138759.

235 14. Guo L, Ren L, Yang S, Xiao M, Chang D, Yang F, Dela Cruz CS, Wang Y, Wu C, Xiao Y, Zhang  
236 L, Han L, Dang S, Xu Y, Yang QW, Xu SY, Zhu HD, Xu YC, Jin Q, Sharma L, Wang L, Wang J.  
237 Profiling Early Humoral Response to Diagnose Novel Coronavirus Disease (COVID-19). *Clin*  
238 *Infect Dis.* 2020 Jul 28;71(15):778-785.

239 15. Bryan A, Pepper G, Wener MH, Fink SL, Morishima C, Chaudhary A, Jerome KR, Mathias  
240 PC, Greninger AL. Performance Characteristics of the Abbott Architect SARS-CoV-2 IgG Assay  
241 and Seroprevalence in Boise, Idaho. *J Clin Microbiol.* 2020 Jul 23;58(8):e00941-20.

242 16. EUA Authorized Serology Test Performance. [https://www.fda.gov/medical-](https://www.fda.gov/medical-devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-devices/eua-authorized-serology-test-performance)  
243 [devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-](https://www.fda.gov/medical-devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-devices/eua-authorized-serology-test-performance)  
244 [devices/eua-authorized-serology-test-performance](https://www.fda.gov/medical-devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-devices/eua-authorized-serology-test-performance)

245 17. Santé Publique France. COVID-19-Point épidémiologique hebdomadaire du 9 Juillet  
246 2020. [https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-](https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-9-juillet-2020)  
247 [infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-](https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-9-juillet-2020)  
248 [point-epidemiologique-du-9-juillet-2020.](https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-9-juillet-2020)

249 18. Theel ES, Harring J, Hilgart H, Granger D. Performance Characteristics of Four High-  
250 Throughput Immunoassays for Detection of IgG Antibodies against SARS-CoV-2. *J Clin*  
251 *Microbiol.* 2020 Jul 23;58(8):e01243-20.

252 19. National SARS-CoV-2 Serology Assay Evaluation Group. Performance characteristics of  
253 five immunoassays for SARS-CoV-2: a head-to-head benchmark comparison. *Lancet Infect*  
254 *Dis.* 2020 Dec;20(12):1390-1400.

255 20. Flannery DD, Gouma S, Dhudasia MB, Mukhopadhyay S, Pfeifer MR, Woodford EC,  
256 Gerber JS, Arevalo CP, Bolton MJ, Weirick ME, Goodwin EC, Anderson EM, Greenplate AR,  
257 Kim J, Han N, Pattekar A, Dougherty J, Kuthuru O, Mathew D, Baxter AE, Vella LA, Weaver J,  
258 Verma A, Leite R, Morris JS, Rader DJ, Elovitz MA, Wherry EJ, Puopolo KM, Hensley SE. SARS-

259 CoV-2 seroprevalence among parturient women in Philadelphia. *Sci Immunol.* 2020 Jul  
260 29;5(49):eabd5709.

261 21. Crovetto F, Crispi F, Llurba E, Figueras F, Gómez-Roig MD, Gratacós E. Seroprevalence  
262 and presentation of SARS-CoV-2 in pregnancy. *Lancet.* 2020 Aug 22;396(10250):530-531.

263

## Tables

**Table 1** : Maternal and neonatal characteristics of the 529 patients.

Data shown as mean (standard deviation) or number (%)

|                                                | Pregnant women at the<br>time of delivery<br>N=529 |
|------------------------------------------------|----------------------------------------------------|
| Maternal age                                   | 33.7 (4.7)                                         |
| BMI                                            | 22.4 (3.7)                                         |
| Multiple pregnancy                             | 16 (3.0%)                                          |
| SARS-CoV-2 RT PCR during<br>pregnancy          | 21 (4%)                                            |
| Positive SARS-CoV-2 RT PCR<br>during pregnancy | 10/21 (47.6%)                                      |
| Gestational age at delivery                    | 38.9 (3.3)                                         |
| Preterm delivery                               | 41 (7.7%)                                          |
| Cesarean section rate                          | 81 (15.3%)                                         |
| Newborn status                                 |                                                    |
| - Alive                                        | 517 (97.7%)                                        |
| - Stillbirth                                   | 12 (2.3%)                                          |

**Table 2** : Description of the 12 fetal losses

|                             | n (%)     |
|-----------------------------|-----------|
| Gestational age at delivery |           |
| 16-17 WG                    | 4 (33.4)  |
| 18-21 WG                    | 3 (25.0)  |
| 22-26 WG                    | 2 (16.7)  |
| 27-30 WG                    | 3 (25.0)  |
| Cause of fetal loss         |           |
| TOP                         | 9 (75.0)  |
| IUFD                        | 3 (25.0)  |
| SARS-CoV-2 IgG at delivery  |           |
| Positive                    | 1 (8.3)   |
| Negative                    | 11 (91.7) |

WG : weeks of gestation, IUFD : intra-uterine fetal death, TOP : termination of pregnancy

**Table 3** : Characteristics of the 529 mothers and their newborns according to the anti-SARS-Cov-2 IgG testing

| Anti-SARS-Cov-2 IgG         |                      |       |          |                       |         |         |
|-----------------------------|----------------------|-------|----------|-----------------------|---------|---------|
|                             | Positive<br>(n = 25) |       |          | Negative<br>(n = 504) |         | p-value |
|                             | n/N                  | (%)   |          | n/N                   | (%)     |         |
| Maternal age                |                      |       |          |                       |         | 0.90    |
|                             | < 35 y               | 15/25 | (60.00)  | 309/504               | (61.31) |         |
|                             | ≥ 35 y               | 10/25 | (40.00)  | 195/504               | (38.69) |         |
| BMI                         |                      |       |          |                       |         | 1.00    |
|                             | < 25                 | 21/25 | (84.00)  | 408/504               | (80.95) |         |
|                             | ≥ 25                 | 4/25  | (16.00)  | 96/504                | (19.05) |         |
| Geographic origin           |                      |       |          |                       |         | 0.17    |
|                             | Africa               | 7/23  | (30.43)  | 90/496                | (18.15) |         |
|                             | Other                | 16/23 | (69.57)  | 406/496               | (81.85) |         |
| Multiple pregnancy          |                      |       |          |                       |         | 1.00    |
|                             | No                   | 25/25 | (100.00) | 488/504               | (96.83) |         |
|                             | Yes                  | 0/25  | (0.00)   | 16/504                | (3.17)  |         |
| Gestational age at delivery |                      |       |          |                       |         | 0.71    |
|                             | < 37 WG              | 1/25  | (4.00)   | 40/504                | (7.94)  |         |
|                             | ≥ 37 WG              | 24/25 | (96.00)  | 464/504               | (92.06) |         |
| Mode of delivery            |                      |       |          |                       |         | 0.40    |
|                             | Vaginal              | 23/25 | (92.00)  | 425/504               | (84.33) |         |
|                             | Cesarean             | 2/25  | (8.00)   | 79/504                | (15.67) |         |
| Neonatal status             |                      |       |          |                       |         | 0.44    |
|                             | Alive                | 24/25 | (96.00)  | 493/504               | (97.82) |         |
|                             | Stillbirth           | 1/25  | (4.00)   | 11/504                | (2.18)  |         |