

## Relationship Between Nutritional Status And Giardia Lamblia Infection Of Children In Al-Karbala City.

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### Abstract:

**Objective:** Malnutrition is delivered and sustained in an unpredictable example in the tropical nations where it is endemic. Gut parasites could deliver ailing health. In kids, giardiasis is all the more regularly connected with looseness of the bowels and malabsorption.

**Materials:** Stool tests were arbitrary gathered from 100 children (50 males and 50 females) between the ages 2–12 from Karbala city emergency clinic during 2020-2021. Tallness, weight and Body Mass Index (BMI) boundaries have been utilized in the current investigation to decide the sustenance status.

**Results:** No critical contrasts saw among young men and young ladies and as indicated by age gatherings. A parasitological stool assessment result demonstrated Giardia lamblia in just 31% of kids. There was proof of 32% of hunger status by W/H, H/Age and BMI ideas individually were related with positive giardiasis. The prevalence of infection males 35.7% was higher than females 25% in children .and 37.5% in males was higher than females 25% of malnutrition. The prevalence of infection and malnutrition in rural 77.4% and 75 % Respectively , 22.6% and 25% in urban .

**Conclusion :** The investigation presumed that giardiasis could be a factor partake with other sterile social factors that impact on nourishing status in children .

**Key words:** children, Giardia lamblia, nutrition status .

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### Introduction:

Intestinal parasitic contamination is a typical affliction of a large part of the total populace and it has been a significant issue in general wellbeing (Yamamoto et al, 2000). Studies had indicated that intestinal parasites is regular in the creating scene (Tinuada et al, 2006) apparently due to poor natural and individual cleanliness largely brought about by helpless sewage removal and deficient water supply (Plutzer J.....et al, 2010). The connection between intestinal parasite disease and nourishing status is a

significant issue (Yamamoto et al, 2000). *Giardia lamblia* (inseparable from *G. intestinalis*, *G. duodenalis*) is a flogged unicellular eukaryotic microorganism that ordinarily causes diarrheal sickness all through the world (Barwick et al, 2000). This parasite was first found in 1681 by Antonym van Leuwenhoek, who discovered it on his own stool, however, in 1915 the parasite was named in honor to Professor A. Giard in Paris (Ford, 2005). Indeed, even *Giardia lamblia* is a protozoan parasite which has overall circulation and is basic in warm and sodden atmospheres all through the world (AL-Saeed and Issa, 2002). In this way, can cause the giardiasis is communicated by the sham oral course and direct by individual to-individual spread. In many causes, it is related with sullied drinking water, yet in addition periodically by sporting movement in still water (Thompson, 2001). The state of material poverty, as well as the bad economic situation in general, results in the spread of these parasites due to poor health care in general, and the result is poor health and the occurrence of disease {(Albonico et al.... 2006); (Mbae CK et al 2013)}. In kids, giardiasis is all the more regularly connected with looseness of the bowels and malabsorption. The *Giardia lamblia* is spread globally, and the kids are more at risk of disease than grown-ups {(Mohammed MAK..... et al 2008); (Anim-Baidoo...et al 2016)}. Giardiasis has been linked with protein-energy starvation, micronutrient deficiency, iron deficiency anemia, and growth failure {(Carvalho-Costa FA...et al 2007); (Astiazarán-García H....et al 2000); (NUNES, Beatriz Coronato et al 2017)} ; that is of the most hazardous intestinal parasitosis to the physical growth of children. {(Carvalho-Costa FA...et al 2007); (NUNES, Beatriz Coronato et al 2017); (Verhagen LM.... et al 2013) } In Iraq numerous investigations revealed high rate with *Giardia lamblia* in Iraqi urban areas, for example, in Al-Hila city (11.32%), Duhuk city (38.5%) and Al-Shula and Al-Kadimya (13.64%) in 2002, 2006 and 2011, respectively .{ (Almusa, 2002); (Al-Saeed, 2006); (Al-Warid, 2011)}. Until now, insufficient consideration has been centered around this parasite and its relationship to lack of healthy sustenance status.

This study was intended to exhibit the relationship of the *Giardia* contamination and nutritional status of kids in Al-Karbala city.

### **Materials and Methods:**

This investigation was completed at Al-Karbala emergency clinic from October 2020 to January 2021. 100 children (50 male and 50 females) between the ages 2 – 15 years were haphazardly picked to be remembered for study. Stool tests were gathered from all children. Every patient was requested to give a feces test. Tests got were dated and marked. Direct smear strategy and formalin ether centrifuged sedimentation procedure were performed for every example to decide *Giardia lamblia* disease as per

(Garcia & Bruckner, 1997). The periods of the children were acquired from talking mother with the assistance of nearby occasion schedule. Statures were taken to the base of 1mm and weight were taken to the base of 10 gm with least dress. Gauging scale was aligned occasionally against known norms and gauging scale was adjusted to the zero preceding taking each estimation. All the estimation were taken according to rule of WHO (WHO ,1995). Stature ,weight and Body Mass Index (BMI ) have been utilized in the current investigation to decide the nourishment status (Funke , 2008). All the anthropometric estimations were take observing the standard suggested by WHO (WHO ,1995). Weight file was controlled by the CDC table for determined Body Mass Index for chosen statures and weight for age ages 2 to 20 years and it was figured utilizing the accompanying equation (Amuta&Houmson , 2009):  $BMI (kg/m^2) = Weight (kg)/Height (m^2)$ .

### **3) Statistical analysis**

In this examination utilized Statistical Analysis System (SAS) (SAS., 2012). This used to discover impact of various elements in these examination boundaries. Chi-square test was utilized to locate the huge contrasts for those proportions in this investigation.

#### **A- The Materials:**

Microscope , Slide ,Cover slip ,Normal saline , Feces samples , Iodine

#### **B- Collection of samples**

##### **1) Stool samples**

The stool samples were collected for patients from central children hospital, in sterile clean and dry plastic containers, especially designed for stool collection and each container was labeled by a special number, name, age and gender.

##### **2) Laboratory Examination**

- General stool examination

A- Direct Stool Examination

The feces were examined by naked eye investigating color consistency, mucus and odor.

B-In Direct Stool Examination

Direct physiological iodine smear. The feces test was analyzed by putting a limited quantity of stool, taken by wooden stick from various spots, particularly bodily fluid then it was placed in dry and clean

slide by adding one drop of Iodine added and blended altogether, and afterward put the cover slip and inspected under 40x amplification to objective find the trophozoite and growth of intestinal protozoa and the assessment was performed from the upper right point finishing off with lower left point of the slide.

### Result:

Prevalence of malnutrition based on <5 percentile of BMI show that (37.5%) of boys and 25% of girls were reported to be malnutrition (table 1). There was significant difference between two age group 4-6 and other group but there was no significant difference between these groups. There was no difference between male and female in all age group but there was a significant difference between them in age group 8-10 and 10-12. There was no significance difference according to age and sex but there was a high significant difference between normal and malnutrition status.

**Table (1): Prevalence of malnutrition (based on <5th percentile of BMI) according to age and sex.**

Age	Normal		%	Malnutrition		%
	Male	female		Male	female	
2/4	4	3	7(63.63%)	2	2	4(36.36%)
4/6	6	7	13(76.47%)	4	1	5(27.77%)
6/8	7	6	13(65%)	5	2	7(35%)
8/10	5	8	13(68.42%)	4	2	6(31.57%)
10/12	13	9	22(68.75%)	6	4	10(31.25%)
total	35(62.5)	33(75)	68(68%)	21(37.5%)	11(25%)	32(32%)

Table 2 shows the distribution of study cases according to age. Most of the infection were in age 4 year old 42.8 % & the less infected group for child aged 3 years old 20 %.

**Table (2): The prevalence rates of Giardia lamblia infection in all children**

Age (y)	No. examined	No. positive (%)
2 y	6	2 (33.33 %)
3 y	5	1 (20 %)
4 y	7	3 (42.8 %)

<b>5 y</b>	<b>11</b>	<b>2 (18.18 %)</b>
<b>6 y</b>	<b>8</b>	<b>3 (37.5 %)</b>
<b>7 y</b>	<b>12</b>	<b>4 (33.33 %)</b>
<b>8 y</b>	<b>8</b>	<b>3 (37.5 %)</b>
<b>9 y</b>	<b>11</b>	<b>3 (27.27 %)</b>
<b>10 y</b>	<b>13</b>	<b>4 (30.76 %)</b>
<b>11 y</b>	<b>9</b>	<b>3 (33.33 %)</b>
<b>12 y</b>	<b>10</b>	<b>3 (30 %)</b>
<b>total</b>	<b>100</b>	<b>31 (31 %)</b>

The higher rate of infection were in males children 35.7%, than females 25 % Table 3.

**Table (3). Distribution of Giardia lamblia in children according to sex.**

<b>Age ( y)</b>	<b>No.examined</b>	<b>No.positive</b>	<b>%</b>
male	56	20	35.7%
female	44	11	25 %
total	100	31	31%

According to the table 4, there was significant difference in place of residence. Where the prevalence of giardiasis and Malnutrition are in rural more than in the urban 77.4% and 75%, 22.5% and 25%, respectively.

**Table (4).Distribution of Malnutritionwith giardiasis by their place of residence:**

	<b>In rural</b>	<b>In urban</b>
No. positive giardiasis	24 (77.4%)	7 (22.5%)
Malnutrition	24 (75%)	8 (25%)

The results showed that only Giardia lamblia was identified and the prevalence of giardiasis was 31% among children. There was evidence of 32 % of malnutrition status in children by Wt/Ht, Ht/age, and BMI concept, while 1% children Malnutrition with no infection (table 4).

**Table (5).Distribution of children with giardiasis by their nutritional status**

malnutrition	Positive infection	Malnutrition with no infection	Normal nutrition with infection
32 (32%)	31 (31%)	1(1%)	0

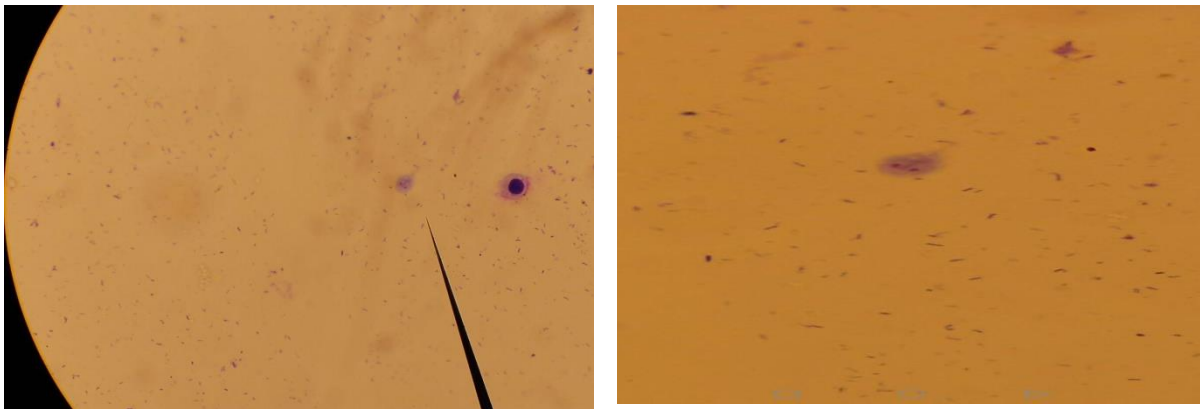


Figure 1 : Giardia lamblia trophozoite under microscope stool examination cases Giardiasis {400X} .

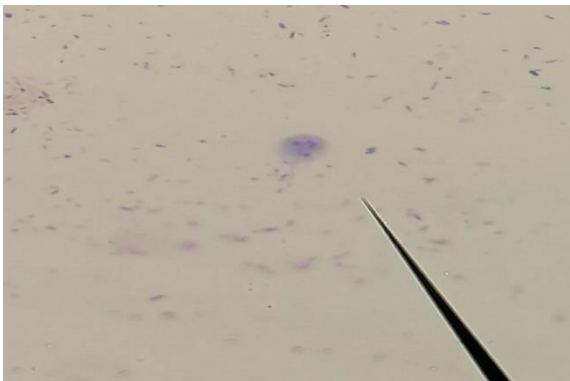


Figure2 : Giardia lamblia cyst under microscope stool examination cases Giardiasisin fecal sample {400X}

#### 4. DISCUSSION

World Health Organization (WHO, 1995) has prescribed different files dependent on anthropometry to assess the wholesome status of the youngsters. This investigation has expressed the healthful status by three ideas in particular, Wt/Ht/age and BMI. The principal ideas utilized as marker of present unhealthiness and the second as pointer of past or long haul under nourishment (Amuta&Houmson, 2009). While the third idea BMI is the favored technique for communicating the muscle to fat ratio

percentiles of gathering (Funke, 2008). It has now been grounded that the Body Mass Index (BMI) is the most proper variable for dietary status among youths (Amuta&Houmson , 2009) .

The spread of giardiasis was slightly higher in children aged 4 year old 42.8 % & child aged 6 & 8 years old 37.5 % (table2). This may mean that transportation of the infection happens early in life; it spreads within families, reasonably from person to person. The result was agree with Al-Mekhlafi ...eat..al 2005, where found the most infected child aged 2-6 years.

Zonta ...eat..al.. 2019, found in his study, that boy more be affected and the outcome be through with the current study, where boys turned out to be slightly more infected than girls Table (3). These results may be related to playing boys outside their homes, then they more likely to be affected.

Complete normal of hunger among the inspected youngsters 32 %. The finding of the present examination shows that lack of healthy sustenance of kids was both because of long-haul hardship just as ongoing causes. This outcome concurs with the finding of (Medhi eat al 2006, ) who show that their outcomes demonstrate that the hunger of the offspring of Tea Garden was because of long-haul hardship just as ongoing causes.

Verhagen LM eat al 2013, found in rural populations in Venezuela helminthiasis and giardiasis were correlated with critical and persistent nutritional status respectively. These studies correspond with our study which manifested that the vast majority of these kids are from the rural sections (table 4), which had a low financial foundation rancher, laborers, and jobless who had low-level schooling and live in houses where the unhygienic expectation for everyday comforts, brought down disinfection and basic inventory.

Such natural components add to the endurance of sickness specialists, for example, parasite, microbes, and viruses(Stephenson, 1994) subsequent to being contaminated with this specialist these kids free the protein-energy, iron, and nutrients admission to the advantage of these illness specialists which later antagonistically influence the development and dietary status of the individual (Mor eat al, 2009).

Giardiasis is emphatically connected with decreased jejunal surface region and a diminished D-xylose discharge particularly in recently tainted individuals (Gupta &Urrutia, eat al, 1982). It appears rational to assume that giardiasis and its relationship of an expanded predominance of squandering in kids. The current investigation (table 5) noticed a connection between Giardia disease and unhealthiness; also Abou-Shady eat al, 2011, observed an important impact of giardiasis that caused a significant decrease in serum zinc, iron levels, and loss of weight were in the infected group compared to

the control. While squandering however saw that factors other than parasitism, for example, social class and cleanliness were more significant this concur with (Bhattacharya et al, 1985). Loewenson et al, 1986, announced a solid relationship between Giardia contamination and nourishing status yet there was no proof of a relationship between social class and other factors with wholesome status. This examination was reasoned that giardiasis could be a take an interest factor with another such socio-economy, instruction and hygiene factors mindful to bother healthful status in essential offspring of Al-Karbala city.

### **Conclusion:**

The study concluded that giardiasis/Lamblia infection is still common among malnourished children in areas with poor health which may be the reason for malnutrition among these children.

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### **References:**

- Abou-Shady, O., El Raziky, M.S., Zaki, M.M. et al.** Impact of Giardia lamblia on Growth, Serum Levels of Zinc, Copper, and Iron in Egyptian Children. Biol Trace Elem Res **140**, 1–6 (2011). <https://doi.org/10.1007/s12011-010-8673-6>
- Albonico M, Montresor A, Crompton DW, Savioli L:** Intervention for the control of soil-transmitted helminthiasis in the community. Adv Parasitol **2006**, 61:311–48.
- Almusa, A.H.A.** Epidemiological study of some parasites causing some intestinal disorders in human in Alhila city. (2002). M.Sc. thesis, Medicine college, Kufa Univ.: 77p.
- Al-Saeed, A.T. and Issa, S.H.** Frequency of Giardia lamblia among children in Dohuk, northern Al-Warid, H.S.J. Prevalence of Giardia lamblia and Entamoeba histolytic/Entamoeba dispar infections among Children in AL-Shulaa and AL-khadimya –Baghdad-Iraq J. of University of Anbar for Pure Science. (2011). 5:6-10.

**Amuta, E.U. & Houmson, R.S.** Assessment of nutritional status of school children in Makurdi, Benue state. (2009) . Pak. J. Nutrit., 8 (5): 691- 694.

**Anim-Baidoo, I., Narh, C. A., Oddei, D., Brown, C. A., Enweronu-Laryea, C., Bando, B., Sampane-Donkor, E., Armah, G., Adjei, A. A., Adjei, D. N., Ayeh-Kumi, P. F., & Gyan, B. A. (2016).** Giardia lamblia infections in children in Ghana. The Pan African medical journal, 24, 217. <https://doi.org/10.11604/pamj.2016.24.217.8012>

**Astiazarán-García H, Espinosa-Cantellano M, Castañón G, Chávez-Munguía B, Martínez-Palomo A (2000)** Giardia lamblia: effect of infection with symptomatic and asymptomatic isolates on the growth of gerbils (Meriones unguiculatus). Exp Parasitol 95: 128-135.

**Barwick, R.S.; Levy, D.A.; Braun, G.F.; Beach, M.J. and Calderon, R.L. (2000).** Surveillance for water-borne disease out breaks-United States, 1977-1998. Morb. Mortal. Wkly. Rep. CDC surveill Summ, 49 (4): 1-36.

**Bhattacharya, S.K.; Bharati, P.; Mukhopadhyaya, B. & Maitra, N.** Prevalence of intestinal parasitic infection in relation to economic status in a village population of Hourah district west Bengal. (1985). Ind.J.Pab.Heal.,1:15- 22.

**Carvalho-Costa FA, Gonçalves AQ, Lassance SL, Silva Neto LM, Salmazo CA, Bóia MN (2007)** Giardia lamblia and other intestinal parasitic infections and their relationships with nutritional status in children in Brazilian Amazon. Rev Inst Med Trop Sao Paulo 49: 147-153.

**Ford, B.J. (2005).** The discovery of Giardia. The microscope, 53(4):148-153.

**Funke, O.M.** Prevalence of underweight: A matter of concern among adolescents in Osun state ;Nigeria. (2008). Pak.J.Nutrit.,7(3):503-508.

**Iraq.(2006).** Eastern Mediterranean Health Journal, Vol. 12( 5):555-561.

**Loewenson, R.; Mason, P. R. &Patherson, B. A.** Giardiasis and nutritional status of Zimbabwean school children, (1986).Ann.Trop.Paed.6:730- 778.

**M.S. Hesham Al-Mekhlafi, M. Azlin, U. Nor Aini, A. Shaik, A. Sa'iah, M.S. Fatmah, M.G. Ismail, M.S. Ahmad Firdaus, M.Y. Aisah, A.R. Rozlida, M. Norhayati,** Giardiasis as a predictor of childhood malnutrition in Orang Asli children in Malaysia, Transactions of The Royal Society of Tropical Medicine and Hygiene, Volume 99, Issue 9, September 2005, Pages 686–691, <https://doi.org/10.1016/j.trstmh.2005.02.006>

**Mbae CK, Nokes DJ, Mulinge E, Nyambura J, Waruru A, Kariuki S.** Intestinal parasitic infections in children presenting with diarrhoea in outpatient and inpatient settings in an informal settlement of Nairobi, Kenya. BMC Infect Dis. 2013 May 27;13:243. doi: 10.1186/1471-2334-13-243. PMID: 23705776; PMCID: PMC3673844.

**Medhi, G.K.; Barua, A. &Mahanta, J.** Growth and Nutritional status of school age children (6- 14 years) of tea Garden worker of Assam . (2006). J. Hum . Ecol.,19(2):83-85.

**Mohammed MAK, Lim YA, Surin J, Wan KL, Al-Mekhlafi MS.** Risk factors for endemic giardiasis: highlighting the possible association of contaminated water and food. Trans R Soc Trop Med Hyg. 2008;102(5):465–470. [PubMed] [Google Scholar]

**Mor, S. M; Tumwine, J. K.; Naumora, E. N.; Ndeezi, G. &Tzipori, S.** Microsporidiosis and malnutrition in children with persistent arrhea, Uganda. (2009). Emer. Infec. Dis.,15(1):49- 52.

**NUNES, Beatriz Coronato et al.** Giardia intestinalis infection associated with malnutrition in children living in northeastern Brazil. The Journal of Infection In Developing Countries, v. 11, n. 7, p. 563-570, July 2017.

**Plutzer J, Ongerth J, Karanis P.** Giardia taxonomy, phylogeny and epidemiology: Facts and open questions. Int J Hyg Environ Health. 2010 Sep;213(5):321-33. doi: 10.1016/j.ijheh.2010.06.005. Epub 2010 Jul 8. PMID: 20619729.

**Shariff, Z.M.; Bond , J.T.&Johson, N.E.** Nutritional status of primary school children from low Income households in Kuala Lumpur. (2000).Mal. J.Nutrit.,6:17-32.

**Stephenson, L. S.(1994).**Helminth parasites, a major factor in malnutrition. World Health forum. 15:169-172.

**Thompson, R.C.A. (2001).** The future impact of societal and cultural factors on parasitic diseases- some emerging issues. International journal for parasitology, 31: 949-959.

**Tinuada, O., John, O.; Saheed, O.; Oyeku, O; Fidelis, N. &Olabisi , D. Parasitic etiology of childhood diarrhea. (2006).**Ind. J. Ped., 73:1081- 1084.

**Verhagen LM, Incani RN, Franco CR, Ugarte A, Cadenas Y, Sierra Ruiz CI, Hermans PW, Hoek D, Campos Ponce M, de Waard JH, Pinelli E (2013)** High malnutrition rate in Venezuelan Yanomami compared to Warao Amerindians and Creoles: significant associations with intestinal parasites and anemia. PLoS One 8: e77581.

**Verhagen LM, Incani RN, Franco CR, Ugarte A, Cadenas Y, Sierra Ruiz CI, et al. (2013)** High Malnutrition Rate in Venezuelan Yanomami Compared to Warao Amerindians and Creoles: Significant Associations WITH Intestinal Parasites and Anemia. PLoS ONE 8(10): e77581. <https://doi.org/10.1371/journal.pone.0077581>

**Widhalm, K.; Rashidian, F.; Emminger, W.; Huber, W.D.; Bariss-Riedl, M.; Fritsch, M. &Reithofer, E.** Malnutrition in hospitalized children aged 3-18 years results by using a new score in comparison with previous described scores. (2007). J. FürErnährun., 9(2):13-17

**World Health Organization working group.** Physical status: the use and interpretation of anthropometry Geneva, (1995). Technical Report Series, 854pp.

**Yamamoto, R.; Nagai, N.; Kawabata, M.; Leon, W.U.; Ninomiya, R.; &Koizum, N. Effect of intestinal helminthiasis on nutritional status of schoolchildren. (2000).**South Asian j. Trop. Med. Pub. Health, 31(4): 755-761.

**Zonta, María L., Cociancic, Paola, Oyhenart, Evelia E., &Navone, Graciela T.. (2019).** Intestinal parasitosis, undernutrition and socio-environmental factors in schoolchildren from Clorinda Formosa, Argentina. Revista de SaludPública, 21(2), 224-231. <https://dx.doi.org/10.15446/rsap.v21n2.73692>

**Jalil, A. T., Dilfy, S. H., Karevskiy, A., & Najah, N. (2020).** Viral Hepatitis In Dhi-Qar Province: Demographics And Hematological Characteristics Of Patients. International Journal Of Pharmaceutical Research, 12(1). <https://doi.org/10.31838/ijpr/2020.12.01.326>

**Dilfy, S. H., Hanawi, M. J., Al-Bideri, A. W., & Jalil, A. T. (2020).** Determination Of Chemical Composition Of Cultivated Mushrooms In Iraq With Spectrophotometrically And High Performance Liquid Chromatographic. Journal Of Green Engineering, 10, 6200-6216.

**Jalil, A. T., Al-Khafaji, A. H. D., Karevskiy, A., Dilfy, S. H., & Hanan, Z. K. (2021).** Polymerase Chain Reaction Technique For Molecular Detection Of Hpv16 Infections Among Women With Cervical Cancer In Dhi-Qar Province. Materials Today: Proceedings. <https://doi.org/10.1016/j.matpr.2021.05.211>

**Jalil, A. T., Kadhum, W. R., Khan, M. U. F., Karevskiy, A., Hanan, Z. K., Suksatan, W., ... & Abdullah, M. M. (2021).** Cancer Stages And Demographical Study Of Hpv16 In Gene L2 Isolated From Cervical Cancer In Dhi-Qar Province, Iraq. Applied Nanoscience, 1-7. <https://doi.org/10.1007/s13204-021-01947-9>

**Widjaja, G., Jalil, A. T., Rahman, H. S., Abdelbasset, W. K., Bokov, D. O., Suksatan, W., ... & Ahmadi, M. (2021).** Humoral Immune Mechanisms Involved In Protective And Pathological Immunity During Covid-19. Human Immunology. <https://doi.org/10.1016/j.humimm.2021.06.011>

**Moghadas, S., Elveny, M., Rahman, H. S., Suksatan, W., Jalil, A. T., Abdelbasset, W. K., ... & Jarahian, M. (2021).** A Paradigm Shift In Cell-Free Approach: The Emerging Role Of Mscs-Derived Exosomes In Regenerative Medicine. Journal Of Translational Medicine, 19(1), 1-21. <https://doi.org/10.1186/s12967-021-02980-6>

**Hanan, Z. K., Saleh, M. B., Mezal, E. H., & Jalil, A. T. (2021).** Detection Of Human Genetic Variation In Vac14 Gene By Arma-Pcr Technique And Relation With Typhoid Fever Infection In Patients With Gallbladder Diseases In Thi-Qar Province/Iraq. Materials Today: Proceedings. <https://doi.org/10.1016/j.matpr.2021.05.236>

**Turki Jalil, A., Hussain Dilfy, S., Oudah Meza, S., Aravindhan, S., M Kadhim, M., & M Aljeboree, A. (2021).** CuO/ZnO Nanocomposites: Facile Synthesis, Characterization And Photocatalytic Degradation Of Tetracycline Antibiotic. Journal Of Nanostructures.

**Sarjito, Elveny, M., Jalil, A., Davarpanah, A., Alfakeer, M., Awadh Bahajjaj, A. & Ouladsmene, M. (2021).** CFD-Based Simulation To Reduce Greenhouse Gas Emissions From Industrial Plants. International Journal Of Chemical Reactor Engineering, (), 20210063. <https://doi.org/10.1515/ijcre-2021-0063>

**Marofi, F., Rahman, H. S., Al-Obaidi, Z. M. J., Jalil, A. T., Abdelbasset, W. K., Suksatan, W., ... & Jarahian, M. (2021).** Novel Car T Therapy Is A Ray Of Hope In The Treatment Of Seriously Ill Aml Patients. *Stem Cell Research & Therapy*, 12(1), 1-23. <https://doi.org/10.1186/s13287-021-02420-8>

**Jalil, A. T., Shanshool, M. T., Dilly, S. H., Saleh, M. M., & Suleiman, A. A. (2021).** Hematological And Serological Parameters For Detection Of Covid-19. *Journal Of Microbiology, Biotechnology And Food Sciences*, E4229. <https://doi.org/10.15414/jmbfs.4229>

**Vakili-Samiani, S., Jalil, A. T., Abdelbasset, W. K., Yumashev, A. V., Karpishev, V., Jalali, P., ... & Jadidi-Niaragh, F. (2021).** Targeting Wee1 Kinase As A Therapeutic Approach In Hematological Malignancies. *Dna Repair*, 103203. <https://doi.org/10.1016/j.dnarep.2021.103203>

**Ngafwan, N., Rasyid, H., Abood, E. S., Abdelbasset, W. K., Al-Shawi, S. G., Bokov, D., & Jalil, A. T. (2021).** Study On Novel Fluorescent Carbon Nanomaterials In Food Analysis. *Food Science And Technology*. <https://doi.org/10.1590/fst.37821>

**Marofi, F., Abdul-Rasheed, O. F., Rahman, H. S., Budi, H. S., Jalil, A. T., Yumashev, A. V., ... & Jarahian, M. (2021).** Car-Nk Cell In Cancer Immunotherapy; A Promising Frontier. *Cancer Science*, 112(9), 3427. <https://doi.org/10.1111/cas.14993>